PROJECT MANUAL

VOLUME 1

Lebanon VA Medical Center Behavioral Health Complex

VA Project No.: 595-109
Array Project No.: 3468

1700 South Lincoln Avenue
Lebanon, PA 17042

100% Construction Documents
July 27, 2012

ARRAY HEALTHCARE FACILITIES SOLUTIONS

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VHA MASTER SPECIFICATIONS

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SECTION 00 10 11

MEDICAL CENTER REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL INTENTION

A. This section pertains to station policy for construction projects performed at the Veterans Affairs Medical Center, Lebanon, Pennsylvania. Safety and health concerns are taken seriously at this facility. Both our staff and yours are expected to adhere to the strictest requirements. This is exceedingly important, since we must be primarily concerned for the safety of our patients. In this regard, OSHA Standards may protect worker safety and health, but they have minimal benefit for protecting the safety and health of our patients, due primarily to their differing medical conditions. Please review this information as orientation with your personnel performing work on site.

B. Our medical center is committed to addressing those construction, protection and occupancy features necessary to minimize danger to life from fire, smoke, fumes and panic. The level of safety is achieved by the combination of prevention, protection, egress and other features. The level of life safety from fire is defined through requirements directed at: prevention, detection, control of development, confinement of effects, extinguishment, provision of refuge/evacuation and staff reaction. This medical center provides its minimum level of life safety by extensively applying the aforementioned measures using a defense in place strategy. This strategy recognizes that our patients are both incapable of self-preservation and difficult to move, particularly vertically to other floors or to the exterior of the buildings. When any of the life safety measures are compromised by construction, an alternate or interim life safety measure must be put in place to maintain the level of safety required by NFPA 101, Life Safety Code.

1.2 REQUIREMENTS

A. Security:

1. Secure all areas of work including, but not limited to construction sites, attics, crawl spaces, mechanical and electrical rooms against entry of unauthorized individuals including patients. Erection of a non-flammable partition to secure the job site may be required. Close all windows at the end of each workday.

2. Notify the Contracting Officers Technical Representative (COTR) for permission to work after hours and weekends.

3. Always wear an ID badge.

B. Key Security:

1. The contractor will not be issued more than required sets of keys to complete this project.
2. The contractor's set(s) of keys will contain only those keys that the COTR can issue without breaching the security of other areas of the medical center.
3. If the contractor loses a key, all areas that are keyed to that key will be rekeyed at the contractor's expense and all new keys required to be issued will be completed at the contractor's expense.

C. General Safety:

1. Follow all safety, fire safety and health requirements as per CFR 29, Subtitle B, Chapter XVII (OSHA), Part 1926 including the submission of a Safety/Fire Safety Plan.
2. Maintain safety in the construction site/area in accordance with the provisions of the contract, which includes the OSHA Regulations, National Electrical Code NFPA 70, and NFPA 101, Life Safety Code.
3. Work in a safe manner and take all proper precautions while performing your work. Extra precautions shall be taken when working around persons occupying the building during construction. Submit a Coredrilling & Firestopping Permit, supplied by the government for all penetrations. Take precautions when coredrilling to protect persons and structural integrity of the building. Firestop all penetrations before the end of the workday. All Firestop material shall be **RED** in color.
4. All ceiling tile must be replaced whenever the work site is left unattended. If tiles are broken, the broken tile must be replaced before the end of the day. This applies to all areas outside of areas closed and labeled as a construction area.
5. Make safety inspections and submit weekly, on government supplied form, directly to Project Coordinator.
6. Provide Personal Preventive Equipment (PPE) for your employees.
7. Post appropriate signs in specific hazardous areas.
8. Keep tools, ladders, etc. away from patients to prevent injuries.

D. Safety Inspections:

1. Safety inspections of all contract operations will be performed on a regular frequency by the professional Occupational Safety & Health Staff at this facility. Written reports of unsafe practices or conditions will be reported to the Contracting Officers Technical Representative (COTR) and Contracting Officer for immediate attention and resolution.

E. Fire Alarms:

1. The fire alarm system connects all buildings at this facility, and is activated by various heat, duct, manual pull stations and smoke sensors. Manual pull stations are provided on each ward. Please survey the area in which you are working to locate the manual pull stations.

   a. If in the event of a fire alarm sounding, you are instructed to remain in your area, unless medical center personnel (Safety, Nursing or Engineering) instruct otherwise, or unless a fire situation is in your area, in which case you should immediately evacuate.The medical center operates an extensive patient evacuation program. A total of approximately 15-20 personnel initially respond to all alarms. Historically, false alarms are caused by contractors generating dust or other disturbances of sensors. When working in an area producing dust, you will cover all alarms with covers provided by Engineering Service. These covers will be removed at the end of the work shift, upon leaving the area after dust has settled.

   b. If an alarm is determined by the COTR to have been activated by contractor’s work other than from or resulting in a fire situation, the contractor will be charged $300 per occurrence.

   c. Any work involving the fire protection systems will require written permission to proceed from the COTR.

DO NOT tamper with or otherwise disturb any fire alarm system components without prior written permission.

F. Hazardous Materials:

1. Many of the operations you are scheduled to perform may involve the use of hazardous materials. Prior to locating hazardous materials on site, all Material Safety Data Sheets will be submitted through the COTR for evaluation by the Facility Industrial Hygienist.

2. Storage of hazardous materials within buildings will be minimal with only enough on hand to perform daily work tasks. Flammable materials will either be removed from buildings at the end of the work shift or stored in approved flammable storage containers.

3. Care must be taken to assure adequate ventilation to remove vapors from hazardous materials in use. Many of the patients being cared for in the facility are susceptible to environmental contaminants, even when odors seem minimal. The more effective method to reduce complaints is to close the work area and use adequate ventilation.

G. Airborne Dust and Fume Control During Construction:

1. Generation of dust is of major concern within staff and especially patient-occupied areas. Dust can be generated by either manual or mechanical cutting, sanding or drilling on surfaces. Where operations involve techniques, which may generate dust, all efforts will be directed at reducing airborne generated dust to the lowest level feasible. This may be accomplished by a number of methods. These include misting the area with water or use of tools attached to high efficiency particulate air (HEPA) filtering vacuums. Where large amounts of materials may be disturbed resulting in airborne dust, establishment of full ceiling to floor plastic barriers may be required.

2. Generation of metal fumes is also a concern to hospital patients and staff. Fumes generated as a result of welding, brazing, soldering and cutting must be controlled through the use of spot ventilation or fume extractors. If fumes are captured and filtered through HEPA filtered fume extractors, exhaust can be returned directly into the work area. Unfiltered fume, like those collected by spot ventilators, shall be exhausted directly to the outside through exterior building openings. In addition to ventilation requirements, arc welding operations shall be shielded by noncombustible or flameproof screens to protect employees and patients from the direct rays of the arc.

3. If waste chutes are used to facilitate disposal of construction debris from upper building floors, cover all waste receptacles and dumpsters to help contain dust. Additionally, cover all waste receptacles during brisk wind conditions to prevent debris from littering the medical center grounds.

4. Classification of Jobs.

   a. All jobs shall be classified and carried out per the Infection Control Risk Assessment (ICRA), Section 01012 of these specifications.

   b. Prior to the start of construction, the contractor shall require all employees and subcontractors to view a training video entitled "Infection Control During Construction" by HCPro (www.hcmarketplace.com) or an approved equal training video. Contractor shall provide written documentation to COTR that all construction personnel have viewed the training video. The written documentation shall include the names of all personnel, their signatures and dates when the training video was offered and viewed.

5. All major areas of construction are to be kept under negative pressure at all times during construction as required by the ICRA. The contractor shall supply, maintain and keep in operation, as many negative air machines as required to keep the construction area under 0.010 inch water column negative pressure. A gauge to monitor and record the negative pressure in the construction area at all times during the construction period including non-working hours will be required to be installed by the contractor. The contractor is to supply the COTR with the Negative pressure records from the gauge on a weekly basis. The contractor will document the visual inspection of negative pressure on a negative air pressure verification located directly outside the construction area at the start of each work shift.

H. Asbestos Containing Materials:

1. Due to the age of many of our buildings, many still contain asbestos containing materials (ACM). Primary ACM uses in the medical center include floor tile, mastic, piping and HVAC insulation. The medical center has performed comprehensive asbestos surveys and has identified accessible ACM. Some areas contain damaged asbestos and should not be accessed without prior abatement.

2. The most common type of ACM insulation you may encounter includes thermal system insulation (TSI) and floor tile. ACM TSI is generally covered with a cloth wrap or lagging, and the asbestos substrate generally appears white in color. **DO NOT SAND, DRILL, GOUGE OR OTHERWISE DISTURB THIS TYPE OF INSULATION.** Contractors disturbing or releasing asbestos containing materials will be liable for all damages and clean up costs.

3. In most cases where disturbance of asbestos is likely or necessary, it has been addressed in the contract. If not, please contact the COTR or Industrial Hygienist to make necessary arrangements for removal.

a. Asbestos insulation has been identified on elbows between fiberglass piping insulation as patching materials among the fiberglass insulation. Fiberglass insulation used in this facility is usually yellow or pink in color, wrapped either by cloth or paper lagging.

4. To protect and ensure all your employees are aware that asbestos containing materials have been used in the construction of this facility, you are required to have them review this section and complete the awareness statement included as Attachment A. Once this document has been signed by all employees, forward to the COTR for documentation.

5. A complete assessment of asbestos materials and conditions are available for viewing by contacting the facility Industrial Hygienist at extension 4008. Prior to performing work above any ceiling or starting in a new area, consult with the COTR concerning existing conditions of ACM.

6. Some of the areas in the facility are identified as restricted areas due to condition of ACM. These are readily labeled. **DO NOT ENTER THESE AREAS** unless first contacting the COTR. Entry requirements to these areas are awareness of the hazards, proper protective clothing (coveralls and respirators) and personal monitoring in accordance with OSHA requirements.

I. Environmental Protection:

1. It may help you to be aware of the seriousness, which the environmental protection requirements of each contract are regarded. Adherence to these requirements are subject to continuing scrutiny from the community and backed by severe penalties, such as fines and incarceration. These environmental requirements will be strictly enforced.

2. NO hazardous materials will be disposed of on government property. All waste will be hauled off-site or disposed in contractor owned and operated waste removal containers.

3. A copy of all waste manifests for special or hazardous wastes will be forwarded to the COTR. Environmental requirements will be strictly enforced.

J. Permit Required Confined Spaces:

1. Contractors performing work on this facility will follow all requirements outlined in OSHA Standards for working in confined spaces. There are numerous permits required for confined spaces on this facility. These spaces have been identified. Some spaces have been posted, but the majority have not due to their configuration. A complete listing of these areas is located in the Engineering Service and Safety Office.

2. Confined spaces are areas which are large enough to be entered, but have limited egress/exit potential and are not designed for permanent human occupancy. If you encounter any space which meets this definition or if it is a suspected confined space, please contact the COTR for a listing of these spaces.

3. Contractors performing work in confined spaces are responsible for compliance with all applicable standards and regulations.

K. Housekeeping:

1. Protect patients and VA personnel in occupied areas from the hazards of dust, noise, construction debris and material associated with a

construction environment.

2. Keep work area clear, clean and free of loose debris, construction materials and partially installed work, which would create a safety hazard or interfere with VA personnel duties and traffic.
3. Wet mop occupied areas and remove any accumulation of dust/debris from cutting or drilling from any surface at the end of each work day.
4. Make every effort to keep dust and noise to a minimum at all times. Take special precautions to protect VA equipment from damage, including excessive dust.
5. Access to mechanical and electrical devices and equipment should be free of debris and material at all times. This is required to ensure access to existing systems in the event of an emergency.
6. Clean area free of all construction debris and dust upon completion of demolition and/or renovation.
7. During construction operations, keep existing finishes protected from damage. Cover and protect all carpets during construction. Any carpets or surfaces damaged, as a result of construction activities, will be replaced at the contractor's expense.

L. Utilities:

1. Maintain existing utility services for this Medical Center at all times in accordance with the contract provisions.

M. Hot Work Permits:

1. Any hot work operations including cutting, welding, thermal welding, brazing, soldering, grinding, thermal spraying, thawing pipes or any other similar activity will require a Hot Work Permit to be obtained by the contractor from the Facility Safety Manager. The contractor will be responsible for conforming to all Medical Center regulations, policies and procedures concerning Hot Work Permits as outlined below:

   a. Prior to the performance of hot work in patient-occupied buildings, a request for a Hot Work Permit will be made to the Facility Safety Manager.

   b. The Facility Safety Manager will inspect the area and ensure that the requirements of NFPA 241 and OSHA Standards have been satisfied. The Hot Work Permit will be granted and will be posted in the immediate area of the work.

   c. The Hot Work Permit will apply only to the location identified on the permit. If additional areas involve hot work, additional permits must be requested.

   d. Upon completion of all hot work, the Facility Safety Manager will be notified by the responsible individual to perform a re-inspection of the area.

   e. In all other areas not occupied by patients, the supervisor will inspect the hot work area for compliance with NFPA 241 and OSHA Standards. Copies of the request form and permit are available from the Facility Safety Manager.

2. Do not use any of the extinguishers in the medical center for standby purpose while conducting hot work. Contractors are required to supply their own Class ABC extinguishers. Medical center extinguishers are only to be used in the event of a fire.

N. Emergency Medical Services:

1. Emergency medical services are available for contractors at this facility. For medical emergencies, dial 4999 when inside any building. Report the nature of the emergency and location. The operator will determine whether to dispatch in-house personnel or outside emergency assistance based on the nature of the emergency.

O. Use of Government Owned Material and Equipment:

1. Use of government owned material and equipment is PROHIBITED.

P. Superintendent Communications:

1. At all times during the performance of this contract, the Contractor’s Superintendent is to be available by telephone (portable cellular phone). At the beginning of the contract and prior to beginning any construction, supply the Contracting Officer with the telephone number for the superintendent.

2. The Contractor’s Superintendent shall post pertinent information at each job site for the benefit of the construction workers and for communicating with Medical Center Staff. A 2’x 4’ construction board shall be placed at the job site entrance in accordance with recommendations set forth by The Joint Commission, as illustrated on the sample Attachment D.

Q. Parking:

1. Contractor employees shall be assigned parking spaces by COTR. Spaces may not be in the immediate area of the construction site.

2. It is the responsibility of the contractor to barricade parking spaces when not in use.

R. Traffic:

1. Traffic hazards are minimal at this facility. Drivers should be particularly concerned with pedestrian traffic.

2. Seat belt use is mandatory on the station.

3. Federal police officers maintain a 24 hour patrol of the area and have state and federal enforcement authority.

4. Contractor is to have all deliveries made via the State Drive Entrance to the medical center. No deliveries will be allowed from the Lincoln Avenue Entrance (Main Entrance).

S. Contractor's Trailers:

1. Contractor's trailers shall be located within the lay down area assigned. All utility connections to the trailer shall be located underground and installed at the contractor’s expense. Their removal is required upon completion of the contract, unless approved by the COTR to leave in place

T. Smoking:

1. No smoking is permitted at the Lebanon VAMC except inside designated smoking shelters. See attachment B.

2. If any contractor's or subcontractor's employee is found smoking in an unauthorized area, the contractor will be charged $200 for the first occurrence and $500 for every occurrence thereafter. The employee is subject to a $50 fine.

U. Contractor shall comply with all applicable elements of the National Fire Protection Association (NFPA) Standard 241. This standard addresses:

1. Temporary Construction, Equipment and Storage
2. Temporary offices and sheds
   a. Temporary enclosures
   b. Equipment
3. Processes and Hazards
   a. Hot work operations including thermic welding
   b. Temporary heating equipment
   c. Smoking
   d. Waste disposal
   e. Flammable and combustible liquids
   f. Explosive materials
4. Utilities
   a. Electrical - temporary wiring (branch circuits, lighting and removal)
5. Fire Protection
   a. VA's responsibility for fire protection
   b. Site security
   c. Fire alarm reporting
   d. Access for fire fighting
   e. Stand pipes
   f. First-aid fire equipment
6. Construction Safeguards
   a. Scaffolding, shoring and forms
   b. Construction material and equipment storage
   c. Roofing operations
   d. Permanent heating equipment
   e. Utilities
   f. Fire cutoffs
   g. Fire protection during construction - water supply, sprinkler protection and stand pipes
7. Demolition Safeguards
   a. Special precautions
   b. Temporary heating equipment

c. Smoking

d. Demolition using explosives

e. Utilities

f. Fire cutoffs

g. Fire protection during demolition

8. Underground Operations

a. Special precautions

b. Equipment and storage requirements

c. Electrical

V. Construction or Demolition Fire Safety Program:

1. A program shall be developed with the following elements addressed:

a. Good housekeeping

b. On-site security

c. Preservation of existing systems during demolition

d. Rapid communication

W. Contractor Life Safety Smoke Barrier Responsibilities:

1. The contractor shall assume full responsibility for compliance to all applicable regulations pertaining to NFPA 101 with respect to medical center building smoke barriers and corridor walls. Maintain the integrity of floor slabs and fire/smoke walls by fire stopping all holes and penetrations before the end of each workday.

X. Enforcement:

1. The COTR on this project is designated as the person responsible for ensuring that the

2. Safety/Fire Safety Plan is carried out to the completion of the project and has the authority

3. to enforce the provisions of this specification section and other applicable fire protection standards.

Y. Submittals:

1. Within ten working days after the Notice to Proceed, submit a Safety/Fire Safety Plan for Architect-Engineer and VA review.

2. Submit Material Safety Data Sheets for all chemicals and hazardous materials to be used on the project prior to location and use on the job site.

3. Submit Contractor Asbestos Awareness Statements and Notification of Smoking Policy for all persons working on the site prior to commencing work.

4. Submit Weekly Construction Site Inspection Report. The contractor must submit along with each Wednesday's daily log, a completed and signed, government supplied, Construction Site Inspection Report.

5. To expedite project actions, the use of certain government forms is required. During the pre-construction conference, the following forms, but not limited to, will be supplied to the contractor: Daily Logs, Weekly Safety Inspection Report, Hot Work Permit, Excavation Permit, Variance Request, Coredrilling and Firestopping Permit, Construction Progress Graph, Submittal Transmittal Letter, Proposal Cost Breakdown Summary, Construction Contractor Invoice, Construction Payment Worksheet, Project Specified Training Log, Contract Progress Report, WH-347 Payroll and Request for Information(RFI).
6. Submit a signed and dated “Orientation of Construction Workers” (Attachment C) for each worker on the project.
7. Prior to final inspection of the project, submit a master list of equipment installed as part of this project. Provide information (model number, serial number, item description and manufacturer) for the following: fan coil units, HVAC roof top units, ice machines, pumps, fire alarm systems, energy management system and nurse call system.

- - - END - - -

Attachment A

CONTRACTOR/SUBCONTRACTOR/EMPLOYEE
NOTIFICATION OF ASBESTOS

THE DEPARTMENT OF VETERANS AFFAIRS MEDICAL CENTER LOCATED IN LEBANON, PENNSYLVANIA WAS CONSTRUCTED DURING A PERIOD WHEN ASBESTOS WAS COMMONLY USED IN BUILDING MATERIALS.

THE MEDICAL CENTER HAS COMPLETED A SURVEY FOR ASBESTOS. ALL BUILDINGS CONTAIN SOME TYPE OF ASBESTOS (I.E., STEAM LINES, FLOOR TILES, CRAWLSPACES, ETC.).

IF YOU OR YOUR EMPLOYEE ENCOUNTERS SUSPECTED FRIABLE ASBESTOS OR CONDITIONS THAT MAY CAUSE SUSPECTED ASBESTOS TO BECOME FRIABLE, NOTIFY THE COTR IMMEDIATELY.

WHEN WORKING IN AREAS THAT ARE SUSPECTED OF HAVING ASBESTOS, RELOCATE EMPLOYEES AND PATIENTS FROM THE AREA UNTIL WORK IS COMPLETED.

IF THERE ARE ANY QUESTIONS, PLEASE FEEL FREE TO CONTACT THE PROJECT COORDINATOR AT EXT. 4720.

THANK YOU FOR YOUR ASSISTANCE.

PLEASE SIGN AND DATE AS ACKNOWLEDGEMENT OF THE ABOVE INFORMATION.

CONTRACTOR/SUBCONTRACTOR EMPLOYEE SIGNATURE:

EMPLOYEE NAME CONTRACTOR/SUBCONTRACTOR
DATE:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Attachment B

6/97 rev 6/07

Contractor / Subcontractor / Employee

Notification of Smoking Policy

 # 7 Prohibit Smoking

The Department of Veterans Affairs' smoking policy is for the safety and protection of its patients, visitors and employees.

Smoking is prohibited:

8. In all buildings and grounds of the medical center, except inside designated Smoking Shelters.

Smoking material litter is prohibited anywhere in the medical center and on its grounds, except when properly deposited in a safe receptacle. This material shall be out of sight.

VA Police are authorized to issue $50.00 citations to the person for any smoking violations. The employer of the person will be charged $200.00 for the first occurrence and $500.00 for every occurrence thereafter.

If there are any questions, please contact the COTR. Thank you for your assistance.

Sign and **date** acknowledgment of the above information.

Contractor / Subcontractor Employee Signature:

Employee Name	Date	Contractor / Sub

This policy is consistent with the

Joint Commission Accreditation of Healthcare Organizations

Orientation of Construction Workers

Objective: To ensure a safe and healthful environment in the worksite and the adjacent areas.

Expectations (areas within and outside construction sites):

Z. Acquire and wear ID badge at all times.

AA. Read and sign asbestos and prohibit smoking attachments.

BB. Keep access points (doors, etc.) secured to prevent injury of patients, staff or visitors and/or theft of property.

CC. When working outside the primary construction site, keep tools and materials under control. No tools/material shall be left unattended.

DD. Firestop/seal all penetrations of fire/smoke walls and floor slabs with approved material. No penetrations shall be left overnight for next shift or some time in future.

EE. Use pilot-hole technique or another absolute method in determining location of coredrilling. No coredrilling through webs, beams, columns, etc.

FF. In finished areas, close ceilings (reset tile in grid) before leaving area for more than 15 minutes. No ceiling shall be left open overnight.

GG. Prevent dust and odors from migrating into adjacent areas.

HH. Keep unattended carts out of stairwells and corridors to prevent obstruction of evacuation in the event of an emergency.

II. Request Hot Work Permit in advance of soldering, welding, etc.

JJ. Smoke only beyond the limits marked on sidewalk outside buildings. No smoking in the construction worksites indoors.

KK. Maintain integrity of fire doors to ensure closing and latching of doors for controlling spread of smoke. No propping, chocking or tying doors open.

LL. Know where the Material Safety Data Sheets are kept for access of information regarding the hazards of substances being used.

MM. Know the locations of local shutoff valves of water systems (domestic & sprinkler) to ensure quick response in the event of a pipe break. Prime contractor will determine who has a need to know.

NN. Secure compressed gas cylinders to adjacent structure using chain or other stabilizing methods.

OO. Secure equipment by using lockout / tagout method. Note: No equipment shall be shutdown without the VA Electrical Foreman’s okay.

Dust Generating Activities

PP. **Follow** the Infection Control Risk Assessment (ICRA) protocol.

QQ. **Keep** space under negative pressure.

RR. **Use** sticky mats at point of exit.

SS. **Protect** property from damage (dirt, grime, breakage).

1. **Remove** items from space.
2. **Cover** remaining items to protect from dust, i.e. protecting carpeting.

Contractor / Sub Employee Name Date

Prime Contractor: Have employee sign and give a copy of this page to employee and to the VA to attached to Daily log

ment D

Construction Board 2’x 4’ plywood posted at each contracted construction site.

…. a comprehensive method of organizing information for construction workers and for communicating with staff and patients

General		Specific	
Contractor’s Safety Plan & Copy of Spec Section	List & Location of Shutoff Valves Serving Piping Systems within the Construction Site	Active Hot Work Permits	Active Requests for Interruption
General ILSM Daily Monitor	General ICRA for Project Duration	Updates/Changes ILSM’s	Updates/Changes ICRA’s

Section **004322**
UNIT PRICES FORM

1.1 BID INFORMATION

A. Project Name: Behavioral Health Complex.

B. Project Location: Lebanon VA Medical Center, Lebanon PA 17042.

C. Owner: Lebanon VA Medical Center.

D. Owner Project Number: 595-109.

E. Architect: Array HFS.

F. Architect Project Number: 3468.

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

B. The undersigned Bidder proposes the amounts below be added to or deducted from the Contract Sum on performance and measurement of the individual items of Work and for adjustment of the quantity given in the Unit-Price Allowance for the actual measurement of individual items of the Work.

C. If the unit price does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."

1.3 UNIT PRICES

A. Unit-Price No. 1: Excavation and removal of rock: Dollars per cu/yd.

B. Unit-Price No. 2: Imported satisfactory soil material - imported, placed and compacted: Dollars per cu/yd.

C. Unit-Price No. 3: Removal of unsuitable material (excavation and removal): Dollars per cu/yd.

D. Unit-Price No. 4: Electrical underground ductbanks: Dollars per linear ft.

E. Unit-Price No. 5: 15kV Medium voltage cabling: Dollars per linear ft.

F. Unit-Price No. 6: Interior conduits within the building larger than 2": Dollars per linear ft.

G. Unit-Price No. 7: Multimode, fiber optic cable (data system cable): Dollars per linear ft.

H. Unit-Price No. 8: 100 Pair copper cable (telephone system cable): Dollars per linear ft.

I. Unit-Price No. 9: 2" HDPE pipe (Geothermal): Dollars per linear ft.

J. Unit-Price No. 10: 1 1/2" HDPE pipe (Geothermal): Dollars per linear ft.

K. Unit-Price No. 11: 1 1/4" HDPE pipe (Geothermal) Dollars per linear ft.

L. Unit-Price No. 12: 3" or larger indoor hot water and chilled water piping: Dollars per linear ft.

M. Unit-Price No. 13: 4" underground storm piping: Dollars per linear ft.

N. Unit-Price No. 14: 4" sanitary piping Dollars per linear ft.

O. Unit-Price No. 15: dollars per cu yd. of concrete fill

P. Unit-Price No. 16: dollars per cu yd of granular fill, compacted.

Q. Unit-Price No. 17: per ton of structural steel, installed

R. Unit-Price No. 18: per ton of misc. steel, installed

S. Unit-Price No. 19: per ton of rebar, installed

Respectfully submitted this ____ day of _____, 2012.

Submitted By:
(Insert name of bidding firm or corporation)

Authorized
Signature:
(Handwritten signature)

Signed By:
(Type or print name)

Title:
(Owner/Partner/President/Vice President

- - - END - - -

SECTION **01 00 00**
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL INTENTION

A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for the Behavioral Health Complex project as required by drawings and specifications.

B. Visits to the site by Bidders may be made only by appointment with the Medical Center Engineering Officer..

C. Offices of Array HFS, as Architect-Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.

D. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the Resident Engineer in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the Resident Engineer.

E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.

F. Prior to commencing work, general contractor shall provide proof that a OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2) will maintain a presence at the work site whenever the general or subcontractors are present.

G. Training:

1. All employees of general contractor or subcontractors shall have the 10-hour OSHA certified Construction Safety course and/or other relevant competency training, as determined by VA CP with input from the ICRA team.

2. Submit training records of all such employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

A. ITEM I, Behavioral Health Complex: Work includes general construction, alterations, roads, walks, grading, drainage, mechanical and electrical work, utility systems, elevators and dumbwaiters, water storage facilities,necessary removal of existing structures and construction and certain other items.

B. ALTERNATE NO.1: Provide demolition and abatement services associated with the demolition of buildings 26 and 28 and associated site demolition work as shown on civil demolition drawings and abatement report.

C. ALTERNATE NO. 2: Provide parking, hardscape, landscape, site lighting and stormwater retention associated with the additional parking as indicated in the civil drawings.

D. Alternate NO. 3: Provide covered roof over base bid sidewalk connecting New Behavioral Health Building to Residential Rehab and Recovery Building. Connecting roof to start from Base Bid roof over Stair Door 1A05.

E. Alternate NO. 4: Provide Landscape work beyond 5'-0" from Building and bicycle rack. Scope of work includes the trees, shrubs and perennials indicated on the alternate landscape plan plant list. In the event Alternate No. 4 is not awarded, contractor is responsible for installation of lawn in groundcover areas. Lawn areas outside of groundcover areas are to be included within the base bid.

F. Alternate NO. 5: Add Bioretention Basin #1:

1. Work includes excavation of basin, installation of manholes, headwall, pipe, relocated outlet structure, impermeable liner, underdrain, and basin landscaping.

1.3 DRAWINGS FOR CONTRACTOR

A. AFTER AWARD OF CONTRACT, 3 sets of specifications and drawings will be furnished. These drawings and specifications will consist of those returned by prospective bidders.

B. Additional sets of drawings may be made by the Contractor, at Contractor's expense, from reproducible sepia prints furnished by Issuing Office. Such sepia prints shall be returned to the Issuing Office immediately after printing is completed.

1.4 CONSTRUCTION SECURITY REQUIREMENTS

A. Security Plan:

1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.

2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.

B. Security Procedures:

1. General Contractor’s employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.

2. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days notice to the Contracting Officer so that security arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.

3. No photography of VA premises is allowed without written permission of the Contracting Officer.

4. VA reserves the right to close down or shut down the project site and order General Contractor’s employees off the premises in the event of

a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.

C. Guards:

1. The General Contractor shall provide unarmed guards at the project site after construction hours.
2. The guard shall have communication devices to report events as directed by VA police.
3. The general Contractor shall install equipment for recording guard rounds to ensure systematic checking of the premises.

D. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the Resident Engineer for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.
2. The General Contractor shall turn over all permanent lock cylinders to the VA locksmith for permanent installation. See Section 08 71 00, DOOR HARDWARE and coordinate.

E. Document Control:

1. Before starting any work, the General Contractor/Subcontractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".
2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.
4. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
5. All paper waste or electronic media such as CD’s and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
7. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
   a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
   b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

F. Motor Vehicle Restrictions

1. Vehicle authorization request shall be required for any vehicle entering the site and such request shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies.
2. Separate permits shall be issued for General Contractor and its employees for parking in designated areas only.

1.5 FIRE SAFETY

A. Applicable Publications: Publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.

1. American Society for Testing and Materials (ASTM):

a. E84-2009 Surface Burning Characteristics of Building Materials

2. National Fire Protection Association (NFPA):

a. 10-2010 Standard for Portable Fire Extinguishers

b. 30-2008 Flammable and Combustible Liquids Code

c. 51B-2009 Standard for Fire Prevention During Welding, Cutting and Other Hot Work

d. 70-2011 National Electrical Code

e. 241-2009 Standard for Safeguarding Construction, Alteration, and Demolition Operations

3. Occupational Safety and Health Administration (OSHA):

a. 29 CFR 1926 Safety and Health Regulations for Construction

B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to Project Engineer and Facility Safety for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the general contractor’s competent person per OSHA requirements. This briefing shall include information on the construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, etc. Documentation shall be provided to the Resident Engineer that individuals have undergone contractor’s safety briefing.

C. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.

D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).

E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.

F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Resident Engineer and facility Safety Officer .

G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Project Engineer and facility Safety Officer.

H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.

I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.

J. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Project Engineer and facility Safety Officer .

K. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Project Engineer. Obtain permits from facility Safety Officer at least 24 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

L. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Project Engineer and facility Safety Manager.

M. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.

N. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.

O. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

1.6 OPERATIONS AND STORAGE AREAS

A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

C. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting

Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

D. Working space and space available for storing materials shall be as determined by the Resident Engineer.

E. Working space and space available for storing materials shall be as shown on the drawings.

F. Workmen are subject to rules of Medical Center applicable to their conduct.

G. Execute work in such a manner as to interfere as little as possible with work being done by others. Keep roads clear of construction materials, debris, standing construction equipment and vehicles at all times.

H. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.

1. Do not store materials and equipment in other than assigned areas.

2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.

3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.

I. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by Resident Engineer. All such actions shall be coordinated with the Utility Company involved:

1. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

?. Building (s) No. (s) 26 and 28 will be vacated by Government in accordance with above phasing beginning immediately after date of receipt of Notice to Proceed and turned over to Contractor.

?. Building(s) for the Residential Rehab and Recovery will be occupied during performance of work ; but immediate areas of alterations will be vacated.

?. Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Medical Centers operations will not be hindered. Contractor shall permit access to Department of Veterans Affairs

personnel and patients through other construction areas which serve as routes of access to such affected areas and equipment. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Medical Center operations will continue during the construction period.

J. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Remove the fence when directed by Resident Engineer.

K. When a building is turned over to Contractor, Contractor shall accept entire responsibility therefore.

1. Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.

2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre-inspection of site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from Contractor's employee or watchman.

L. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by Resident Engineer.

1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of Resident Engineer. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the Medical Center Director’s prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 27 05 11 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS for additional requirements.

2. Contractor shall submit a request to interrupt any such services to Resident Engineer, in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.

3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center . Interruption time

approved by Medical Center may occur at other than Contractor's normal working hours.

4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the Resident Engineer.

5. In case of a contract construction emergency, service will be interrupted on approval of Resident Engineer. Such approval will be confirmed in writing as soon as practical.

6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

M. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.

N. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:

1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.

2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the Resident Engineer.

O. Coordinate the work for this contract with other construction operations as directed by Resident Engineer. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

1.7 ALTERATIONS

A. Survey: Before any work is started, the Contractor shall make a thorough survey with the Resident Engineer and a representative of VA Supply Service, of areas of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by all three, to the Contracting Officer. This report shall list by rooms and spaces:

1. Existing condition and types of flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of building.

2. Shall note any discrepancies between drawings and existing conditions at site.

3. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and Resident Engineer.

B. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and Resident Engineer together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:

1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.

C. Protection: Provide the following protective measures:

1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.

2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.

1.8 INFECTION PREVENTION MEASURES

A. Implement the requirements of VAMC’s Infection Control Risk Assessment (ICRA) team. ICRA Group may monitor dust in the vicinity of the construction work and require the Contractor to take corrective action immediately if the safe levels are exceeded.

B. Establish and maintain a dust control program as part of the contractor’s infection preventive measures in accordance with the guidelines provided by ICRA Group as specified here for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

1. All personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.

C. Medical center Infection Control personnel shall monitor for airborne disease (e.g. aspergillosis) as appropriate during construction. A baseline of conditions may be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality. In addition:

1. The RE and VAMC Infection Control personnel shall review pressure differential monitoring documentation to verify that pressure differentials in the construction zone are appropriate for their settings. The requirement for negative air pressure in the construction zone shall depend on the location and type of activity. Upon notification, the contractor shall implement corrective measures to restore proper pressure differentials as needed.

2. In case of any problem, the medical center, along with assistance from the contractor, shall conduct an environmental assessment to find and eliminate the source.

D. Final Cleanup:

1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.
3. All new air ducts shall be cleaned prior to final inspection.

1.9 DISPOSAL AND RETENTION

A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:

1. Reserved items which are to remain property of the Government are noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by Resident Engineer.
2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center .
3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.
4. PCB Transformers and Capacitors : The Contractor shall be responsible for disposal of the Polychlorinated Biphenyl (PCB) transformers and capacitors . The transformers and capacitors shall be taken out of service and handled in accordance with the procedures of the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) as outlined in Code of Federal Regulation (CFR), Titled 40 and 49 respectively. The EPA's Toxic Substance Control Act (TSCA) Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7 also apply. Upon removal of PCB transformers and capacitors for disposal, the "originator" copy of the Uniform Hazardous Waste Manifest (EPA Form 8700-22), along with the Uniform Hazardous Waste Manifest Continuation Sheet (EPA Form 8700-22A) shall be returned to the Contracting Officer who will annotate the contract file and transmit the Manifest to the Medical Center's Chief.

   a. Copies of the following listed CFR titles may be obtained from the Government Printing Office:

      1) 40 CFR 261 Identification and Listing of Hazardous Waste
      2) 40 CFR 262 Standards Applicable to Generators of Hazardous Waste
      3) 40 CFR 263 Standards Applicable to Transporters of Hazardous Waste

4) 40 CFR 761 PCB Manufacturing, Processing, Distribution in Commerce, and use Prohibitions

5) 49 CFR 172 Hazardous Material tables and Hazardous Material Communications Regulations

6) 49 CFR 173 Shippers - General Requirements for Shipments and Packaging

7) 49 CRR 173 Subpart A General

8) 49 CFR 173 Subpart B Preparation of Hazardous Material for Transportation

9) 49 CFR 173 Subpart J Other Regulated Material; Definitions and Preparation

10) TSCA Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7

1.10 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Resident Engineer.

B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Resident Engineer may have the necessary work performed and charge the cost to the Contractor.

(FAR 52.236-9)

C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.

D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate medical center) office. The apparent low bidder, contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit

process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:

1. Designating areas for equipment maintenance and repair;
2. Providing waste receptacles at convenient locations and provide regular collection of wastes;
3. Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
4. Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
5. Providing adequately maintained sanitary facilities.

1.11 RESTORATION

A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the Resident Engineer. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the Resident Engineer before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.

B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.

C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.

D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.12 PHYSICAL DATA

A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

B. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by

_____.

(FAR 52.236-4)

C. Subsurface conditions have been developed by core borings and test pits. Logs of subsurface exploration are shown diagrammatically on drawings.

D. A copy of the soil report will be made available for inspection by bidders upon request to the Engineering Officer at the VA Medical Center, _____ and shall be considered part of the contract documents.

E. Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine site of work and logs of borings; and, after investigation, decide for themselves character of materials and make their bids accordingly. Upon proper application to Department of Veterans Affairs, bidders will be permitted to make subsurface explorations of their own at site.

1.13 PROFESSIONAL SURVEYING SERVICES

A. A registered professional land surveyor or registered civil engineer whose services are retained and paid for by the Contractor shall perform services specified herein and in other specification sections. The Contractor shall certify that the land surveyor or civil engineer is not one who is a regular employee of the Contractor, and that the land surveyor or civil engineer has no financial interest in this contract.

1.14 LAYOUT OF WORK

A. The Contractor shall lay out the work from Government established base lines and bench marks, indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Resident Engineer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the Resident Engineer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

(FAR 52.236-17)

B. Establish and plainly mark center lines for each building and/or addition to each existing building, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, roads, parking lots, are in accordance with lines and elevations shown on contract drawings.

C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. Survey

shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:

1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the Resident Engineer before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.

D. During progress of work, and particularly as work progresses from floor to floor, Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the Resident Engineer before any major items of concrete work are placed. In addition, Contractor shall also furnish to the Resident Engineer certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.

1. Lines of each building and/or addition.
2. Elevations of bottoms of footings and tops of floors of each building and/or addition.
3. Lines and elevations of sewers and of all outside distribution systems.
4. Lines of elevations of all swales and interment areas.
5. Lines and elevations of roads, streets and parking lots.

E. Whenever changes from contract drawings are made in line or grading requiring certificates, record such changes on a reproducible drawing bearing the registered land surveyor or registered civil engineer seal, and forward these drawings upon completion of work to Resident Engineer.

F. Upon completion of the work, the Contractor shall furnish the Resident Engineer, reproducible drawings at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work, including burial monuments and fifty foot stationing along new road centerlines. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.

G. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.15 AS-BUILT DRAWINGS

A. The contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.

B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the Resident Engineer's review, as often as requested.

C. Contractor shall deliver two approved completed sets of as-built drawings to the Resident Engineer within 15 calendar days after each completed phase and after the acceptance of the project by the Resident Engineer.

D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.16 USE OF ROADWAYS

A. For hauling, use only established public roads and roads on Medical Center property and, when authorized by the Resident Engineer, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

B. When new permanent roads are to be a part of this contract, Contractor may construct them immediately for use to facilitate building operations. These roads may be used by all who have business thereon within zone of building operations.

C. When certain buildings (or parts of certain buildings) are required to be completed in advance of general date of completion, all roads leading thereto must be completed and available for use at time set for completion of such buildings or parts thereof.

1.17 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to compliance with the following provisions:

1. Permission to use each unit or system must be given by Resident Engineer. If the equipment is not installed and maintained in accordance with the following provisions, the Resident Engineer will withdraw permission for use of the equipment.

2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.

3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.

4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.

5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.

6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.

B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.

C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

1.18 TEMPORARY USE OF NEW ELEVATORS

A. The Contractor and his personnel shall be permitted use of new elevator(s) subject to the following provisions:

1. Contractor shall make arrangements with the Resident Engineer for use of elevator(s). Contractor may obtain elevator(s) for exclusive use.

2. Prior to the use of elevator(s), the Contractor shall have the elevator(s) inspected and accepted by an ASME accredited, certified elevator safety inspector. The acceptance report shall be submitted to the Resident Engineer.

3. Submit to the Resident Engineer the schedule and procedures for maintaining equipment. Indicate the day or days of the week and total hours required for maintenance. A report shall be submitted to the Resident Engineer monthly indicating the type of maintenance conducted, hours used, and any repairs made to the elevator(s).

4. The Contractor shall be responsible for enforcing the maintenance procedures.

5. During temporary use of elevator(s) all repairs, equipment replacement and cost of maintenance shall be the responsibility of the Contractor.

6. Personnel for operating elevator(s) shall not be provided by the Department of Veterans Affairs.

7. Contractor shall cover and provide maximum protection of the entire elevator(s) installation.

8. The Contractor shall arrange for the elevator company to perform operation of the elevator(s) so that an ASME accredited, certified elevator safety inspector can evaluate the equipment. The Contractor shall be responsible for any costs of the elevator company.

9. All elevator(s) parts worn or damaged during temporary use shall be removed and replaced with new parts. This shall be determined by an ASME accredited certified elevator safety inspector after temporary use and before acceptance by the Government. Submit report to the Resident Engineer for approval.

10. Elevator shall be tested as required by the testing section of the elevator(s) specifications before acceptance by the Department of Veterans Affairs.

1.19 TEMPORARY TOILETS

A. Provide where directed, (for use of all Contractor's workmen) ample temporary sanitary toilet accommodations with suitable sewer and water connections; or, when approved by Resident Engineer, provide suitable dry closets where directed. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

B. Contractor may have for use of Contractor's workmen, such toilet accommodations as may be assigned to Contractor by Medical Center . Contractor shall keep such places clean and be responsible for any damage done thereto by Contractor's workmen. Failure to maintain satisfactory condition in toilets will deprive Contractor of the privilege to use such toilets.

1.20 AVAILABILITY AND USE OF UTILITY SERVICES

A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.

B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

C. Contractor shall install meters at Contractor's expense and furnish the Medical Center a monthly record of the Contractor's usage of electricity as hereinafter specified.

D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

1. Obtain heat by connecting to Medical Center heating distribution system.

a. Steam is available at no cost to Contractor.

E. Electricity (for Construction and Testing): Furnish all temporary electric services.

1. Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.

F. Water (for Construction and Testing): Furnish temporary water service.

1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection. Water is available at no cost to the Contractor.

2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at Resident Engineer's discretion) of use of water from Medical Center's system.

G. Steam: Furnish steam system for testing required in various sections of specifications.

1. Obtain steam for testing by connecting to the Medical Center steam distribution system. Steam is available at no cost to the Contractor.
2. Maintain connections, pipe, fittings and fixtures and conserve steam-use so none is wasted. Failure to stop leakage or other waste will be cause for revocation (at Resident Engineer's discretion), of use of steam from the Medical Center's system.

H. Fuel: Natural and LP gas and burner fuel oil required for boiler cleaning, normal initial boiler-burner setup and adjusting, and for performing the specified boiler tests will be furnished by the Government. Fuel required for prolonged boiler-burner setup, adjustments, or modifications due to improper design or operation of boiler, burner, or control devices shall be furnished by the Contractor at Contractor's expense.

1.21 NEW TELEPHONE EQUIPMENT

A. The contractor shall coordinate with the work of installation of telephone equipment by others. This work shall be completed before the building is turned over to VA.

1.22 TESTS

A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.

B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.

C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam, chilled water, refrigerant, hot water, controls and electricity, etc. Another example of a complex which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of fuel, combustion air, controls, steam, feedwater, condensate and other related components.

D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.

E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.23 INSTRUCTIONS

A. Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications

and as hereinafter specified.

B. Manuals: Maintenance and operating manuals (four copies each) for each separate piece of equipment shall be delivered to the Resident Engineer coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

C. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system, shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the Resident Engineer and shall be considered concluded only when the Resident Engineer is satisfied in regard to complete and thorough coverage. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the Resident Engineer, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.24 GOVERNMENT-FURNISHED PROPERTY

A. The Government shall deliver to the Contractor, the Government-furnished property shown on the drawings .

B. Equipment furnished by Government to be installed by Contractor will be furnished to Contractor at the Medical Center .

C. Contractor shall be prepared to receive this equipment from Government and store or place such equipment not less than 90 days before Completion Date of project.

D. Storage space for equipment will be provided by the Government and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Medical Center .

E. Notify Contracting Officer in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.

1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.

2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.

F. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.

G. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.

H. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

I. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated by symbol "R" or otherwise shown to be relocated by the Contractor.

J. Perform relocation of such equipment or items at such times and in such a manner as directed by the Resident Engineer.

K. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".

L. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.

M. Contractor shall employ services of an installation engineer, who is an authorized representative of the manufacturer of this equipment to supervise assembly and installation of existing equipment, required to be relocated.

N. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

1.25 STORAGE SPACE FOR DEPARTMENT OF VETERANS AFFAIRS EQUIPMENT

A. Contractor shall complete approximately _____ square meters _____

(square feet) of space in building accessible from ground level without use of elevators for storage of certain materials and equipment by Department of Veterans Affairs.

1. Provide such space with adequate light, ventilation and heat in season and lock for adequate security. Contractor shall also install and connect portion of nearest specified fire protection system including all apparatus for instant use to provide water for adequate fire protection of storage space.
2. Storage space shall be turned over to Contracting Officer ninety days prior to Completion Date of the buildings involved.
3. Forward two sets of drawings to Contracting Officer through the Resident Engineer 120 days prior to Completion Date of building; drawings shall indicate those areas which will be made available to Department of Veterans Affairs for temporary storage.
4. All cost for utility services for such storage space shall be borne by Contractor until entire building is turned over for occupancy.

B. "Completion Date" shall mean that date as established by Contracting Officer upon which Contractor will turn over entire project or portions thereof to the Government.

1.26 CONSTRUCTION SIGN

A. Provide a Construction Sign where directed by the Resident Engineer. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Provide three 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 1200 mm (four feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50 x 100 mm (two by four inch) material as directed.

B. Paint all surfaces of sign and posts two coats of white gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.

C. Maintain sign and remove it when directed by the Resident Engineer.

D. Detail Drawing of construction sign showing required legend and other characteristics of sign is attached hereto and made a part of this specification.

1.27 SAFETY SIGN

A. Provide a Safety Sign where directed by Resident Engineer. Face of sign shall be 19 mm (3/4 inch) thick exterior grade plywood. Provide two 100 mm by 100 mm (four by four inch) posts extending full height of sign and 900 mm (three feet) into ground. Set bottom of sign level at 1200 mm (four feet) above ground.

B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.

C. Maintain sign and remove it when directed by Resident Engineer.

D. Standard Detail Drawing Number SD10000-02 (Found on VA TIL) of safety sign showing required legend and other characteristics of sign is attached hereto and is made a part of this specification.

E. Post the number of accident free days on a daily basis.

Estimated Cost		Number of Photographs
Up to	$250,000	50 to 100
" "	$500,000	100 to 150
" "	$1,000,000	150 to 200
" "	$2,000,000	200 to 250
" "	$5,000,000	250 to 300
" "	$10,000,000	300 to 400
More than	$10,000,000	400 to 500

1.28 PHOTOGRAPHIC DOCUMENTATION

A. During the construction period through completion, provide photographic documentation of construction progress and at selected milestones including electronic indexing, navigation, storage and remote access to the documentation, as per these specifications. The commercial photographer or the subcontractor used for this work shall meet the following qualifications:

1. Demonstrable minimum experience of three (3) years in operation providing documentation and advanced indexing/navigation systems including a representative portfolio of construction projects of similar type, size, duration and complexity as the Project.

2. Demonstrable ability to service projects throughout North America, which shall be demonstrated by a representative portfolio of active projects of similar type, size, duration and complexity as the Project.

B. Photographic documentation elements:

1. Each digital image shall be taken with a professional grade camera with minimum size of 6 megapixels (MP) capable of producing 200x250mm (8 x 10 inch) prints with a minimum of 2272 x 1704 pixels and 400x500mm (16 x 20 inch) prints with a minimum 2592 x 1944 pixels.

2. Indexing and navigation system shall utilize actual AUTOCAD construction drawings, making such drawings interactive on an on-line interface. For all documentation referenced herein, indexing and navigation must be organized by both time (date-stamped) and location throughout the project.

3. Documentation shall combine indexing and navigation system with inspection-grade digital photography designed to capture actual conditions throughout construction and at critical milestones. Documentation shall be accessible on-line through use of an internet connection. Documentation shall allow for secure multiple-user access, simultaneously, on-line.

4. Before construction, the building pad, adjacent streets, roadways, parkways, driveways, curbs, sidewalks, landscaping, adjacent utilities and adjacent structures surrounding the building pad and site shall be documented. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings. If site work or pad preparation is extensive, this documentation may be required immediately before construction and at several pre-determined intervals before building work commences.

5. Construction progress for all trades shall be tracked at pre-determined intervals, but not less than once every thirty (30) calendar days ("Progressions"). Progression documentation shall track both the exterior and interior construction of the building. Exterior Progressions shall track 360 degrees around the site and each building. Interior Progressions shall track interior improvements beginning when stud work commences and continuing until Project completion.

6. As-built condition of pre-slab utilities and site utilities shall be documented prior to pouring slabs, placing concrete and/or backfilling. This process shall include all underground and in-slab utilities within the building(s) envelope(s) and utility runs in the immediate vicinity of the building(s) envelope(s). This may also include utilities enclosed in slab-on-deck in multi-story buildings. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive site utility plans.

7. As-built conditions of mechanical, electrical, plumbing and all other systems shall be documented post-inspection and pre-insulation, sheet rock or dry wall installation. This process shall include all finished systems located in the walls and ceilings of all buildings at the Project. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.

8. As-built conditions of exterior skin and elevations shall be documented with an increased concentration of digital photographs as directed by the Resident Engineer in order to capture pre-determined focal points, such as waterproofing, window flashing, radiused steel work, architectural or Exterior Insulation and Finish Systems (EIFS) detailing. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive elevations or elevation details.

9. As-built finished conditions of the interior of each building including floors, ceilings and walls shall be documented at certificate of occupancy or equivalent, or just prior to occupancy, or both, as directed by the Resident Engineer. Overlapping photographic techniques shall be

used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.

10. Miscellaneous events that occur during any Contractor site visit, or events captured by the Department of Veterans Affairs independently, shall be dated, labeled and inserted into a Section in the navigation structure entitled “Slideshows,” allowing this information to be stored in the same “place” as the formal scope.

11. Customizable project-specific digital photographic documentation of other details or milestones. Indexing and navigation accomplished through interactive architectural plans.

12. Monthly (29 max) exterior progressions (360 degrees around the project) and slideshows (all elevations and building envelope). The slideshows allow for the inclusion of Department of Veterans Affairs pictures, aerial photographs, and timely images which do not fit into any regular monthly photopath.

13. Weekly (21 Max) Site Progressions - Photographic documentation capturing the project at different stages of construction. These progressions shall capture underground utilities, excavation, grading, backfill, landscaping and road construction throughout the duration of the project.

14. Regular (8 max) interior progressions of all walls of the entire project to begin at time of substantial framed or as directed by the Resident Engineer through to completion.

15. Detailed Exact-Built of all Slabs for all project slab pours just prior to placing concrete or as directed by the Resident Engineer.

16. Detailed Interior exact built overlapping photos of the entire building to include documentation of all mechanical, electrical and plumbing systems in every wall and ceiling, to be conducted after rough-ins are complete, just prior to insulation and or drywall, or as directed by Resident Engineer.

17. Finished detailed Interior exact built overlapping photos of all walls, ceilings, and floors to be scheduled by Resident Engineer prior to occupancy.

18. In event a greater or lesser number of images than specified above are required by the Resident Engineer, adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).

C. Images shall be taken by a commercial photographer and must show distinctly, at as large a scale as possible, all parts of work embraced in the picture.

D. Coordination of photo shoots is accomplished through Resident Engineer. Contractor shall also attend construction team meetings as necessary. Contractor’s operations team shall provide regular updates regarding the status of the documentation, including photo shoots concluded, the availability of new Progressions or Exact-Builts viewable on-line and anticipated future shoot dates.

E. Contractor shall provide all on-line domain/web hosting, security measures, and redundant server back-up of the documentation.

F. Contractor shall provide technical support related to using the system or service.

G. Upon completion of the project, final copies of the documentation (the "Permanent Record") with the indexing and navigation system embedded (and active) shall be provided in an electronic media format, typically a DVD or external hard-drive. Permanent Record shall have Building Information Modeling (BIM) interface capabilities. On-line access terminates upon delivery of the Permanent Record.

1.29 FINAL ELEVATION DIGITAL IMAGES

A. A minimum of four (4) images of each elevation shall be taken with a minimum 6 MP camera, by a professional photographer with different settings to allow the Resident Engineer to select the image to be printed. All images are provided to the RE on a CD.

B. Photographs shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day to obtain sufficient detail to show depth and to provide clear, sharp pictures. Pictures shall be 400 mm x 500 mm (16 by 20 inches), printed on regular weight paper, matte finish archival grade photographic paper and produced by a RA4 process from the digital image with a minimum 300 PPI. Identifying data shall be carried on label affixed to back of photograph without damage to photograph and shall be similar to that provided for final construction photographs.

C. Furnish six (6) 400 mm x 500 mm (16 by 20 inch) color prints of the following buildings constructed under this project (elevations as selected by the RE from the images taken above). Photographs shall be artistically composed showing full front elevations. All images shall become property of the Government. Each of the selected six prints shall be placed in a frame with a minimum of 2 inches of appropriate matting as a border. Provide a selection of a minimum of 3 different frames from which the SRE will select one style to frame all six prints. Photographs with frames shall be delivered to the Resident Engineer in boxes suitable for shipping.

1. Hospital Building No. ____.
2. Clinical Building No. ____.
3. Nursing Home Care Building No. _____.
4. Chapel Building No. _____.
5. Boiler Plant Building No. _____.

1.30 HISTORIC PRESERVATION

A. Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the Resident Engineer verbally, and then with a written follow up.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION (Not used)

- - - E N D - - -

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.1 Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.

1.2 For the purposes of this contract, samples (including laboratory samples to be tested) , Submit for approval, all of the items specifically mentioned under the separate sections of the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.

1.3 Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:

A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;

B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;

C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.

1.4 Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in contract time for completion.

1.5 Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Resident Engineer on behalf of the Contracting Officer.

1.6 Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.

1.7 The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.

1.8 A completed LEED Building Materials Certification Form (Sample Included at

the end of this section). Information to be supplied for this form shall include

A. Material cost(s) for the building materials included in the contractor's or subcontractor's work. The material costs shall not include costs associated with contractors or subcontractors' labor or equipment.

B. The amount of post consumer and/or post industrial recycled content in the supplied products.

C. The location of origin and location of manufacturer for the supplied products.

D. The amount of FSC Certified wood products used.

E. Letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied on the LEED Building Materials Certification Form.

F. Product cut sheets for all materials that meet the LEED Building Performance criteria identified in each specification.

G. Documentation for all new wood products, including FSC Certified. Provide vendor invoices for all permanently installed wood products, FSC Certified or not. Each wood product must be identified on a line-item basis, FSC products must be identified as such on a line item basis, the dollar value of each line item must be shown, the vendors Chain-of-Custody certificate number must be shown on any invoice that includes FSC products.

H. Material Safety Data Sheets (MSDS) for all applicable products. Applicable products include but are not limited to adhesives, sealants, carpets, paints, coatings, flooring systems, and composite wood materials. MSDS shall indicate the Volatile Organic Compound (VOC) content of products submitted (if an MSDS sheet does not contain the VOC content, manufacturer letters or product data sheets must be provided that indicate the VOC contents).

I. The LEED Building Submittal information shall be assembled into one package per specification section (or per subcontractor) and sent to the Architect for review. Incomplete or inaccurate LEED Building submittals may be used as the basis for the Architects rejection of products or assemblies

1.9 Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect-Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.

1.10 Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.

A. Submit samples required by Section 09 06 00, SCHEDULE FOR FINISHES, in quadruplicate. Submit other samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.

B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via electronic mail and shall contain the list of items, name of Medical Center , name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.

1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Medical Center , name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.

C. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.

1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
4. Contractor shall send a copy of transmittal letter to both Resident Engineer and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
5. Contractor shall forward a copy of transmittal letter to Resident Engineer simultaneously with submission to a commercial testing laboratory.
6. Laboratory test reports shall be sent directly to Resident Engineer for appropriate action.
7. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
8. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.

D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.

E. Approved samples will be kept on file by the Resident Engineer at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.

F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.

1. For each drawing required, submit one legible photographic paper or vellum reproducible.
2. Reproducible shall be full size.
3. Each drawing shall have marked thereon, proper descriptive title, including Medical Center location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

1.11 Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to:

Array HFS
2520 Renaissance Blvd., Suite 110
King of Prussia, PA 19406

1.12 At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the Resident Engineer.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION (Not used)

- - - E N D - - -

SECTION 01 3329

SUSTAINABLE DESIGN REPORTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Sustainable design reporting and documentation.

B. Related Sections:

1. Section 01 33 23 – SHOP DRAWING, PRODUCT DATA AND SAMPLES, General requirements applicable to all submittals.
2. Section 01 35 46 - Indoor Air Quality Management.
3. Section 01 74 19 - Construction Waste Management.
4. Section 01 81 13.13 - Sustainable Design Requirements.

1.2 REFERENCES

A. U.S. Green Building Council (USGBC) - Leadership in Energy and Environmental Design (LEED) 2009 - Green Building Rating System For New Construction and Major Renovations.

1.3 SUSTAINABLE DESIGN ACTION PLAN

A. Submit Sustainable Design Action Plan within 14days after date of Notice to Proceed.
B. Indicate in Sustainable Design Action Plan how following requirements will be met:
1. SS Prerequisite 1 - Erosion and Sedimentation Control: Erosion and sedimentation control plan.
2. Credit EA 5 - Measurement and Verification: Measurement and verification plan.
3. Credit MR 2 - Construction Waste Management: Include preliminary construction waste management plan per Section 01 7419.
4. Credit MR 3 - Materials Reuse: List proposed reused materials; indicate value or cost of reused materials.
5. Credit MR 4 - Recycled Content: List proposed materials containing recycled content; indicate product cost, recycled content percent, and whether pre-consumer or post-consumer.
6. Credit MR 5 - Regional Materials: List proposed materials extracted, processed, or harvested and manufactured within 500 mile radius of Project site; indicate product cost.
7. Credit MR 7 - Certified Wood: List proposed certified wood products; indicate product cost.
8. Credit EQ 3.1 - Construction IAQ Management Plan: Include preliminary Indoor Air Quality Management Plan per Section 01 3546.

C. Submit electronically in Adobe PDF format.

1.4 SUSTAINABLE DESIGN SUBMITTALS

A. Submit cost schedule of products meeting sustainable design criteria.

B. Coordinate Schedule of Values line items specified in Section 01 2900 with Sustainable Design Cost Data Submittals line items.

C. Submit updated Sustainable Design Cost Data Submittal along with each Application for Payment.

D. Except in instances where documentation is dependent on actual shipments, batches, or lots transported to Project, submit Sustainable Design Submittals concurrently with Submittals for Review.

E. Submit electronically in Adobe PDF format.

F. Content:
   1. Product descriptions:
      a. Identify products by specification section number.
      b. Provide product name and name of manufacturer or supplier.
      c. Provide separate line item for each product requiring sustainable design credit.
   2. Product cost data: Provide product cost for each line item, excluding installation labor and equipment rental.
   3. Project cost data; provide total cost to Contractor for:
      a. Products used in Divisions 03 through 10, 31, and 32.
      b. Wood-based products used.

G. Required Submittals:
   1. Sustainable Sites:
      a. SS Prerequisite 1 - Construction Activity Pollution Prevention:
         1) Copy of Erosion and Sedimentation Control Plan.
         2) Date-stamped photographs showing erosion and sedimentation controls implemented.
      b. Credit SS 7.2 - Heat Island Effect - Roof: Certify Solar Reflectance Index of roof surfaces.
      c. Credit SS 8 - Light Pollution Reduction: Product Data for automatic lighting controls.
   2. Water Efficiency:
      a. Credit WE 3 - Water Use Reduction: Certify flow and flush rates of water consuming fixtures.
   3. Energy and Atmosphere:
      a. EA Prerequisite 1 - Fundamental Commissioning of Building Energy Systems: Submit documentation specified in Section 01 9100.
      b. Credit EA 3 - Enhanced Commissioning: Submit documentation specified in Section 01 9100.
      c. Credit EA 4 - Enhanced Refrigeration Management: Product Data for refrigerants and HVAC equipment.
      d. Credit EA 5 - Measurement and Verification: Product Data for metering of building energy use.
   4. Materials and Resources:
      a. Credit MR 2 - Construction Waste Management: Submit documentation specified in Section 01 7419.
      b. Credit MR 4 - Recycled Content:
         1) Certify percentages of post-consumer and pre-consumer recycled content.
         2) Show cost of products containing recycled content.

3) Certify manufacturer, product, and recycled content information source.

c. Credit MR 5 - Regional Materials:
1) Indicate cost of products harvested, extracted, recovered, or manufactured within 500 mile radius of Project site.
2) Certify distance between manufacturer and project and between manufacturer and extraction or harvest point in miles.
3) Show cost of products meeting regional material requirements.
4) Certify manufacturer, product, and regional information source.

d. Credit MR 7 - Certified Wood:
1) Certify percentage of certified wood.
2) Certify Forest Stewardship Council chain-of-custody certificate number.

5. Indoor Environmental Quality:

a. Credit EQ 1 - Outdoor Air Delivery Monitoring: Product Data for carbon dioxide monitors and airflow measurement devices.

b. Credit EQ 3.1 - Construction IAQ Management Plan: During Construction: Submit documentation specified in Section 01 3546.

c. Credit EQ 3.2 - Construction IAQ Management Plan: Before Occupancy: Submit documentation specified in Section 01 3546.

d. Credit EQ 4.1 - Low-Emitting Materials - Adhesives and Sealants: Certify volatile organic compound (VOC) content.

e. Credit EQ 4.2 - Low-Emitting Materials - Paints and Coatings: Certify volatile organic compound (VOC) content.

f. Credit EQ 4.3 - Low-Emitting Materials - Flooring Systems:
1) Certify that carpet meets CRI Green Label Plus Program requirements.
2) Certify that hard surface flooring meets RFCI FloorScore requirements.
3) Indicate volatile organic compound (VOC) content for adhesives.

g. Credit EQ 4.4 - Low-Emitting Materials - Composite Wood and Agrifiber Products:
1) Certify that products do not contain urea-formaldehyde resins.
2) Certify manufacturer, product, and information source.

h. Credit EQ 5 - Indoor Pollution Source Control: Product Data for air infiltration media used including manufacturer and MERV rating.

i. Credit EQ 6.1 - Controllability of Systems Lighting: Product Data and Shop Drawings for sensors and control systems.

6. Innovation and Design Process:

a. Credit ID 1 - Innovation in Design: Integrated Pest Management and Green Housekeeping- Submit as per specification requirements in Section 0108150

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

LEED Building Material Certification Form

Project Name: _____ Contractor Name: _____ Submittal Number: _____
Project Location: _____ Telephone Number: _____ Submittal Date: _____

		Recycled Content		Regional Materials					
MANUFACTURER / PRODUCT NAME	MATERIAL COST[1] Less Labor & Equip	POST CONSUMER[2]	PRE-CONSUMER[3] Post-Industrial	MANUFACTURING LOCATION[4]	RAW RESOURCES LOCATIONS[5]	RAPIDLY RE-NEWABLE[7]	FSC CERTIFIED WOOD[6] Wood Products Only		SUPPORTING DOCUMENTS[8]
	$	$	%	(City, State)	(City, State)	%	%	(COC#)	Indicate type(s)
Example:	$8,550	5%	94%	Paterson, NY	Lebanon, PA	0%	0%	n/a	MSDS or Cut Sheet Manufacturer Letter Other
									MSDS or Cut Sheet Manufacturer Letter Other
									MSDS or Cut Sheet Manufacturer Letter Other
									MSDS or Cut Sheet Manufacturer Letter Other
									MSDS or Cut Sheet Manufacturer Letter Other

[1]*Material cost ($):* The cost of the materials as it would appear on the manufacturer's or distributor's invoice to the contractor or subcontractor. *Note*: Material cost does not include labor or equipment costs associated with the installation of the product.

[2]*Post-Consumer Recycled Content (%):* Portion (by Weight) of material or product which derives from discarded consumer waste that has served its intended purpose and has been recovered for use as a raw material (EG a plastic bottle from a soft drink).

[3]*Pre-Consumer Recycled Content (%):* (also called Post-Industrial) Portion (by weight) of material or product which derives from recovered industrial and manufacturing waste materials that are diverted for use in a different manufacturing process prior to use by a consumer (e.g. fly-ash concrete and synthetic gypsum board, both use recovered waste products from coal burning electricity plants). Note: Pre-Consumer Recycled Content does not include scrap raw materials that can be reused in the same manufacturing process from which they are recovered.

[4]*Manufacturing Location (City, State):* Manufacturing Location is the final assembly location of components into a building product that is then installed by the tradesmen (e.g. if a windows glass comes from Atlanta, GA and the aluminum casing from Charlotte, NC and the window was assembled in Baltimore, MD, then the Manufacturing Location of the window is Baltimore, MD).

[5]*Raw Resources Location (City, State):* The location from which the building product components were extracted, harvested, or recovered (e.g. in the example above, the window would have two Raw Resources Locations: Atlanta, GA and Charlotte, NC).

[6]*FSC Certified:* Portion (by weight) of wood-based material or products that are certified by the Forest Stewardship Council (FSC). A Chain-of Custody number (COC#) is required for all FSC certified wood products. *Note*: This column is only applicable to wood products.

[7]*Rapidly Renewable (%):* Portion (by weight) of materials and products made from raw materials that are harvested within a 10-year cycle (e.g. bamboo, cork, linoleum, wool, cotton, insulation, and wheat board).

[8]*Supporting Documents:* are required to verify the accuracy of the information of this form. Please indicate the types(s) of Supporting Documents that ate attached to this form. Supporting Documents may include, but are into limited to one of the following: Material Safety Data Sheets(MSDS), Cut sheets, and Manufacturer Letters of Certification (must be provided on the manufacturer's letterhead).

VOC Compliance: For products that are Adhesives, Sealants, Paints, Coatings, Carpets Systems, Composite Wood and Agrifiber products, please fill out the LEED VOC Certification Form.

I,_____ a duly authorized representative of _____ hereby certify that the material information contained herein is an accurate representation of the material qualifications to be provided by us, as components of the final building construction. Furthermore, I understand that any change in such qualifications during the purchasing period will require prior written approval from the Construction Manager and Owner.

_____ _____

Signature of Authorized Representative Date

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)

A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to – GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.

B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM descriptions (FAR 52.211-4) (JUN 1988)

1. The specifications and standards cited in this solicitation can be examined at the following location:

   a. DEPARMENT OF VETERANS AFFAIRS
   Office of Construction & Facilities Management
   Facilities Quality Service (00CFM1A)
   425 Eye Street N.W., (sixth floor) -
   Washington, DC 20001
   Telephone Numbers: (202) 632-5249 or (202) 632-5178 -
   Between 9:00 AM - 3:00 PM

1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)

A. The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

AA Aluminum Association Inc
http://www.aluminum.org
AABC Associated Air Balance Council
http://www.aabchq.com

AAMA American Architectural Manufacturer's Association
http://www.aamanet.org
AAN American Nursery and Landscape Association
http://www.anla.org
AASHTO American Association of State Highway and Transportation Officials
http://www.aashto.org
AATCC American Association of Textile Chemists and Colorists
http://www.aatcc.org
ACGIH American Conference of Governmental Industrial Hygienists
http://www.acgih.org
ACI American Concrete Institute
http://www.aci-int.net
ACPA American Concrete Pipe Association
http://www.concrete-pipe.org
ACPPA American Concrete Pressure Pipe Association
http://www.acppa.org
ADC Air Diffusion Council
http://flexibleduct.org
AGA American Gas Association
http://www.aga.org
AGC Associated General Contractors of America
http://www.agc.org
AGMA American Gear Manufacturers Association, Inc.
http://www.agma.org
AHAM Association of Home Appliance Manufacturers
http://www.aham.org
AISC American Institute of Steel Construction
http://www.aisc.org
AISI American Iron and Steel Institute
http://www.steel.org
AITC American Institute of Timber Construction
http://www.aitc-glulam.org
AMCA Air Movement and Control Association, Inc.
http://www.amca.org
ANLA American Nursery & Landscape Association
http://www.anla.org
ANSI American National Standards Institute, Inc.
http://www.ansi.org
APA The Engineered Wood Association
http://www.apawood.org
ARI Air-Conditioning and Refrigeration Institute
http://www.ari.org
ASAE American Society of Agricultural Engineers
http://www.asae.org
ASCE American Society of Civil Engineers
http://www.asce.org
ASHRAE American Society of Heating, Refrigerating, and Air-Conditioning Engineers
http://www.ashrae.org
ASME American Society of Mechanical Engineers
http://www.asme.org
ASSE American Society of Sanitary Engineering
http://www.asse-plumbing.org
ASTM American Society for Testing and Materials

http://www.astm.org
AWI Architectural Woodwork Institute
http://www.awinet.org
AWS American Welding Society http://www.aws.org
AWWA American Water Works Association
http://www.awwa.org
BHMA Builders Hardware Manufacturers Association
http://www.buildershardware.com
BIA Brick Institute of America
http://www.bia.org
CAGI Compressed Air and Gas Institute
http://www.cagi.org
CGA Compressed Gas Association, Inc.
http://www.cganet.com
CI The Chlorine Institute, Inc.
http://www.chlorineinstitute.org
CISCA Ceilings and Interior Systems Construction Association
http://www.cisca.org
CISPI Cast Iron Soil Pipe Institute
http://www.cispi.org
CLFMI Chain Link Fence Manufacturers Institute
http://www.chainlinkinfo.org
CPMB Concrete Plant Manufacturers Bureau
http://www.cpmb.org
CRA California Redwood Association
http://www.calredwood.org
CRSI Concrete Reinforcing Steel Institute
http://www.crsi.org
CTI Cooling Technology Institute
http://www.cti.org
DHI Door and Hardware Institute
http://www.dhi.org
EGSA Electrical Generating Systems Association
http://www.egsa.org
EEI Edison Electric Institute
http://www.eei.org
EPA Environmental Protection Agency
http://www.epa.gov
ETL ETL Testing Laboratories, Inc.
http://www.et1.com
FAA Federal Aviation Administration
http://www.faa.gov
FCC Federal Communications Commission
http://www.fcc.gov
FPS The Forest Products Society
http://www.forestprod.org
GANA Glass Association of North America
http://www.cssinfo.com/info/gana.html/
FM Factory Mutual Insurance
http://www.fmglobal.com
GA Gypsum Association
http://www.gypsum.org
GSA General Services Administration
http://www.gsa.gov

HI Hydraulic Institute
http://www.pumps.org
HPVA Hardwood Plywood & Veneer Association
http://www.hpva.org
ICBO International Conference of Building Officials
http://www.icbo.org
ICEA Insulated Cable Engineers Association Inc.
http://www.icea.net
ICAC Institute of Clean Air Companies
http://www.icac.com
IEEE Institute of Electrical and Electronics Engineers
http://www.ieee.org\
IMSA International Municipal Signal Association
http://www.imsasafety.org
IPCEA Insulated Power Cable Engineers Association
NBMA Metal Buildings Manufacturers Association
http://www.mbma.com
MSS Manufacturers Standardization Society of the Valve and Fittings Industry Inc.,
http://www.mss-hq.com
NAAMM National Association of Architectural Metal Manufacturers
http://www.naamm.org
NAPHCC Plumbing-Heating-Cooling Contractors Association
http://www.phccweb.org.org
NBS National Bureau of Standards, See - NIST
NBBPVI National Board of Boiler and Pressure Vessel Inspectors,
http://www.nationboard.org
NEC National Electric Code, See - NFPA National Fire Protection Association
NEMA National Electrical Manufacturers Association
http://www.nema.org
NFPA National Fire Protection Association
http://www.nfpa.org
NHLA National Hardwood Lumber Association
http://www.natlhardwood.org
NIH National Institute of Health
http://www.nih.gov
NIST National Institute of Standards and Technology
http://www.nist.gov
NLMA Northeastern Lumber Manufacturers Association, Inc.
http://www.nelma.org
NPA National Particleboard Association 18928 Premiere Court,
Gaithersburg, MD 20879 (301) 670-0604
NSF National Sanitation Foundation
http://www.nsf.org
NWWDA Window and Door Manufacturers Association
http://www.nwwda.org
OSHA Occupational Safety and Health Administration Department of Labor
http://www.osha.gov
PCA Portland Cement Association
http://www.portcement.org
PCI Precast Prestressed Concrete Institute
http://www.pci.org
PPI The Plastic Pipe Institute

http://www.plasticpipe.org
PEI Porcelain Enamel Institute, Inc.
http://www.porcelainenamel.com
PTI Post-Tensioning Institute
http://www.post-tensioning.org
RFCI The Resilient Floor Covering Institute
http://www.rfci.com
RIS Redwood Inspection Service, See - CRA
RMA Rubber Manufacturers Association, Inc.
http://www.rma.org
SCMA Southern Cypress Manufacturers Association
http://www.cypressinfo.org
SDI Steel Door Institute
http://www.steeldoor.org
IGMA Insulating Glass Manufacturers Alliance
http://www.igmaonline.org
SJI Steel Joist Institute
http://www.steeljoist.org
SMACNA Sheet Metal and Air-Conditioning Contractors National Association, Inc.,
http://www.smacna.org
SSPC The Society for Protective Coatings
http://www.sspc.org
STI Steel Tank Institute
http://www.steeltank.com
SWI Steel Window Institute
http://www.steelwindows.com
TCA Tile Council of America, Inc.
http://www.tileusa.com
TEMA Tubular Exchange Manufacturers Association
http://www.tema.org
TPI Truss Plate Institute, Inc.
583 D'Onofrio Drive; Suite 200,
Madison, WI 53719
(608) 833-5900
UBC The Uniform Building Code
See ICBO
UL Underwriters' Laboratories Incorporated
http://www.ul.com
ULC Underwriters' Laboratories of Canada
http://www.ulc.ca
WCLIB West Coast Lumber Inspection Bureau
6980 SW Varns Road, P.O. Box 23145
Portland, OR 97223
(503) 639-0651
WRCLA Western Red Cedar Lumber Association
P.O. Box 120786
New Brighton, MN 55112
(612) 633-4334
WWPA Western Wood Products Association
http://www.wwpa.org

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SECTION **01 45 29**
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained by Department of Veterans Affairs.

1.2 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Concrete Institute (ACI):

1. (R2004) Guide for the Evaluation of Shotcrete

C. American Society for Testing and Materials (ASTM):

1. A325-06 Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
2. A370-07 Definitions for Mechanical Testing of Steel Products
3. A490-06 Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
4. C31/C31M-06 Making and Curing Concrete Test Specimens in the Field
5. C33-03 Concrete Aggregates
6. C39/C39M-05 Compressive Strength of Cylindrical Concrete Specimens
7. C109/C109M-05 Compressive Strength of Hydraulic Cement Mortars
8. C138-07 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
9. C140-07 Sampling and Testing Concrete Masonry Units and Related Units
10. C143/C143M-05 Slump of Hydraulic Cement Concrete
11. C172-07 Sampling Freshly Mixed Concrete
12. C173-07 Air Content of freshly Mixed Concrete by the Volumetric Method
13. C330-05 Lightweight Aggregates for Structural Concrete
14. C567-05 Density Structural Lightweight Concrete
15. C780-07 Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
16. C1019-08 Sampling and Testing Grout
17. C1064/C1064M-05 Freshly Mixed Portland Cement Concrete
18. C1077-06 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
19. C1314-07 Compressive Strength of Masonry Prisms

20. D698-07 Laboratory Compaction Characteristics of Soil Using Standard Effort
21. D1188-07 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
22. D1556-07 Density and Unit Weight of Soil in Place by the Sand-Cone Method
23. D1557-07 Laboratory Compaction Characteristics of Soil Using Modified Effort
24. D2166-06 Unconfined Compressive Strength of Cohesive Soil
25. D2167-94(R2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
26. D2216-05 Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
27. D2922-05 Density of soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
28. D2974-07 Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
29. D3666-(2002) Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
30. D3740-07 Minimum Requirements for Agencies Engaged in the Testing and Inspecting Road and Paving Material
31. E94-04 Radiographic Testing
32. E164-03 Ultrasonic Contact Examination of Weldments
33. E329-07 Agencies Engaged in Construction Inspection and/or Testing
34. E543-06 Agencies Performing Non-Destructive Testing
35. E605-93(R2006) Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
36. E709-(2001) Guide for Magnetic Particle Examination
37. E1155-96(R2008) Determining FF Floor Flatness and FL Floor Levelness Numbers

D. American Welding Society (AWS):

1. Structural Welding Code-Steel

1.3 REQUIREMENTS:

A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory’s scope of accreditation must include the appropriate ASTM standards (i.e.; E 329, C 1077, D 3666, D3740, A 880, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the “Corporate Office.”

B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by Resident Engineer. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of Resident Engineer to such failure.

C. Written Reports: Testing laboratory shall submit test reports to Resident Engineer, Contractor, and Local Building Authority within 24 hours after each test is completed unless other arrangements are agreed to in writing by the Resident Engineer. Submit reports of tests that fail to meet construction contract requirements on colored paper.

D. Verbal Reports: Give verbal notification to Resident Engineer immediately of any irregularity.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EARTHWORK:

A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:

1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the Resident Engineer regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to Resident Engineer extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.

2. Provide full time observation of fill placement and compaction and field density testing in building areas and provide full time observation of fill placement and compaction and field density testing in pavement areas to verify that Testing Compaction:

3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with AASHTO Section 31 20 00, EARTH MOVING.

2. Make field density tests in accordance with the primary testing method following ASTM D2922 wherever possible. Field density tests utilizing ASTM D1556 , or ASTM D2167 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide

satisfactory explanation to the Resident Engineer before the tests are conducted.

3. Building Slab Subgrade: At least one test of subgrade for every 185m2 (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m2 (2000 square feet) of overlaying building slab, but in no case fewer than three tests.

4. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.

5. Pavement Subgrade: One test for each 335 m2 (400 square yards), but in no case fewer than two tests.

6. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.

7. Trenches: One test at maximum 30 m (100 foot) intervals per 1200mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.

8. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to Resident Engineer. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.

C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.

D. Testing Materials: Test suitability of on-site and off-site borrow as directed by Resident Engineer.

3.2 LANDSCAPING:

A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.

1. Test for organic material by using ASTM D2974.

2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.

B. Submit laboratory test report of topsoil to Resident Engineer.

3.3 ASPHALT CONCRETE PAVING:

A. Aggregate Base Course:

1. Determine maximum density and optimum moisture content for aggregate base material in in accordance with ASTM D1557, Method D.

2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556 .

3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.

B. Asphalt Concrete:

1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104).

2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.

3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

3.4 SITE WORK CONCRETE:

A. Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.5 CONCRETE:

A. Batch Plant Inspection and Materials Testing:

1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of Resident Engineer with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by Resident Engineer.

2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to Resident Engineer.

3. Sample and test mix ingredients as necessary to insure compliance with specifications.

4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.

5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.

2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor’s expense. Any rejected concrete that is placed will be subject to removal.

3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m3 (50 cubic yards) or less

of each concrete type, and at least three cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by Resident Engineer make three cylinders for each 80 m3 (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. Resident Engineer may require additional cylinders to be molded and cured under job conditions.

4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day’s pumping operations to determine change in slump.

5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m3 (25 cubic yards) thereafter each for concrete not required to be air-entrained, test every 80 m3 (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.

6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.

7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.

8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.

9. Verify that specified mixing has been accomplished.

10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:

    a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.

    b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.

11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.

12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.

13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.

14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.

15. Observe preparations for placement of concrete:

    a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.

    b. Inspect preparation of construction, expansion, and isolation joints.

16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.

17. Observe concrete mixing:

    a. Monitor and record amount of water added at project site.

    b. Observe minimum and maximum mixing times.

18. Measure concrete flatwork for levelness and flatness as follows:

    a. Perform Floor Tolerance Measurements FF and FL in accordance with ASTM E1155. Calculate the actual overall F-numbers using the inferior/superior area method.

    b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.

    c. Provide the Contractor and the Resident Engineer with the results of all profile tests, including a running tabulation of the overall FF and FL values for all slabs installed to date, within 72 hours after each slab installation.

19. Other Inspections:

    a. Grouting under base plates.

    b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:

1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by Resident Engineer. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.

2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.

3. Furnish certified compression test reports (duplicate) to Resident Engineer. In test report, indicate the following information:

    a. Cylinder identification number and date cast.

    b. Specific location at which test samples were taken.

    c. Type of concrete, slump, and percent air.

    d. Compressive strength of concrete in MPa (psi).

    e. Weight of lightweight structural concrete in kg/m3 (Pounds per cubic feet).

f. Weather conditions during placing.

g. Temperature of concrete in each test cylinder when test cylinder was molded.

h. Maximum and minimum ambient temperature during placing.

i. Ambient temperature when concrete sample in test cylinder was taken.

j. Date delivered to laboratory and date tested.

3.6 REINFORCEMENT:

A. Review mill test reports furnished by Contractor.

B. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.

C. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.

D. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.7 MASONRY:

A. Mortar Tests:

1. Laboratory compressive strength test:

a. Comply with ASTM C780.

b. Obtain samples during or immediately after discharge from batch mixer.

c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.

d. Test one sample at 7 days and 2 samples at 28 days.

2. Two tests during first week of operation; one test per week after initial test until masonry completion.

B. Grout Tests:

1. Laboratory compressive strength test:

a. Comply with ASTM C1019.

b. Test one sample at 7 days and 2 samples at 28 days.

c. Perform test for each 230 m2 (2500 square feet) of masonry.

C. Masonry Unit Tests:

1. Laboratory Compressive Strength Test:

a. Comply with ASTM C140.

b. Test 3 samples for each 460 m2 (5000 square feet) of wall area.

3.8 STRUCTURAL STEEL:

A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS Structural Welding Code.

B. Prefabrication Inspection:

1. Review design and shop detail drawings for size, length, type and location

of all welds to be made.

2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
3. Approve welder qualifications by certification or retesting.
4. Approve procedure for control of distortion and shrinkage stresses.
5. Approve procedures for welding in accordance with applicable sections of AWSD1.1.

C. Fabrication and Erection:

1. Weld Inspection:
   a. Inspect welding equipment for capacity, maintenance and working condition.
   b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
   c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
   d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
   e. Measure 25 percent of fillet welds.
   f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
      1) 20 percent of all shear plate fillet welds at random, final pass only.
      2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
      3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
      4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
      5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
   g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
   h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.
   i. Verify that correction of rejected welds are made in accordance with D1.1.
   j. Testing and inspection do not relieve the Contractor of the responsibility Testing and inspection do not relieve the Contractor of the responsibility specified requirements.
2. Bolt Inspection:
   a. Inspect high-strength bolted connections in accordance AISC

Specifications for Structural Joints Using ASTM A325 or A490 Bolts.

b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.

c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.

d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.

e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.

f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.

D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to Resident Engineer.

3.9 STEEL DECKING:

A. Provide field inspection of welds of metal deck to the supporting steel, and testing services to insure steel decking has been installed in accordance with contract documents and manufacturer’s requirements.

B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS D1.1. Refer to the "Plug Weld Qualification Procedure" in Part 3 "Field Quality Control."

C. Submit inspection reports, certification, and instances of noncompliance to Resident Engineer.

3.10 SHEAR CONNECTOR STUDS:

A. Provide field inspection and testing services required by AWS D.1 to insure shear connector studs have been installed in accordance with contract documents.

B. Tests: Test 20 percent of headed studs for fastening strength in accordance with AWS D1.1.

C. Submit inspection reports, certification, and instances of noncompliance to Resident Engineer.

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SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

1.1 DESCRIPTION

A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.

B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:

1. Adversely effect human health or welfare,
2. Unfavorably alter ecological balances of importance to human life,
3. Effect other species of importance to humankind, or;
4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

C. Definitions of Pollutants:

1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
5. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "water of the United States" and would require a permit to discharge water from the governing agency.
6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.
7. Sanitary Wastes:
   a. Sewage: Domestic sanitary sewage and human and animal waste.
   b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2 QUALITY CONTROL

A. Establish and maintain quality control for the environmental protection of all items set forth herein.

B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. National Archives and Records Administration (NARA):

1. 33 CFR 328 Definitions

1.4 SUBMITTALS

A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Resident Engineer to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the Resident Engineer for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:

a. Name(s) of person(s) within the Contractor's organization who is (are)responsible for ensuring adherence to the Environmental Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.

f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.

g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.

h. Permits, licenses, and the location of the solid waste disposal area.

i. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as Work Area Plan showing the proposed activity in each portion of the Conservation Service and the Department of Veterans Affairs.

j. Environmental Monitoring Plans for the job site including land, water, air, and noise.

k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.

B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.5 PROTECTION OF ENVIRONMENTAL RESOURCES

A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.

B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the Resident Engineer. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.

1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.

2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.

a. Box and protect from damage existing trees and shrubs to remain on the construction site.

b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.

c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.

3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.

4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.

   a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local (design year) storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, draining from the surface.

   b. Reuse or conserve the collected topsoil sediment as directed by the Resident Engineer. Topsoil use and requirements are specified in Section 31 20 00, EARTH MOVING.

   c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.

5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features shown. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.

6. Manage borrow areas on (and off if applicable)Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.

7. Manage and control spoil areas on (and off if applicable)and prevent erosion of soil or sediment from entering nearby water courses or lakes.

8. Protect adjacent areas from despoilment by temporary excavations and embankments.

9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.

10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.

11. Handle discarded materials other than those included in the solid waste category as directed by the Resident Engineer.

C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.

1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.

2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.

3. Monitor water areas affected by construction.

D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.

E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Pennsylvania Department of Environmental Protection and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.

1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.

2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.

3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.

4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.

F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the Resident Engineer. Maintain noise-produced work at or below the decibel levels and within the time periods specified.

1. Perform construction activities involving repetitive, high-level impact noise only between 8:00 a.m. and 6:00p.m unless otherwise permitted by local ordinance or the Resident Engineer. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:

   a. Maintain maximum permissible construction equipment noise levels at 15 m (50 feet) (dBA):

EARTHMOVING	DBA
FRONT LOADERS	75
BACKHOES	75
DOZERS	75
TRACTORS	75
SCAPERS	80
GRADERS	75
TRUCKS	75
PAVERS, STATIONARY	80
PUMPS	75
GENERATORS	75
COMPRESSORS	75

MATERIALS HANDLING	DBA
CONCRETE MIXERS	75
CONCRETE PUMPS	75
CRANES	75
DERRICKS IMPACT	75
PILE DRIVERS	95
JACK HAMMERS	75
ROCK DRILLS	80
PNEUMATIC TOOLS	80
BLASTING	--
SAWS	75
VIRATORS	75

   b. Use shields or other physical barriers to restrict noise transmission.

   c. Provide soundproof housings or enclosures for noise-producing machinery.

   d. Use efficient silencers on equipment air intakes.

   e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.

   f. Line hoppers and storage bins with sound deadening material.

   g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.

3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound

waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the Resident Engineer noting any problems and the alternatives for mitigating actions.

G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.

H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the Resident Engineer. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.

B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.

C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:

1. Waste Management Plan development and implementation.
2. Techniques to minimize waste generation.
3. Sorting and separating of waste materials.
4. Salvage of existing materials and items for reuse or resale.
5. Recycling of materials that cannot be reused or sold.

D. At a minimum the following waste categories shall be diverted from landfills:

1. Soil.
2. Inerts (eg, concrete, masonry and asphalt).
3. Clean dimensional wood and palette wood.
4. Green waste (biodegradable landscaping materials).
5. Engineered wood products (plywood, particle board and I-joists, etc).
6. Metal products (eg, steel, wire, beverage containers, etc).
7. Cardboard, paper and packaging.
8. Bitumen roofing materials.
9. Plastics (eg, ABS, PVC).
10. Carpet and/or pad.
11. Gypsum board.
12. Insulation.
13. Paint.
14. Fluorescent lamps.

1.2 RELATED WORK

A. Section 02 41 00, DEMOLITION.

B. Section 01 00 00, GENERAL REQUIREMENTS.

C. Lead Paint: Section 02 83 33.13, LEAD BASED PAINT REMOVAL AND DISPOSAL.

1.3 QUALITY ASSURANCE

A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:

1. Excess or unusable construction materials.
2. Packaging used for construction products.
3. Poor planning and/or layout.
4. Construction error.
5. Over ordering.
6. Weather damage.
7. Contamination.
8. Mishandling.
9. Breakage.

B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.

C. Contractor shall develop and implement procedures to reuse and recycle new materials to a minimum of 50 percent.

D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.

E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website http:www.wbdg.org provides a Construction Waste Management Database that Contractor shall provide on-site instructions and supervision of separation, handling, construction projects.

F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.

H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

1.4 TERMINOLOGY

A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.

B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils,

solvents, mastics and like products.

C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.

D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.

E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).

F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.

G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.

H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.

I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.

J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.

K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.

L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.

1. On-site Recycling – Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.

2. Off-site Recycling – Materials hauled to a location and used in an altered form in the manufacture of new products.

M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.

N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.

O. Return: To give back reusable items or unused products to vendors for credit.

P. Salvage: To remove waste materials from the site for resale or re-use by a third party.

Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.

R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.

S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:

B. Prepare and submit to the Resident Engineer a written demolition debris management plan. The plan shall include, but not be limited to, the following information:

1. Procedures to be used for debris management.

2. Techniques to be used to minimize waste generation.

3. Analysis of the estimated job site waste to be generated:

a. List of each material and quantity to be salvaged, reused, recycled.

b. List of each material and quantity proposed to be taken to a landfill.

4. Detailed description of the Means/Methods to be used for material handling.

a. On site: Material separation, storage, protection where applicable.

b. Off site: Transportation means and destination. Include list of materials.

1) Description of materials to be site-separated and self-hauled to designated facilities.

2) Description of mixed materials to be collected by designated waste haulers and removed from the site.

c. The names and locations of mixed debris reuse and recycling facilities or sites.

d. The names and locations of trash disposal landfill facilities or sites.

e. Documentation that the facilities or sites are approved to receive the materials.

C. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.

D. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.

B. U.S. Green Building Council (USGBC): LEED Green Building Rating System for New Construction

1.7 RECORDS

A. Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and LEED Template.

PART 2 - PRODUCTS

2.1 MATERIALS

A. List of each material and quantity to be salvaged, recycled, reused.

B. List of each material and quantity proposed to be taken to a landfill.

C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

PART 3 - EXECUTION

3.1 COLLECTION

A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.

B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.

C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.2 DISPOSAL

A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.

B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

3.3 REPORT

A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.

B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed,

transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.

C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

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SECTION 01 81 11

SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section describes general requirements and procedures to comply with the Guiding Principles for Leadership in High Performance and Sustainable Buildings Memorandum of Understanding incorporated in the Executive Orders 13423 and 13514; Energy Policy Act of 2005 (EPA 2005) and the Energy Independence and Security Act of 2007 (EISA 2007)

B. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED Silver certification based on USGBC's "LEED 2009 for New Construction & Major Renovations."

1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
3. A copy of the LEED Project checklist is attached at the end of this Section for information only.

C. Related Requirements:

1. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.3 OBJECTIVES

A. To obtain acceptable Indoor Air Quality (IAQ) for the completed project and minimize the environmental impacts of the construction and

operation, the Contractor during the construction phase of this project shall implement the following procedures:

1. Select products that minimize consumption of non-renewable resources, consume reduced amounts of energy and minimize amounts of pollution to produce, and employ recycled and/or recyclable materials. It is the intent of this project to conform with EPA's Five Guiding Principles on environmentally preferable purchasing. The five principles are:

   a. Include environmental considerations as part of the normal purchasing process.

   b. Emphasize pollution prevention early in the purchasing process.

   c. Examine multiple environmental attributes throughout a product's or service's life cycle.

   d. Compare relevant environmental impacts when selecting products and services.

   e. Collect and base purchasing decisions on accurate and meaningful information about environmental performance.

2. Control sources for potential IAQ pollutants by controlled selection of materials and processes used in project construction in order to attain superior IAQ.

3. Products and processes that achieve the above objectives to the extent currently possible and practical have been selected and included in these Construction Documents. The Contractor is responsible to maintain and support these objectives in developing means and methods for performing the work of this Contract and in proposing product substitutions and/or changes to specified processes.

   Use building practices that insure construction debris and particulates do not contaminate or enter duct work prior to system startup and turn over.

1.4 DEFINITIONS

A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

B. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

C. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Respond to questions and requests from Architect and the USGBC regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the project's LEED certification application. Document responses as informational submittals.

1.6 ACTION SUBMITTALS

A. General: Submit additional LEED submittals required by other Specification Sections.

B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.

C. LEED Documentation Submittals:
1. Credit MR 2: Comply with Division 01 Section "Construction Waste Management and Disposal."
2. Credit MR 4: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating cost for each product having recycled content.
3. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
4. Credit MR 7: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.

5. Credit EQ 3.1:

   a. Construction indoor-air-quality management plan.
   b. Product data for temporary filtration media.
   c. Product data for filtration media used during occupancy.
   d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.

6. Credit IEQ 3.2:

   a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
   b. Product data for filtration media used during flush-out and during occupancy.
   c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
   d. Flush out time options (see chart below):
   1) Consult with COTR regarding the desired flush out scenario.
   2) The VA will have the option for the Contractor to provide any of the LEED flushout options during the review of the project duration.
   3) Contractor to validate PROJECTED FLUSHOUT CHART (below) with Mechanical Engineer for duration with installed equipment and performance.

   PROJECTED FLUSHOUT CHART

LEED NC 2009 FLUSHOUT OPTIONs	AHU	DAYS MIN	DAYS MAX	HRS/DAY
1	1	12.7	46.6	24
	2	54.7		
2 PH1	1	3.2	11.7	24
	2	13.7		
2 PH2	1	19.0	69.9	12
	2	82.0		

7. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used.
8. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used.

9. Credit IEQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For LEED coordinator.

B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:

1. Plumbing.
2. Mechanical.
3. Electrical.
4. Specialty items such as elevators and equipment.
5. Wood-based construction materials.

C. LEED Action Plans: Provide preliminary submittals within 30 ays of date established for commencement of the Work indicating how the following requirements will be met:

1. Credit MR 2: Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal."
2. Credit MR 3: List of proposed salvaged, refurbished, and reused materials. Identify each material that will be salvaged, refurbished, or reused, including its source, cost, and replacement cost if the item was to be purchased new.
3. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
4. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
5. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
6. Credit IEQ 3.1: Construction indoor-air-quality management plan.

D. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following using collected LEED Submittal Form pages submitted to Contractor:

1. Credit MR 2: Waste reduction progress reports complying with Division 01 Section "Construction Waste Management and Disposal."
2. Credit MR 3: Salvaged, refurbished, and reused materials.
3. Credit MR 4: Recycled content.
4. Credit MR 5: Regional materials.

5. Credit MR 7: Certified wood products.

1.8 QUALITY ASSURANCE

A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

2.2 RECYCLED CONTENT OF MATERIALS

A. Credit MR 4: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of 10 percent of cost of materials used for Project.

1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
2. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.3 REGIONAL MATERIALS

A. Credit MR 5: Not less than 10 percent of building materials (by cost) shall be regional materials.

2.4 CERTIFIED WOOD

A. Credit MR 7: Not less than 50 percent (by cost) of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:

   a. Concrete Wood Forms

   b. Temporary Construction

   c. Heavy Timber Trusses

   d. Miscellaneous carpentry.
   e. Architectural woodwork.
   f. Wood Windows.
   .

   g. Wood cabinets.

2.5 LOW-EMITTING MATERIALS

A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Single-Ply Roof Membrane Adhesive: 250 g/L.
20. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine-covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
21. Top and Trim Adhesive: 250 g/L.
22. Plastic Cement Welding Compounds: 250 g/L.
23. ABS Welding Compounds: 325 g/L.

24. CPVC Welding Compounds: 490 g/L.
25. PVC Welding Compounds: 510 g/L.
26. Adhesive Primer for Plastic: 550 g/L.
27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
30. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
31. Other Adhesives: 250 g/L.
32. Architectural Sealants: 250 g/L.
33. Nonmembrane Roof Sealants: 300 g/L.

34. Other Sealants: 420 g/L.
35. Sealant Primers for Nonporous Substrates: 250 g/L.
36. Sealant Primers for Porous Substrates: 775 g/L.
37. Modified Bituminous Sealant Primers: 500 g/L.
38. Other Sealant Primers: 750 g/L.

B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Flat Paints and Coatings: VOC not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC not more than 150 g/L.
3. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
6. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
7. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
8. Floor Coatings: VOC not more than 100 g/L.
9. Stains: VOC not more than 250 g/L.

C. Credit IEQ 4.4: Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 REFRIGERANT AND CLEAN-AGENT FIRE-EXTINGUISHING-AGENT REMOVAL

A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in Division 23 Sections.

B. Credit EA 4: Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons. See Division 21 Section "Clean-Agent Fire-Extinguishing Systems" for additional requirements.

3.2 CONSTRUCTION WASTE MANAGEMENT

A. Credit MR 2: Comply with Division 01 Section "Construction Waste Management and Disposal."

3.3 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Credit IEQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace all air filters immediately prior to occupancy.

B. Credit IEQ 3.2: Comply with one of the following requirements:

1. After construction ends, prior to occupancy and with all interior finishes installed, install new filtration media and perform a building flush-out by supplying a total volume of 14000 cu. ft.of outdoor air per sq. ft. of floor area calculated approximately in the flush out chart in above. The flushout must maintain an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.

2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in IEQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation must begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space, calculated approximately in the flush out chart in above.

a. Air-Quality Testing:

b. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing

protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and Construction Reference Guide."

c. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:

1) Formaldehyde: 27 ppb.
2) Particulates (PM10): 50 micrograms/cu. m.
3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.

d. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.

e. Air-sample testing shall be conducted as follows:

1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
3) Number of sampling locations varies depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
4) Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION 018113.13

Lebanon VA: Behavioral Health

LEED 2009 Scorecard

Based on LEED-NC V. 3

Likely	Psble	L.L.	N.V.			
42	27	34	26	**Total Project Score**	Possible Points	110

Certified 40 to 49 points **Silver** 50 to 59 points **Gold** 60 to 79 points **Platinum** 80 to 110 points

Sustainable Sites — Possible Points 26

Likely	Psble	L.L.	N.V.			LCC	Costs	
Y				Prereq 1	**Construction Activity Pollution Prevention**		$$$	
			1	Crdt 1	**Site Selection**		-	1
	5			Crdt 2	**Development Density and Community Connectivity**		-	5
			1	Crdt 3	**Brownfield Redevelopment**		n/a	1
6				Crdt 4.1	**Alternative Transportation**, Public Transportation Access		$	6
1				Crdt 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms		$$	1
3				Crdt 4.3	**Alternative Transportation**, Low Emitting and Fuel Efficient Vehicles		$$	3
	2			Crdt 4.4	**Alternative Transportation**, Parking Capacity		$$	2
		1		Crdt 5.1	**Site Development**, Protect or Restore Habitat		$$$	1
		1		Crdt 5.2	**Site Development**, Maximize Open Space		$$$	1
			1	Crdt 6.1	**Stormwater Management**, Rate and Quantity		$$$$	1
1				Crdt 6.2	**Stormwater Management**, Treatment		$$$	1
			1	Crdt 7.1	**Heat Islands Effect**, Non-Roof		$$$	1
1				Crdt 7.2	**Heat Islands Effect**, Roof		$$$- $$$$	1
	1			Crdt 8	**Light Pollution Reduction**		$$	1

Water Efficiency — Possible Points 10

Likely	Psble	L.L.	N.V.					
Y				Prereq 1	**Water Use Reduction, 20% Reduction**			
2	2			Crdt 1.1-1.2	**Water Efficient Landscaping**, Reduce by 50% (1) No Potable (2)		$$	4
		2		Crdt 2	**Innovative Wastewater Technologies**			2
2		2		Crdt 3.1-3.2	**Water Use Reduction**			4

Energy & Atmosphere — Possible Points 54

Likely	Psble	L.L.	N.V.					
Y				Prereq 1	**Fundamental Building Systems Commissioning**		$$$	
Y				Prereq 2	**Minimum Energy Performance**		$$$	
Y				Prereq 3	**Fundamental Refrigeration Management**		$	
6	4		9	Crdt 1.5	**Optimize Energy Performance**, 60% New / 50% Existing	28% req- varies	$$$$	19
		7		Crdt 2	**On Site Renewable Energy**	5% req- varies	$$$$	7
			2	Crdt 3	**Enchanced Commissioning**		$$$	2
	2			Crdt 4	**Enhanced Refrigeration Management**			2
			3	Crdt 5	**Measurement & Verification**		$$$$	3
	2			Crdt 6	**Green Power**		$$$	2

Costs **$= under 1k, $$=1-10k, $$$10-50k,$$$$50k-up**

Targeted: Likely + Possible, and summary of potential issues

- Earned through established conditions (e.g. site location, design decisions, etc)
- Targeted but require alternate compliance
- Targeted but require design changes/evaluations
- Targeted but contingent on construction results
- Targeted but require O&M commitments
- **Total**
- Mandated to VA in LEED 2.1 2007 for Major Projects (see comparable chart)

Materials & Resources — Possible Points 14

Likely	Psble	L.L.	N.V.					
Y				Prereq 1	**Storage & Collection of Recyclables**		$$	
			1	Crdt 1	**Building Reuse**, Maintain Existing Walls, Floors, and Roof		$$	3
			1	Crdt 1	**Building Reuse**, Interior Non-Structural Element			1
2				Crdt 2	**Construction Waste Management**, Divert 50% (1), 75% (2)		$	2
		2		Crdt 3	**Material Reuse**		$$	2
1	1			Crdt 4	**Recycled Content**		$	2
1	1			Crdt 5	**Local/Regional Materials**		$	2
		1		Crdt 6	**Rapidly Renewable Materials**		$$	1
	1			Crdt 7	**Certified Wood**		$$$	1

Indoor Environmental Quality — Possible Points 15

Likely	Psble	L.L.	N.V.					
Y				Prereq 1	**Minimum IAQ Performance**			
Y				Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**			
1				Crdt 1	**Outdoor Air Delivery Monitoring**		$$	1
1				Crdt 2	**Increase Ventilation**		$$$-$$$$	1
1				Crdt 3.1	**Construction IAQ Management Plan**, During Construction			1
1				Crdt 3.2	**Construction IAQ Management Plan**, Before Occupancy		$$	1
1				Crdt 4.1	**Low-Emitting Materials**, Adhesives & Sealants		$	1
1				Crdt 4.2	**Low-Emitting Materials**, Paints and Coatings		$	1
1				Crdt 4.3	**Low-Emitting Materials**, Flooring Systems		$	1
	1			Crdt 4.4	**Low-Emitting Materials**, Composite Wood and Agrifiber Products		$$	1
1				Crdt 5	**Indoor Chemical & Pollutant Source Control**		$$$	1
1				Crdt 6.1	**Controllability of Systems**, Lighting			1
1				Crdt 6.2	**Controllability of Systems**, Thermal Comfort			1
1				Crdt 7.1	**Thermal Comfort**, Design - Comply with ASHRAE 55-1992			1
1				Crdt 7.2	**Thermal Comfort**, Verification - Permanent Monitoring System			1
1				Crdt 8.1	**Daylight & Views**, Daylight 75% of Spaces			1
		1		Crdt 8.1	**Daylight & Views**, Viewss		$$	1

Innovation & Design Process — Possible Points 6

Likely	Psble	L.L.	N.V.				
		1		Crdt 1.1	**Innovation in Design**: (A) Educational Display	$$	1
1				Crdt 1.2	**Innovation in Design**:(B) Green Housekeeping / IPM	$$	1
		1		Crdt 1.3	**Innovation in Design**:Following LEED Mandate VA Requirements	$	1
	1			Crdt 1.4	**Innovation in Design**: No Mercury in Fixture design	$$	1
	1			Crdt 1.4	**Innovation in Design**: Exemplary Performance in one of the prior points- Construction Waste Management 90%	$$	1
1				Crdt 2	**LEED™ Accredited Professional**		1

Regional Priority Credits — Possible Points 17042 ZIP 4

Likely	Psble	L.L.	N.V.				
	1			Crdt 1.1	**Regional Priority Credits**	SSc4.4	1
		1		Crdt 1.2	**Regional Priority Credits**	SSc5.1	1
		1		Crdt 1.3	**Regional Priority Credits**	SSc6.1	1
1				Crdt 1.4	**Regional Priority Credits**	WEc1, Opt. 1	1
		1		Crdt 1.4	**Regional Priority Credits**	WEc2	
	1			Crdt 1.4	**Regional Priority Credits**	EAc2(1%)	

SECTION **01 81 13**

VOLATILE ORGANIC COMPOUND (VOC) LIMITS FOR ADHESIVES, SEALANTS, PAINTS AND COATINGS

PART- 1 - GENERAL

Summary
This Section includes requirements for volatile organic compound (VOC) content in adhesives and sealants used for the project. The criteria are included as part of the LEED Building requirements for the project.

Related Sections:
The following Sections contain requirements that relate to this Section:

1.1 All sections in the Specifications with Interior adhesive or sealant

1.2 Division 1, Section 018119: “Construction Indoor Air Quality (IAQ) Management”, for requirements for the Construction IAQ Management Plan.

PERFORMANCE REQUIREMENTS

LEED BUILDING – GENERAL REQUIREMENTS

A. Implement practices and procedures to meet the project’s environmental goals, which include achieving a LEED™ 2009 New Construction Silver rating. Specific project goals which may impact this and the other sections of this specification include: use of recycled-content materials; use of locally-manufactured materials; use of low-emitting materials; use of certified wood products; construction waste recycling; and the implementation of a construction indoor air quality management plan. Ensure that the requirements related to these goals, as defined in this Section and other Sections of the contract documents, are implemented to the fullest extent. Substitutions or other changes to the work shall not be allowed if such changes substantially compromise the stated LEED Building criteria.

REFERENCES

1.3 Rule 1168 – “Adhesive and Sealant Applications”, amended 7 January 2005: South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov

1.4 GreenSeal Standard 36 (GS-36) for Commercial Adhesives, effective date October 19, 2000.

1.5 GreenSeal Standard 11 (GS-11), First Edition, May 20, 1993

1.6 GreenSeal Standard 03 (GS-03), Anti-Corrosive Paints, Second Edition, January 7, 1997

1.7 Rule 1113 – “Architectural Coatings”. Rule in effect January 1, 2004. South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov

VOC REQUIREMENTS FOR INTERIOR ADHESIVES AND SEALANTS

The volatile organic compound (VOC) content of interior adhesives and sealants used in this project shall not exceed the limits defined in Rule 1168 – "Adhesive and Sealant Applications" of the South Coast Air Quality Management District (SCAQMD), of the State of California.

The VOC limits defined by SCAQMD are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds.

General:

Unless otherwise specified below, the VOC content of all adhesives and sealants shall not be in excess of **250 grams per liter.**

For specified building construction related applications, the allowable VOC content is as follows:

Adhesive VOC Limits

Architectural Applications:

Indoor carpet adhesive	50	
Carpet pad adhesive		50
Wood Flooring adhesive	100	
Rubber floor adhesive		60
Subfloor adhesive	50	
Ceramic tile adhesive		65
VCT and asphalt tile adhesive	50	
Drywall and panel adhesive		50
Cove base adhesive		50
Multipurpose construction adhesive		70
Structural glazing adhesive		100

Specialty Applications:

PVC welding	510	
CPVC welding		490
ABS welding	325	
Plastic cement welding	250	
Adhesive primer for plastic		550
Contact Adhesive	80	
Special Purpose Contact Adhesive		250
Adhesive Primer for Traffic Marking Tape		150
Structural Wood Member Adhesive		140
Sheet Applied Rubber Lining Operations		850
Top and Trim Adhesive	250	

Substrate Specific Applications:

Metal to metal		30
Plastic foams	50	
Porous material (except wood)	50	
Wood	30	
Fiberglass	80	

Sealant VOC Limits:

Architectural		**250**	
Single Ply Roof Material Installation/Repair			450
Nonmembrane Roof Installation/Repair		300	
Other		420	
Sealant Primer:			
Architectural – Nonporous		250	
Architectural – Porous	775		
Other	750		

VOC LIMTS FOR PAINTS AND COATINGS

The volatile organic compound (VOC) content of interior paints, primers, and coatings used in this project shall not exceed the limits below as defined in GreenSeal Standard 11 (GS-11), First Edition, May 20, 1993.

Paints, Primers, and Coatings:		
Flat Finishes	50	
Non-Flat Finishes (i.e. satin, gloss)		150

The volatile organic compound (VOC) content of interior anti-corrosive and anti-rust paints used in this project shall not exceed the limits defined in GreenSeal Standard 03 (GS-03), Anti-Corrosive Paints, Second Edition, January 7, 1997

Anti-Corrosive Paint Finishes	250

The volatile organic compound (VOC) content of interior Clear wood finishes, floor coatings, stains, sealers, and shellacs used in this project shall not exceed the limits defined in Rule 1113 – “Architectural Coatings”. Rule in effect January 1, 2004. South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov

Architectural Coatings:	Clear Wood Finish: Varnish		
	350		
	Clear Wood Finish: Laquer	550	
	Stains	250	
	Floor Coatings	100	
Water Proofing Sealers	250		
Sanding Sealers	275		
All Other Sealers	200		
Shellac: Clear		730	
Shellac: Pigmented		550	

END OF SECTION

SECTION **01** 81 19

CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT

PART 1 - GENERAL

CONSTRUCTION IAQ MANAGEMENT GOALS FOR THE PROJECT
The Owner has established that this Project shall minimize the detrimental impacts on Indoor Air Quality (IAQ) resulting from construction activities. Factors that contaminate indoor air, such as dust entering HVAC systems and ductwork, improper storage of materials on-site, poor housekeeping, shall be minimized.

Summary
This Section includes requirements for the development of a Construction Indoor Air Quality Management Plan (alternately referred to as “the Plan”). Develop the Plan for approval by the Owner and Architect. The Plan shall be implemented throughout the duration of the project construction, and shall be documented as outlined in the Submittal Requirements of Item 1.08 below. The Plan is included as part of the LEED BUILDING requirements for the project.

Related Sections

1. All sections of the Specifications related to interior construction, MEP systems, and items affecting indoor air quality.
2. Division 1, Section 018113 – Volatile Organic Compound (VOC) Limits For Adhesives, Sealants, Paints and Coatings
3. Section 09900 – Painting and Finishing.

PERFORMANCE REQUIREMENTS

LEED BUILDING – GENERAL REQUIREMENTS

A. Implement practices and procedures to meet the project’s environmental goals, which include achieving a LEED™ 2009 New Construction Silver rating. Specific project goals which may impact this and the other sections of this specification include: use of recycled-content materials; use of locally-manufactured materials; use of low-emitting materials; use of certified wood products; construction waste recycling; and the implementation of a construction indoor air quality management plan. Ensure that the requirements related to these goals, as defined in this Section and other Sections of the contract documents, are implemented to the fullest extent. Substitutions or other changes to the work shall not be allowed if such changes substantially compromise the stated LEED Building criteria.

   Comply with LEED (Leadership in Energy and Environmental Design) Green Building Rating System BD+C, Version 3, Silver.

REFERENCES

1. “IAQ Guidelines for Occupied Buildings Under Construction”, Second

Edition, 2007, The Sheet Metal and Air Conditioner Contractors National Association (SMACNA). (703) 803-2980, www.smacna.org.

2. ANSI/ASHRAE 52.2-1999, “Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size”, www.ashrae.org

DEFINITIONS

1. Volatile Organic Compounds (VOC’s): Chemical compounds common in and emitted by many building products, including solvents in paints, coatings, adhesives and sealants, wood preservatives; composite wood binder, and foam insulations. Not all VOC’s are harmful, but many of those contained within building products contribute to the formation of smog and irritate (at best) building occupants by their smell and/or health impact.

2. Materials that act as “sinks” for VOC contamination: Absorptive materials, typically dry and soft (such as textiles, carpeting, acoustical ceiling tiles and gypsum board) that readily absorb VOC’s emitted by “source” materials and release them over a prolonged period of time.

3. Materials that act as “sources” for VOC contamination: Products with high VOC contents that emit VOC’s either rapidly during application and curing (typically "wet" products, such as paints, sealants, adhesives, caulks and sealers) or over a prolonged period (typically “dry” products such flooring coverings with plasticizers and engineered wood with formaldehyde).

CONSTRUCTION IAQ MANAGEMENT PLAN

Prepare and submit a Construction IAQ Management Plan to the Owner for approval. The Construction IAQ Management Plan shall meet the following criteria:

a. Construction activities shall be planned to meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors’ Association (SMACNA) “IAQ Guidelines for Occupied Buildings under Construction”, Second Edition, 2007.

b. Absorptive materials shall be protected from moisture damage when stored on-site and after installation.

c. If air handlers are to be used during construction, filtration with a Minimum Efficiency Reporting Value (MERV) of 8 must be at each return air grill, as determined by ASHRAE 52.2-1999.

d. Filtration media shall be replaced immediately prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999.

e. A “Sequence of Finish Installation Plan” shall be developed, highlighting measures to reduce the absorption of VOCs by materials that act as “sinks”.

Upon approval of the Plan by the Owner and Architect, it shall be implemented through the duration of the construction process, and documented in accordance with the Submittal Requirements of Item 1.08 below.

Further description of the Construction IAQ Management Plan requirements is as follows:

1) 1. SMACNA Guidelines: Chapter 3 of the referenced "IAQ Guidelines for Occupied Buildings Under Construction", outline IAQ measures in five categories as listed below. The Construction IAQ Management Plan shall be organized in accordance with the SMACNA format, and shall address measures to be implemented in each of the five categories (including subsections). All subsections shall be listed in the Plan; items that are not applicable for this project should be listed as such.

HVAC Protection

- Return Side
- Central Filtration
- Supply Side
- Duct Cleaning

Source Control

- Product Substitution
- Modifying Equipment Operation
- Changing Work Practices
- Local Exhaust
- Air Cleaning
- Cover or Seal

Pathway Interruption

- Depressurize Work Area
- Pressurize Occupied Space
- Erect Barriers to Contain Construction Areas
- Relocate Pollutant Sources
- Temporarily Seal the Building

Housekeeping

Scheduling

f. Protect of Materials from Moisture Damage: As part of the "Housekeeping" section of the Construction IAQ Management Plan, measures to prevent installed materials or material stored on-site from moisture damage shall be described. This section should also describe measures to be taken if moisture damage does occur to absorptive materials during the course of construction.

g. Replacement of Filtration Media: Under the "HVAC Protection" section of the Construction IAQ Management Plan, a description of the filtration media in all ventilation equipment shall be provided. The description shall include replacement criteria for filtration media during construction, and confirmation of filtration media replacement for all equipment immediately prior to occupancy.

h. Sequence of Finish Installation for Materials: Where feasible, absorptive materials shall be installed after the installation of materials or finishes which have high short-term emissions of VOC's, formaldehyde, particulates, or other air-borne compounds. Absorptive

materials include, but are not limited to: carpets; acoustical ceiling panels; fabric wall coverings; insulations (exposed to the airstream); upholstered furnishings; and other woven, fibrous or porous materials. Materials with high short-term emissions include, but are not limited to: adhesives, sealants and glazing compounds (specifically those with petrochemical vehicles or carriers); paints, wood preservatives and finishes; control and/or expansion joint fillers; hard finishes requiring adhesive installation; gypsum board (with associated finish processes and products); and composite or engineered wood products with formaldehyde binders.

Develop a separate sequencing plan that identifies feasible opportunities to meet the above-stated goals for the project. The plan shall be submitted to the Architect and Owner in accordance with the Submittal Requirements of Item 1.08 of this specification.

i. Implementation and Coordination: Implement the Construction IAQ Management Plan, and coordinate the Plan with all affected trades. Designate one individual as the Construction IAQ Representative, who will be responsible for communicating the progress of the Plan with the Owner and Architect on a regular basis, and for assembling the required LEED documentation. Include provisions in the Construction IAQ Management Plan for addressing conditions in the field that do not adhere to the Plan, including provisions to implement a stop work order, or to rectify non-compliant conditions.

1.2 SUBMITTALS

Submit the following LEED-required records and documents:

1. A copy of the Construction IAQ Management Plan as defined in section 1.07 of this specification.

2. Product cut-sheets for all filtration media used during construction and installed immediately prior to occupancy, with MERV values highlighted. Cut sheets shall be submitted with the Contactor’s or Subcontractor’s ‘approved’ stamp as confirmation that the products are the products installed on the project.

3. Provide the Architect or Owner’s Representative with a minimum of 18 photographs comprising of at least six photographs taken on three different occasions during construction. The photographs shall document the implementation of each of the measures followed in the Construction IAQ Management Plan throughout the course of the project construction. Examples include photographs of ductwork sealing and protection, temporary ventilation measures, and conditions of on-site materials storage (to prevent moisture damage). Photographs shall be submitted with brief descriptions of the Construction IAQ Management Plan measure documented, or be referenced to project meeting minutes or similar project documents which reference to the Construction IAQ Management Plan measure documented.

PART 2 - – PRODUCTS

Not used.

PART 3 - – EXECUTION

Not used.

END OF SECTION **018119**

SECTION **01 91 00**

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 **DESCRIPTION**:

A. This Section **01 91 00** GENERAL COMMISSIONING REQUIREMENTS shall form the basis of the construction phase commissioning process and procedures. The Commissioning Agent shall add, modify, and refine the commissioning procedures, as approved by the Department of Veterans Affairs (VA), to suit field conditions and actual manufacturer's equipment, incorporate test data and procedure results, and provide detailed scheduling for all commissioning tasks.

B. Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the Division 7, Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 series sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The Contractor shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.

C. Where individual testing, adjusting, or related services are required in the project specifications and not specifically required by this commissioning requirements specification, the specified services shall be provided and copies of documentation, as required by those specifications shall be submitted to the VA and the Commissioning Agent to be indexed for future reference.

D. Where training or educational services for VA are required and specified in other sections of the specifications, including but not limited to Division 7, Division 8, Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 series sections of the specification, these services are intended to be provided in addition to the training and educational services specified herein.

E. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the VA's operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction, and post-occupancy phases is intended to achieve the following specific objectives according to the contract documents:

1. Verify that the applicable equipment and systems are installed in accordance with the contact documents and according to the manufacturer's recommendations.

2. Verify and document proper integrated performance of equipment and systems.
3. Verify that Operations & Maintenance documentation is complete.
4. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.
5. Verify that the VA's operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
6. Document the successful achievement of the commissioning objectives listed above.

F. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

1.2 **CONTRACTUAL RELATIONSHIPS**:

A. For this construction project, the Department of Veterans Affairs contracts with a Contractor to provide construction services. The contracts are administered by the VA Contracting Officer and the Resident Engineer as the designated representative of the Contracting Officer. On this project, the authority to modify the contract in any way is strictly limited to the authority of the Contracting Officer and the Resident Engineer.

B. In this structure, only two contract parties are recognized and communications on contractual issues are strictly limited to VA Resident Engineer and the Contractor. It is the practice of the VA to require that communications between other parties to the contracts (Subcontractors and Vendors) be conducted through the Resident Engineer and Contractor. It is also the practice of the VA that communications between other parties of the project (Commissioning Agent and Architect/Engineer) be conducted through the Resident Engineer.

C. Whole Building Commissioning is a process that relies upon frequent and direct communications, as well as collaboration between all parties to the construction process. By its nature, a high level of communication and cooperation between the Commissioning Agent and all other parties (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc) is essential to the success of the Commissioning effort.

D. With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and Resident Engineer. Thus, the procedures outlined in this specification must be executed within the following limitations:

1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Department of Veterans Affairs and the Contractor.

2. Commissioning Issues identified by the Commissioning Agent will be

delivered to the Resident Engineer and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.

3. In the event that any Commissioning Issues and suggested resolutions are deemed by the Resident Engineer to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or Resident Engineer will issue an official directive to this effect.

4. All parties to the Commissioning Process shall be individually responsible for alerting the Resident Engineer of any issues that they deem to constitute a potential contract change prior to acting on these issues.

5. Authority for resolution or modification of design and construction issues rests solely with the Contracting Officer or Resident Engineer, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Agent.

1.3 **RELATED WORK**:

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 07 08 00 FACILITY EXTERIOR CLOSURE COMMISSIONING.

C. Section 21 08 00 COMMISSIONING OF FIRE PROTECTION SYSTEMS.

D. Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

E. Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

F. Section 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS.

G. Section 27 08 00 COMMISSIONING OF COMMUNICATIONS SYSTEMS.

H. Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

1.4 **SUMMARY**:

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

C. The commissioning activities have been developed to support the United States Green Building Council (USGBC) LEED ™ rating program and to support delivery of project performance in accordance with the VA requirements developed for the project.

1. Commissioning activities and documentation for the LEED™ section on “Energy and Atmosphere” and the prerequisite of “Fundamental Building Systems Commissioning.”

2. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" requirements for the "Enhanced Building System Commissioning" credit.
3. Activities and documentation for the LEED™ section on "Measurement and Verification" requirements for the Measurement and Verification credit.

D. The commissioning activities have been developed to support the Green Buildings Initiative Green Globes rating program and to support delivery of project performance in accordance with the VA requirements developed for the project.

1.5 **DEFINITIONS**:

A. Architect: Includes Architect identified in the Contract for Construction between the Department of Veterans Affairs and Contractor, plus consultant/design professionals responsible for design of fire suppression, plumbing, HVAC, controls for HVAC systems, electrical, communications, electronic safety and security, as well as other related systems.

B. CxA: Commissioning Agent.

C. Commissioning Plan: a document that is an overall plan that outlines the commissioning process, commissioning team responsibilities, schedule for commissioning activities, and commissioning documents.

D. Commissioning Issue: a condition in the installation or function of a component, piece of equipment or system that affects the system operations, maintenance, and/or repair.

E. Commissioning Observation: a condition in the installation or function of a component, piece of equipment or system that may not be in compliance with the Contract Documents, or may not be in compliance with the manufacturer's installation instruction, or may not be in compliance with generally accepted industry standards.

F. Systems Functional Performance Test: a test, or tests, of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Systems Functional Performance Testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not Systems Functional Performance Testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while System Functional Performance Testing is verifying that the system has already been set up properly and is functioning in accordance with the Construction Documents. The Commissioning Agent develops the Systems Functional Performance Test Procedures in a sequential written form, coordinates, witnesses, and documents the actual testing. Systems

Functional Performance Testing is performed by the Contractor. Systems Functional Performance Tests are performed after startups, control systems are complete and operational, TAB functions and Pre-Functional Checklists are complete.

G. System: A system is defined as the entire set of components, equipment, and subsystems which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one component of an entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam supply, chilled water supply, refrigerant supply, hot water supply, controls and electrical service, etc. Another example of a system which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of the fuel supply, combustion air, controls, steam, feedwater supply, condensate return and other related components.

H. Pre-Functional Checklist: a list of items provided by the Commissioning Agent to the Contractor that require inspection and elementary component tests conducted to verify proper installation of equipment. Pre-Functional Checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some Pre-Functional Checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The term “Pre-Functional” refers to before Systems Functional Performance Testing. Pre-Functional Checklists augment and are combined with the manufacturer's startup checklist and the Contractor's Quality Control checklists.

I. Seasonal Functional Performance Testing: a test or tests that are deferred until the system will experience conditions closer to their design conditions.

J. VA: Includes the Contracting Officer, Resident Engineer, or other authorized representative of the Department of Veterans Affairs.

K. TAB: Testing, Adjusting, and Balancing.

1.6 **SYSTEMS TO BE COMMISSIONED**:

A. Commissioning of a system or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following systems will be commissioned as part of this project:

1. Facility exterior closure (Division 7 and Division 8)

a. Roofs (Asphalt shingles, slate shingles, wood shingles, clay roof tiles, built-up bituminous, modified bituminous, , sprayed cellulose insulation, flashing & sheet metal, roof specialties, and roof accessories)

b. Louvers and Vents

c. Sealants (Caulking, mechanical seals, and wind and vapor barriers)

2. Fire Suppression (Division 21)

a. Fire Protection System Wet-pipe fire suppression

3. Plumbing (Division 22)

a. Domestic Hot Water systems (Domestic water heaters, hot water circulating pumps and motors, controls, combustion burners/fans/motors).

b. Sewage Ejection Pumps (Sump level controls, pump alternator, alarms and alarm panel, pumps and motors).

4. HVAC (Division 23)

a. Air Handling Systems (Fans, motors, Variable Speed Drives, cooling coils and control valves, heating coils and control valves, filters, dampers, safeties such as smoke detectors or freezestats and damper end switches, controls, gages, and vibration isolation).

b. Heating Hot Water Systems (controls, instrumentation and gages, flues, heating water pumps and motors, Variable Speed Drives, mixing valves).

c. Exhaust Fans (Fan, motor, Variable Speed Drives, controls and safeties).

d. Direct Digital Control System (BACnet or similar Local Area Network (LAN), Operator Work Station hardware and software, building controller hardware and software, terminal unit controller hardware and software, all sequences of operation, system accuracy and response time).

5. Electrical (Division 26)

a. Utility Service Entrance Switchgear (Fuses and circuit breaker settings, metering, mimic diagram, gages, and controls).

b. Utility Power Unit Substations (Transformers and tap settings, fuses and circuit breaker settings, metering, gages, and controls).

c. Normal Power Distribution Systems (Grounding tests, coordination study review, major circuit breaker settings, meters and gages, and controls).

d. Lighting Controls (Control system hardware and software, scene settings, zone settings, occupancy sensor interface, and unoccupied cycle control).

e. Uninterruptible Power Supply Systems and UPS Power Distribution Systems (Battery chargers, static and dynamic power generators - i.e. inverters, MG sets, metering and controls, system power displays, and distribution panel circuit breakers).

6. Communications (Division 27)

a. Facility Telecommunications and Data Distribution Systems.

b. Nurse Call (Local stations, system hardware and software, reset functions, response time per activation, and notification signals).

c. Address and Mass Notification Systems (Amplifiers and head-end hardware, speaker volume, and background noise - i.e. hiss or similar interference).

d. Healthcare Intercommunications and Program Systems (Local stations, system hardware and software, and notification signals).

7. Electronic Safety and Security (Division 28)

a. Fire Detection and Alarm (Master panel and software, addressable units - i.e. pull stations, flow detectors, hear detectors, etc., controls and alarm functions, horns/bells/door releases and other output devices, and fire command center functions - stairwell communications, stairwell pressurization fan start, mechanical systems shutdowns).

1.7 **COMMISSIONING TEAM**:

A. Members Appointed by Contractor:

1. Contractor: The designated person, company, or entity that plans, schedules and coordinates the commissioning activities for the construction team.

2. Contractor's Commissioning Representative(s): Individual(s), each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project Superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the Department of Veterans Affairs (VA) and Commissioning Agent.

B. Members Appointed by VA:

1. Commissioning Agent: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. The VA will engage the CxA under a separate contract.

2. Representatives of the facility user and operation and maintenance personnel.

3. Architect and engineering design professionals.

1.8 **VA'S COMMISSIONING RESPONSIBILITIES**:

A. Appoint an individual, company or firm to act as the Commissioning Agent.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:

1. Coordination meetings.

2. Training in operation and maintenance of systems, subsystems, and equipment.

3. Testing meetings.

4. Witness and assist in Systems Functional Performance Testing.

5. Demonstration of operation of systems, subsystems, and equipment.

C. Provide the Construction Documents, prepared by Architect and approved by VA, to the Commissioning Agent and for use in managing the commissioning process, developing the commissioning plan, systems manuals, and reviewing the operation and maintenance training plan.

1.9 **CONTRACTOR'S COMMISSIONING RESPONSIBILITIES**:

A. The Contractor shall assign a Commissioning Manager to manage commissioning activities of the Contractor, and subcontractors.

B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and that subcontractors comply with the requirements of these specifications.

C. The Contractor shall ensure that each installing subcontractor shall assign representatives with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in commissioning coordination meetings.

2. Conduct operation and maintenance training sessions in accordance with approved training plans.

3. Verify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.

4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues Log, field reports, test reports or other commissioning documents. In collaboration with entity responsible for system and equipment installation, recommend corrective action.

5. Review and comment on commissioning documentation.

6. Participate in meetings to coordinate Systems Functional Performance Testing.

7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Agent for incorporation into the commissioning plan.

8. Provide information to the Commissioning Agent for developing commissioning plan.

9. Participate in training sessions for VA's operation and maintenance personnel.

10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

1.10 **COMMISSIONING AGENT'S RESPONSIBILITIES**:

A. Organize and lead the commissioning team.

B. Prepare the commissioning plan. See Paragraph 1.11-A of this specification Section for further information.

C. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents. Review and comment on the ability to test and operate the system and/or equipment, including providing gages, controls and other components required to operate, maintain, and test the system. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents.

D. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.

E. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss status of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The Commissioning Agent shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.

F. Observe construction and report progress, observations and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component replacement or repair, and for general conformance with the Construction Documents.

G. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.

H. Coordinate Systems Functional Performance Testing schedule with the Contractor.

I. Witness selected systems startups.

J. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.

K. Witness and document Systems Functional Performance Testing.

L. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.

M. Review and comment on operation and maintenance (O&M) documentation and systems manual outline for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Paragraph 1.25, Section 01 00 00 GENERAL REQUIREMENTS.

N. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.

O. Prepare commissioning Field Observation Reports.

P. Prepare the Final Commissioning Report.

Q. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Systems Functional Performance Testing. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

R. Assemble the final commissioning documentation, including the Final Commissioning Report and Addendum to the Final Commissioning Report.

1.11 **COMMISSIONING DOCUMENTATION**:

A. Commissioning Plan: A document, prepared by Commissioning Agent, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited, to the following:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.

2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.

3. Identification of systems and equipment to be commissioned.

4. Schedule of Commissioning Coordination meetings.

5. Identification of items that must be completed before the next operation can proceed.

6. Description of responsibilities of commissioning team members.

7. Description of observations to be made.

8. Description of requirements for operation and maintenance training.

9. Schedule for commissioning activities with dates coordinated with overall construction schedule.

10. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.

11. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.

12. Preliminary Systems Functional Performance Test procedures.

B. Systems Functional Performance Test Procedures: The Commissioning Agent will develop Systems Functional Performance Test Procedures for each system to be commissioned, including subsystems, or equipment and interfaces or interlocks with other systems. Systems Functional Performance Test Procedures will include a separate entry, with space for comments, for each item to be tested. Preliminary Systems Functional Performance Test Procedures will be provided to the VA, Architect/Engineer, and Contractor for review and comment. The Systems Performance Test Procedure will include test procedures for each mode of operation and provide space to indicate whether the mode under test responded as required. Each System Functional Performance Test procedure, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested system.
2. Test number.
3. Time and date of test.
4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
5. Dated signatures of the person performing test and of the witness, if applicable.
6. Individuals present for test.
7. Observations and Issues.
8. Issue number, if any, generated as the result of test.

C. Pre-Functional Checklists: The Commissioning Agent will prepare Pre-Functional Checklists. Pre-Functional Checklists shall be completed and signed by the Contractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Agent will spot check Pre-Functional Checklists to verify accuracy and readiness for testing. Inaccurate or incomplete Pre-Functional Checklists shall be returned to the Contractor for correction and resubmission.

D. Test and Inspection Reports: The Commissioning Agent will record test data, observations, and measurements on Systems Functional Performance Test Procedure. The report will also include recommendation for system acceptance or non-acceptance. Photographs, forms, and other means appropriate for the application shall be included with data. Commissioning Agent Will compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

E. Corrective Action Documents: The Commissioning Agent will document corrective action taken for systems and equipment that fail tests. The documentation will include any required modifications to systems and equipment and/or revisions to test procedures, if any. The Commissioning Agent will witness and document any retesting of systems and/or equipment requiring corrective action and document retest results.

F. Commissioning Issues Log: The Commissioning Agent will prepare and maintain Commissioning Issues Log that describes Commissioning Issues and Commissioning Observations that are identified during the Commissioning

process. These observations and issues include, but are not limited to, those that are at variance with the Contract Documents. The Commissioning Issues Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and document how the issue was resolved. The Master Commissioning Issues Log will also track the status of unresolved issues.

1. Creating an Commissioning Issues Log Entry:

   a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.

   b. Assign a descriptive title for the issue.

   c. Identify date and time of the issue.

   d. Identify test number of test being performed at the time of the observation, if applicable, for cross reference.

   e. Identify system, subsystem, and equipment to which the issue applies.

   f. Identify location of system, subsystem, and equipment.

   g. Include information that may be helpful in diagnosing or evaluating the issue.

   h. Note recommended corrective action.

   i. Identify commissioning team member responsible for corrective action.

   j. Identify expected date of correction.

   k. Identify person that identified the issue.

2. Documenting Issue Resolution:

   a. Log date correction is completed or the issue is resolved.

   b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.

   c. Identify changes to the Contract Documents that may require action.

   d. State that correction was completed and system, subsystem, and equipment are ready for retest, if applicable.

   e. Identify person(s) who corrected or resolved the issue.

   f. Identify person(s) verifying the issue resolution.

G. Final Commissioning Report: The Commissioning Agent will document results of the commissioning process, including unresolved issues, and performance of systems, subsystems, and equipment. The Commissioning Report will indicate whether systems, subsystems, and equipment have been properly installed and are performing according to the Contract Documents. This report will be used by the Department of Veterans Affairs when determining that systems will be accepted. This report will be used to evaluate systems, subsystems, and equipment and will serve as a future reference document during VA occupancy and operation. It shall describe components and performance that

exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. The commissioning report will include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances with the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. Design Narrative documentation maintained by the Commissioning Agent.
2. Commissioning plan.
3. Pre-Functional Checklists completed by the Contractor, with annotation of the Commissioning Agent review and spot check.
4. Systems Functional Performance Test Procedures, with annotation of test results and test completion.
5. Commissioning Issues Log.
6. Listing of deferred and off season test(s) not performed, including the schedule for their completion.

H. Addendum to Final Commissioning Report: The Commissioning Agent will prepare an Addendum to the Final Commissioning Report near the end of the Warranty Period. The Addendum will indicate whether systems, subsystems, and equipment are complete and continue to perform according to the Contract Documents. The Addendum to the Final Commissioning Report shall include, but is not limited to, the following:

1. Documentation of deferred and off season test(s) results.
2. Completed Systems Functional Performance Test Procedures for off season test(s).
3. Documentation that unresolved system performance issues have been resolved.
4. Updated Commissioning Issues Log, including status of unresolved issues.
5. Identification of potential Warranty Claims to be corrected by the Contractor.

I. Systems Manual: The Commissioning Agent will gather required information and compile the Systems Manual. The Systems Manual will include, but is not limited to, the following:

1. Design Narrative, including system narratives, schematics, single-line diagrams, flow diagrams, equipment schedules, and changes made throughout the Project.
2. Reference to Final Commissioning Plan.
3. Reference to Final Commissioning Report.
4. Approved Operation and Maintenance Data as submitted by the Contractor.

1.12 **SUBMITTALS**:

A. Preliminary Commissioning Plan Submittal: The Commissioning Agent has prepared a Preliminary Commissioning Plan based on the final Construction

Documents. The Preliminary Commissioning Plan is included as an Appendix to this specification section. The Preliminary Commissioning Plan is provided for information only. It contains preliminary information about the following commissioning activities:

1. The Commissioning Team: A list of commissioning team members by organization.

   ?. Systems to be commissioned. A detailed list of systems to be commissioned for the project. This list also provides preliminary information on systems/equipment submittals to be reviewed by the Commissioning Agent; preliminary information on Pre-Functional Checklists that are to be completed; preliminary information on Systems Performance Testing, including information on testing sample size (where authorized by the VA).

   ?. Commissioning Team Roles and Responsibilities: Preliminary roles and responsibilities for each Commissioning Team member.

   ?. Commissioning Documents: A preliminary list of commissioning-related documents, include identification of the parties responsible for preparation, review, approval, and action on each document.

   ?. Commissioning Activities Schedule: Identification of Commissioning Activities, including Systems Functional Testing, the expected duration and predecessors for the activity.

   ?. Pre-Functional Checklists: Preliminary Pre-Functional Checklists for equipment, components, subsystems, and systems to be commissioned. These Preliminary Pre-Functional Checklists provide guidance on the level of detailed information the Contractor shall include on the final submission.

   ?. Systems Functional Performance Test Procedures: Preliminary step-by-step System Functional Performance Test Procedures to be used during Systems Functional Performance Testing. These Preliminary Systems Functional Performance procedures provide information on the level of testing rigor, and the level of Contractor support required during performance of system's testing.

B. Final Commissioning Plan Submittal: Based on the Final Construction Documents and the Contractor's project team, the Commissioning Agent will prepare the Final Commissioning Plan as described in this section. The Commissioning Agent will submit three hard copies and three sets of electronic files of Final Commissioning Plan. The Contractor shall review the Commissioning Plan and provide any comments to the VA. The Commissioning Agent will incorporate review comments into the Final Commissioning Plan as directed by the VA.

   ?. Systems Functional Performance Test Procedure: The Commissioning Agent will submit preliminary Systems Functional Performance Test Procedures to the Contractor, and the VA for review and comment. The Contractor shall return review comments to the VA and the Commissioning Agent. The VA will also return review comments to the Commissioning Agent. The Commissioning Agent will incorporate review comments into the Final Systems Functional Test Procedures to be used in Systems Functional Performance Testing.

?. Pre-Functional Checklists: The Commissioning Agent will submit Pre-Functional Checklists to be completed by the Contractor.

?. Test and Inspection Reports: The Commissioning Agent will submit test and inspection reports to the VA with copies to the Contractor and the Architect/Engineer.

?. Corrective Action Documents: The Commissioning Agent will submit corrective action documents to the VA Resident Engineer with copies to the Contractor and Architect.

?. Preliminary Commissioning Report Submittal: The Commissioning Agent will submit three electronic copies of the preliminary commissioning report. One electronic copy, with review comments, will be returned to the Commissioning Agent for preparation of the final submittal.

?. Final Commissioning Report Submittal: The Commissioning Agent will submit four sets of electronically formatted information of the final commissioning report to the VA. The final submittal will incorporate comments as directed by the VA.

?. Data for Commissioning:

1. The Commissioning Agent will request in writing from the Contractor specific information needed about each piece of commissioned equipment or system to fulfill requirements of the Commissioning Plan.

   ?. The Commissioning Agent may request further documentation as is necessary for the commissioning process or to support other VA data collection requirements, including Construction Operations Building Information Exchange (COBIE), Building Information Modeling (BIM), etc.

1.13 **COMMISSIONING PROCESS**:

A. The Commissioning Agent will be responsible for the overall management of the commissioning process as well as coordinating scheduling of commissioning tasks with the VA and the Contractor. As directed by the VA, the Contractor shall incorporate Commissioning tasks, including, but not limited to, Systems Functional Performance Testing (including predecessors) with the Master Construction Schedule.

B. Within [30] days of contract award, the Contractor shall designate a specific individual as the Commissioning Manager (CM) to manage and lead the commissioning effort on behalf of the Contractor. The Commissioning Manager shall be the single point of contact and communications for all commissioning related services by the Contractor.

C. Within [30] days of contract award, the Contractor shall ensure that each subcontractor designates specific individuals as Commissioning Representatives (CR) to be responsible for commissioning related tasks. The Contractor shall ensure the designated Commissioning Representatives participate in the commissioning process as team members providing commissioning testing services, equipment operation, adjustments, and corrections if necessary. The Contractor shall ensure that all Commissioning Representatives shall have sufficient authority to direct their respective staff to provide the services required, and to speak on

behalf of their organizations in all commissioning related contractual matters.

1.14 **QUALITY ASSURANCE**:

A. Instructor Qualifications: Factory authorized service representatives shall be experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: The Contractor shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.15 **COORDINATION**:

A. Management: The Commissioning Agent will coordinate the commissioning activities with the VA and Contractor. The Commissioning Agent will submit commissioning documents and information to the VA. All commissioning team members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

B. Scheduling: The Contractor will work with the Commissioning Agent and the VA to incorporate the commissioning activities into the construction schedule. The Commissioning Agent will provide sufficient information on commissioning activities to allow the Contractor and the VA to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction as directed by the VA.

C. Initial Schedule of Commissioning Events: The Commissioning Agent will provide the initial schedule of primary commissioning events in the Commissioning Plan and at the commissioning coordination meetings. The Commissioning Plan will provide a format for this schedule. As construction progresses, more detailed schedules will be developed by the Contractor with information from the Commissioning Agent.

D. Commissioning Coordinating Meetings: The Commissioning Agent will conduct periodic Commissioning Coordination Meetings of the commissioning team to review status of commissioning activities, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

E. Pretesting Meetings: The Commissioning Agent will conduct pretest meetings of the commissioning team to review startup reports, Pre-Functional Checklist results, Systems Functional Performance Testing procedures, testing personnel and instrumentation requirements.

F. Systems Functional Performance Testing Coordination: The Contractor shall coordinate testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. The Contractor shall coordinate the schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - **PRODUCTS**

2.1 **TEST EQUIPMENT**:

A. The Contractor shall provide all standard and specialized testing equipment required to perform Systems Functional Performance Testing. Test equipment required for Systems Functional Performance Testing will be identified in the detailed System Functional Performance Test Procedure prepared by the Commissioning Agent.

B. Data logging equipment and software required to test equipment shall be provided by the Contractor.

?. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 oC (1.0 oF) and a resolution of + or - 0.1 oC (0.2 oF). Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - **EXECUTION**

3.1 **STARTUP, INITIAL CHECKOUT, AND PRE-FUNCTIONAL CHECKLISTS**:

A. The following procedures shall apply to all equipment and systems to be commissioned, according to Part 1, Systems to Be Commissioned.

1. Pre-Functional Checklists are important to ensure that the equipment and systems are hooked up and operational. These ensure that Systems Functional Performance Testing may proceed without unnecessary delays. Each system to be commissioned shall have a full Pre-Functional Checklist completed by the Contractor prior to Systems Functional Performance Testing. No sampling strategies are used.

a. The Pre-Functional Checklist will identify the trades responsible for completing the checklist. The Contractor shall ensure the appropriate trades complete the checklists.

b. The Commissioning Agent will review completed Pre-Functional Checklists and field-verify the accuracy of the completed checklist using sampling techniques.

2. Startup and Initial Checkout Plan: The Contractor shall develop detailed startup plans for all equipment. The primary role of the Contractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.

a. The Contractor shall develop the full startup plan by combining (or adding to) the checklists with the manufacturer's detailed startup and

checkout procedures from the O&M manual data and the field checkout sheets normally used by the Contractor. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

b. The full startup plan shall at a minimum consist of the following items:

1) The Pre-Functional Checklists.

2) The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.

3) The manufacturer's normally used field checkout sheets.

a) The Commissioning Agent will submit the full startup plan to the VA and Contractor for review. Final approval will be by the VA.

b) The Contractor shall review and evaluate the procedures and the format for documenting them, noting any procedures that need to be revised or added.

3. Sensor and Actuator Calibration

a. All field installed temperature, relative humidity, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described in Division 21, Division 22, Division 23, Division 26, Division 27, and Division 28 specifications.

b. All procedures used shall be fully documented on the Pre-Functional Checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

4. Execution of Equipment Startup

a. Four weeks prior to equipment startup, the Contractor shall schedule startup and checkout with the VA and Commissioning Agent. The performance of the startup and checkout shall be directed and executed by the Contractor.

b. The Commissioning Agent will observe the startup procedures for selected pieces of primary equipment.

c. The Contractor shall execute startup and provide the VA and Commissioning Agent with a signed and dated copy of the completed startup checklists, and contractor tests.

d. Only individuals that have direct knowledge and witnessed that a line item task on the Startup Checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

3.2 **DEFICIENCIES, NONCONFORMANCE, AND APPROVAL IN CHECKLISTS AND STARTUP**:

A. The Contractor shall clearly list any outstanding items of the initial startup and Pre-Functional Checklist procedures that were not completed successfully,

at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the VA and the Commissioning Agent within two days of completion.

B. The Commissioning Agent will review the report and submit comments to the VA. The Commissioning Agent will work with the Contractor to correct and verify deficiencies or uncompleted items. The Commissioning Agent will involve the VA and others as necessary. The Contractor shall correct all areas that are noncompliant or incomplete in the checklists in a timely manner, and shall notify the VA and Commissioning Agent as soon as outstanding items have been corrected. The Contractor shall submit an updated startup report and a Statement of Correction on the original noncompliance report. When satisfactorily completed, the Commissioning Agent will recommend approval of the checklists and startup of each system to the VA.

C. The Contractor shall be responsible for resolution of deficiencies as directed the VA.

3.3 **PHASED COMMISSIONING**:

A. The project may require startup and initial checkout to be executed in phases. This phasing shall be planned and scheduled in a coordination meeting of the VA, Commissioning Agent, and the Contractor. Results will be added to the master construction schedule and the commissioning schedule.

3.4 **TRENDING AND ALARMS**:

A. Trending is a method of testing as a standalone method or to augment manual testing. The Contractor shall trend any and all points of the system or systems at intervals specified below.

B. Alarms are a means to notify the system operator that abnormal conditions are present in the system. Alarms shall be structured into three tiers - Critical, Priority, and Maintenance.

1. Critical alarms are intended to be alarms that require the immediate attention of and action by the Operator. These alarms shall be displayed on the Operator Workstation in a popup style window that is graphically linked to the associated unit's graphical display. The popup style window shall be displayed on top of any active window within the screen, including non DDC system software.

2. Priority level alarms are to be printed to a printer which is connected to the Operator's Work Station located within the engineer's office. Additionally Priority level alarms shall be able to be monitored and viewed through an active alarm application. Priority level alarms are alarms which shall require reaction from the operator or maintenance personnel within a normal work shift, and not immediate action.

3. Maintenance alarms are intended to be minor issues which would require examination by maintenance personnel within the following shift. These alarms shall be generated in a scheduled report automatically by the DDC system at the start of each shift. The generated maintenance report will be printed to a printer located within the engineer's office.

C. The Contractor shall provide a wireless internet network in the building for use during controls programming, checkout, and commissioning. This network will allow project team members to more effectively program, view, manipulate and test control devices while being in the same room as the controlled device.

D. The Contractor shall provide graphical trending through the DDC control system of systems being commissioned. Trending requirements are indicated below and included with the Systems Functional Performance Test Procedures. Trending shall occur before, during and after Systems Functional Performance Testing. The Contractor shall be responsible for producing graphical representations of the trended DDC points that show each system operating properly during steady state conditions as well as during the System Functional Testing. These graphical reports shall be submitted to the Resident Engineer and Commissioning Agent for review and analysis before, during dynamic operation, and after Systems Functional Performance Testing. The Contractor shall provide, but not limited to, the following trend requirements and trend submissions:

1. Pre-testing, Testing, and Post-testing - Trend reports of trend logs and graphical trend plots are required as defined by the Commissioning Agent. The trend log points, sampling rate, graphical plot configuration, and duration will be dictated by the Commissioning Agent. At any time during the Commissioning Process the Commissioning Agent may recommend changes to aspects of trending as deemed necessary for proper system analysis. The Contractor shall implement any changes as directed by the Resident Engineer. Any pre-test trend analysis comments generated by the Commissioning Team should be addressed and resolved by the Contractor, as directed by the Resident Engineer, prior to the execution of Systems Functional Performance Testing.

2. Dynamic plotting - The Contractor shall also provide dynamic plotting during Systems Functional Performance testing at frequent intervals for points determined by the Systems Functional Performance Test Procedure. The graphical plots will be formatted and plotted at durations listed in the Systems Functional Performance Test Procedure.

3. Graphical plotting - The graphical plots shall be provided with a dual y-axis allowing 15 or more trend points (series) plotted simultaneously on the graph with each series in distinct color. The plots will further require title, axis naming, legend etc. all described by the Systems Functional Performance Test Procedure. If this cannot be sufficiently accomplished directly in the Direct Digital Control System then it is the responsibility of the Contractor to plot these trend logs in Microsoft Excel.

4. The following tables indicate the points to be trended and alarmed by system. The Operational Trend Duration column indicates the trend duration for normal operations. The Testing Trend Duration column indicates the trend duration prior to Systems Functional Performance Testing and again after Systems Functional Performance Testing. The Type column indicates point type: AI = Analog Input, AO = Analog Output, DI = Digital Input, DO = Digital Output, Calc = Calculated Point. In the Trend Interval Column, COV = Change of Value. The Alarm Type indicates the alarm priority; C = Critical, P = Priority, and M = Maintenance. The Alarm Range column indicates when the point is

considered in the alarm state. The Alarm Delay column indicates the length of time the point must remain in an alarm state before the alarm is recorded in the DDC. The intent is to allow minor, short-duration events to be corrected by the DDC system prior to recording an alarm.

E. The Contractor shall provide the following information prior to Systems Functional Performance Testing. Any documentation that is modified after submission shall be recorded and resubmitted to the Resident Engineer and Commissioning Agent.

1. Point-to-Point checkout documentation;

2. Sensor field calibration documentation including system name, sensor/point name, measured value, DDC value, and Correction Factor.

3. A sensor calibration table listing the referencing the location of procedures to following in the O&M manuals, and the frequency at which calibration should be performed for all sensors, separated by system, subsystem, and type. The calibration requirements shall be submitted both in the O&M manuals and separately in a standalone document containing all sensors for inclusion in the commissioning documentation. The following table is a sample that can be used as a template for submission.

SYSTEM		
		O&M Calibration Procedure Reference
Discharge air temperature	Once a year	Volume I Section D.3.aa

AIR HANDLING UNIT AHU-1				
Control Reference	Proportional Constant	Integral Constant	Derivative Constant	Interval

3.5 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.

B. Objectives and Scope: The objective of Systems Functional Performance Testing is to demonstrate that each system is operating according to the Contract Documents. Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Agent will develop specific Systems Functional Test Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Agent in developing the Systems Functional Performance Test procedures as requested by the Commissioning Agent i.e. by answering questions about equipment, operation, sequences, etc. Prior to execution, the Commissioning Agent will provide a copy of the Systems Functional Performance Test procedures to the VA, the Architect/Engineer, and the Contractor, who shall review the tests for feasibility, safety, equipment and warranty protection.

D. Purpose of Test Procedures: The purpose of each specific Systems Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. Representative test formats and examples are found in the Commissioning Plan for this project. (The Commissioning Plan is issued as a separate document and is available for review.) The test procedure forms developed by the Commissioning Agent will include, but not be limited to, the following information:

1. System and equipment or component name(s)
2. Equipment location and ID number
3. 3Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment.
4. Date
5. Project name
6. Participating parties
7. A copy of the specification section describing the test requirements
8. A copy of the specific sequence of operations or other specified parameters being verified
9. Formulas used in any calculations
10. Required pretest field measurements
11. Instructions for setting up the test.
12. Special cautions, alarm limits, etc.
13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
15. A section for comments.
16. Signatures and date block for the Commissioning Agent. A place for the Contractor to initial to signify attendance at the test.

E. Test Methods: Systems Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The Contractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.

1. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been

calibrated.

3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.

4. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 12 C (54 F), when the outside air temperature is above 12 C (54 F), temporarily change the lockout setpoint to be 2 C (4 F) above the current outside air temperature.

5. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout.

F. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.

G. Sampling: No sampling is allowed in completing Pre-Functional Checklists. Sampling is allowed for Systems Functional Performance Test Procedures execution. The Commissioning Agent will determine the sampling rate. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the Commissioning Agent may stop the testing and require the Contractor to perform and document a checkout of the remaining units, prior to continuing with Systems Functional Performance Testing of the remaining units.

H. Cost of Retesting: The cost associated with expanded sample System Functional Performance Tests shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

I. Coordination and Scheduling: The Contractor shall provide a minimum of 7 days notice to the Commissioning Agent and the VA regarding the completion schedule for the Pre-Functional Checklists and startup of all equipment and systems. The Commissioning Agent will schedule Systems Functional Performance Tests with the Contractor and VA. The Commissioning Agent will witness and document the Systems Functional Performance Testing of systems. The Contractor shall execute the tests in accordance with the Systems Functional Performance Test Procedure.

J. Testing Prerequisites: In general, Systems Functional Performance Testing will be conducted only after Pre-Functional Checklists have been

satisfactorily completed. The control system shall be sufficiently tested and approved by the Commissioning Agent and the VA before it is used to verify performance of other components or systems. The air balancing and water balancing shall be completed before Systems Functional Performance Testing of air-related or water-related equipment or systems are scheduled. Systems Functional Performance Testing will proceed from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.

K. Problem Solving: The Commissioning Agent will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

3.6 **DOCUMENTATION, NONCONFORMANCE AND APPROVAL OF TESTS**:

A. Documentation: The Commissioning Agent will witness, and document the results of all Systems Functional Performance Tests using the specific procedural forms developed by the Commissioning Agent for that purpose. Prior to testing, the Commissioning Agent will provide these forms to the VA and the Contractor for review and approval. The Contractor shall include the filled out forms with the O&M manual data.

B. Nonconformance: The Commissioning Agent will record the results of the Systems Functional Performance Tests on the procedure or test form. All items of nonconformance issues will be noted and reported to the VA on Commissioning Field Reports and/or the Commissioning Master Issues Log.

1. Corrections of minor items of noncompliance identified may be made during the tests. In such cases, the item of noncompliance and resolution shall be documented on the Systems Functional Test Procedure.

2. Every effort shall be made to expedite the systems functional Performance Testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the Commissioning Agent shall not be pressured into overlooking noncompliant work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so by direction from the VA.

3. As the Systems Functional Performance Tests progresses and an item of noncompliance is identified, the Commissioning Agent shall discuss the issue with the Contractor and the VA.

4. When there is no dispute on an item of noncompliance, and the Contractor accepts responsibility to correct it:

a. The Commissioning Agent will document the item of noncompliance and the Contractor's response and/or intentions. The Systems Functional Performance Test then continues or proceeds to another test or sequence. After the day's work is complete, the Commissioning Agent will submit a Commissioning Field Report to the VA. The Commissioning Agent will also note items of noncompliance and the Contractor's response in the Master Commissioning Issues Log. The Contractor shall correct the item of noncompliance and report completion to the VA and the Commissioning Agent.

b. The need for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test and the test shall be repeated.

5. If there is a dispute about item of noncompliance, regarding whether it is an item of noncompliance, or who is responsible:

a. The item of noncompliance shall be documented on the test form with the Contractor's response. The item of noncompliance with the Contractor's response shall also be reported on a Commissioning Field Report and on the Master Commissioning Issues Log.

b. Resolutions shall be made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive and acceptance authority is with the Department of Veterans Affairs.

c. The Commissioning Agent will document the resolution process.

d. Once the interpretation and resolution have been decided, the Contractor shall correct the item of noncompliance, report it to the Commissioning Agent. The requirement for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test. Retesting shall be repeated until satisfactory performance is achieved.

C. Cost of Retesting: The cost to retest a System Functional Performance Test shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

D. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform in compliance with the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance specifications, all identical units may be considered unacceptable by the VA. In such case, the Contractor shall provide the VA with the following:

1. Within one week of notification from the VA, the Contractor shall examine all other identical units making a record of the findings. The findings shall be provided to the VA within two weeks of the original notice.

2. Within two weeks of the original notification, the Contractor shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

3. The VA shall determine whether a replacement of all identical units or a repair is acceptable.

4. Two examples of the proposed solution shall be installed by the Contractor and the VA shall be allowed to test the installations for up to one week, upon which the VA will decide whether to accept the solution.

5. Upon acceptance, the Contractor shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

E. Approval: The Commissioning Agent will note each satisfactorily demonstrated function on the test form. Formal approval of the Systems Functional Performance Test shall be made later after review by the Commissioning Agent and by the VA. The Commissioning Agent will evaluate each test and report to the VA using a standard form. The VA will give final approval on each test using the same form, and provide signed copies to the Commissioning Agent and the Contractor.

3.7 **DEFERRED TESTING**:

A. Unforeseen Deferred Systems Functional Performance Tests: If any Systems Functional Performance Test cannot be completed due to the building structure, required occupancy condition or other conditions, execution of the Systems Functional Performance Testing may be delayed upon approval of the VA. These Systems Functional Performance Tests shall be conducted in the same manner as the seasonal tests as soon as possible. Services of the Contractor to conduct these unforeseen Deferred Systems Functional Performance Tests shall be negotiated between the VA and the Contractor.

B. Deferred Seasonal Testing: Deferred Seasonal Systems Functional Performance Tests are those that must be deferred until weather conditions are closer to the systems design parameters. The Commissioning Agent will review systems parameters and recommend which Systems Functional Performance Tests should be deferred until weather conditions more closely match systems parameters. The Contractor shall review and comment on the proposed schedule for Deferred Seasonal Testing. The VA will review and approve the schedule for Deferred Seasonal Testing. Deferred Seasonal Systems Functional Performances Tests shall be witnessed and documented by the Commissioning Agent. Deferred Seasonal Systems Functional Performance Tests shall be executed by the Contractor in accordance with these specifications.

3.8 **OPERATION AND MAINTENANCE TRAINING REQUIREMENTS**:

A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Agent will convene a training preparation conference to include VA's Resident Engineer, VA's Operations and Maintenance personnel, and the Contractor. The purpose of this conference will be to discuss and plan for Training and Demonstration of VA Operations and Maintenance personnel.

B. The Contractor shall provide training and demonstration as required by other Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 sections. The Training and Demonstration shall include, but is not limited to, the following:

1. Review the Contract Documents.

2. Review installed systems, subsystems, and equipment.

3. Review instructor qualifications.
4. Review instructional methods and procedures.
5. Review training module outlines and contents.
6. Review course materials (including operation and maintenance manuals).
7. Review and discuss locations and other facilities required for instruction.
8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

C. Training Module Submittals: The Contractor shall submit the following information to the VA and the Commissioning Agent:

1. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. At completion of training, submit two complete training manuals for VA's use.
2. Qualification Data: Submit qualifications for facilitator and/or instructor.
3. Attendance Record: For each training module, submit list of participants and length of instruction time.
4. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
5. Demonstration and Training Videotapes: Submit two copies within seven days of end of each training module.

a. Identification: On each copy, provide an applied label with the following information:

1) Name of Project.
2) Name and address of photographer
3) Name of Contractor.
4) Date videotape was recorded.
5) Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

6. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

D. QUALITY ASSURANCE:

1. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

2. Instructor Qualifications: A factory authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

3. Photographer Qualifications: A professional photographer who is experienced photographing construction projects.

E. COORDINATION:

1. Coordinate instruction schedule with VA's operations. Adjust schedule as required to minimize disrupting VA's operations.

2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

3. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the VA.

F. INSTRUCTION PROGRAM:

1. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:

a. Fire protection systems, including fire alarm, fire pumps, and fire suppression systems.

b. Intrusion detection systems.

c. Conveying systems, including elevators, wheelchair lifts, escalators, and automated materials handling systems.

d. Medical equipment, including medical gas equipment and piping.

e. Laboratory equipment, including laboratory air and vacuum equipment and piping.

f. Heat generation, including boilers, feedwater equipment, pumps, steam distribution piping, condensate return systems, heating hot water heat exchangers, and heating hot water distribution piping.

g. Refrigeration systems, including chillers, cooling towers, condensers, pumps, and distribution piping.

h. HVAC systems, including air handling equipment, air distribution systems, and terminal equipment and devices.

i. switchgear, transformers, switchboards, panelboards, uninterruptible power supplies, and motor controls.

j. Packaged engine generators, including synchronizing switchgear/switchboards, and transfer switches.

k. Lighting equipment and controls.

l. Communication systems, including intercommunication, surveillance, nurse call systems, public address, mass evacuation, voice and data, and entertainment television equipment.

m. Site utilities including lift stations, condensate pumping and return systems, and storm water pumping systems.

G. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.

b. Performance and design criteria if Contractor is delegated design responsibility.

c. Operating standards.

d. Regulatory requirements.

e. Equipment function.

f. Operating characteristics.

g. Limiting conditions.

h. Performance curves.

2. Documentation: Review the following items in detail:

a. Emergency manuals.

b. Operations manuals.

c. Maintenance manuals.

d. Project Record Documents.

e. Identification systems.

f. Warranties and bonds.

g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

a. Instructions on meaning of warnings, trouble indications, and error messages.

b. Instructions on stopping.

c. Shutdown instructions for each type of emergency.

d. Operating instructions for conditions outside of normal operating limits.

e. Sequences for electric or electronic systems.

f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.

b. Equipment or system break-in procedures.

c. Routine and normal operating instructions.

d. Regulation and control procedures.

e. Control sequences.

f. Safety procedures.

g. Instructions on stopping.

h. Normal shutdown instructions.

i. Operating procedures for emergencies.

j. Operating procedures for system, subsystem, or equipment failure.

k. Seasonal and weekend operating instructions.

l. Required sequences for electric or electronic systems.

m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.

b. Checking adjustments.

c. Noise and vibration adjustments.

d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.

b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.

b. Types of cleaning agents to be used and methods of cleaning.

c. List of cleaning agents and methods of cleaning detrimental to product.

d. Procedures for routine cleaning

e. Procedures for preventive maintenance.

f. Procedures for routine maintenance.

g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.

b. Repair instructions.

c. Disassembly; component removal, repair, and replacement; and reassembly instructions.

d. Instructions for identifying parts and components.

e. Review of spare parts needed for operation and maintenance.

H. Training Execution:

1. Preparation: Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual. Set up instructional equipment at instruction location.

2. Instruction:

a. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Department of Veterans Affairs for number of participants, instruction times, and location.

b. Instructor: Engage qualified instructors to instruct VA's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1) The Commissioning Agent will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.

2) The VA will furnish an instructor to describe VA's operational philosophy.

3) The VA will furnish the Contractor with names and positions of participants.

3. Scheduling: Provide instruction at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with the VA and the Commissioning Agent with at least seven days' advance notice.

4. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, or a written, performance-based test.

5. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

I. **Demonstration and Training Recording**:

1. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.

2. Video Format: Provide high quality color DVD color on standard size DVD disks.

3. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

4. Narration: Describe scenes on videotape by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of

construction.

----- END -----

SECTION 02 21 00

SITE SURVEYS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the gathering of research documents, performance of a topographic survey and preparation of a topographic survey map.

1.2 DEFINITIONS

A. Professional Land Surveyor: One who possesses a valid state license as a "Professional Land Surveyor" from the state in which they practice.

B. Professional Civil Engineer: One who possesses a valid state license as a "Professional Civil Engineer" from the state in which they practice. For this section, the term "surveyor" shall also include Professional Civil Engineers authorized to practice Land Surveying under the laws of the state in which they practice.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SURVEY

A. The surveyor shall research available public records for all mapping, monumentation, plats, governmental surveys etc. that may pertain to the subject property. Research all applicable public utilities for substructure data such as sewers, storm drains, water lines, electrical conduits etc.

B. The survey shall be performed on the ground in accordance with the current "Accuracy Standards for Land Title Surveys" as adopted, from time to time, by the American Congress on Surveying and Mapping, the National Society of Professional Surveyors, and the American Land Title Association.

C. The surveyor, when applicable, shall consult with the project Architect to determine scale of plat or map and size of drawings.

D. The surveyor shall furnish two sets of prints of the plat or map of survey and an electronic CADD file. If the plat or map of survey consists of more than one sheet, the sheets shall be numbered, the total number of sheets indicated and the match lines be shown on each sheet.

E. On the plat or map, the survey boundary shall be drawn to a convenient scale, or the scale designated by the Architect, with the scale clearly indicated. A graphic scale, shown in feet or meters or both, shall be included. A north arrow shall be shown and when practicable, the plat or map of survey shall be oriented so that north is at the top of the drawing. Symbols or abbreviations used shall be identified on the face of the plat or map by use of a legend or other means. Supplementary or exaggerated diagrams shall be presented accurately on the plat or map where dimensional data is too small to be shown clearly at full scale. The plat or map shall be 30 by 42 inches.

F. The survey shall contain the following applicable information:

1. The name, address, telephone number, and signature of the Professional Land Surveyor who made the survey, his or her official seal and registration number, the date the survey was completed and the dates of all revisions.

2. The survey drawing(s) submitted shall bear the following certification adjacent to the Engineer's official seal:

   a. "I hereby certify that all information indicated on this drawing was obtained or verified by actual measurements in the field and that every effort has been made to furnish complete and accurate information."

3. Vicinity map showing the property surveyed in reference to nearby highways or major street intersections.

4. Flood zone designation (with proper annotation based on Federal Flood Insurance Rate Maps or the state or local equivalent, by scaled map location and graphic plotting only).

5. Land area as defined by the boundaries of the legal description of the surveyed premises.

6. All data necessary to indicate the mathematical dimensions and relationships of the boundary represented by bearings and distances, and the length and radius of each curve, together with elements necessary to mathematically define each curve. The point of beginning of the surveyor's description and the basis of bearings shall also be shown.

7. When record bearings or angles or distances differ from measured bearings, angles or distances, both record and measured bearings, angles, and distances shall be clearly indicated. If the record description fails to form a mathematically closed figure, the surveyor shall so indicate.

8. Measured and record distances from corners of parcels surveyed to the nearest right-of-way lines of streets in urban or suburban areas, together with recovered lot corners and evidence of lot corners, shall be noted. The distances to the nearest intersecting street shall be indicated and verified. Names and widths of streets and highways abutting the property surveyed and widths of rights of way shall be given. Observable evidence of access (or lack thereof) to such abutting streets or highways shall be indicated. Observable evidence of private roads shall be so indicated. Streets abutting the premises, which have been described in Record Documents, but not physically opened, shall be shown and so noted.

9. The identifying titles of all recorded plats, filed maps, right of way maps, or similar documents which the survey represents, wholly or in part, with their appropriate recording data. The survey shall indicate platted setback or building restriction lines which have been recorded in subdivision plats or which appear in a Record Document which has been delivered to the surveyor. Contiguity, gores, and overlaps along the exterior boundaries of the survey premises, where ascertainable from field evidence or Record Documents, or interior to those exterior boundaries, shall be clearly indicated or noted. Where only a part of a recorded lot or parcel is included in the survey, the balance of the lot or parcel shall be indicated.

10. All evidence of found monuments shall be shown and noted. All evidence of monuments found beyond the surveyed premises on which establishment of the corners of the survey premises are dependent, and their application related to the survey shall be indicated.

11. The character of any and all evidence of possession shall be stated and the location of such evidence carefully given in relation to both the measured boundary lines and those established by the record. An absence of notation on the survey shall be presumptive of no observable evidence of possession. The term "possession" does not imply "ownership".

12. The location of all buildings upon the plot or parcel shall be shown and their locations defined by measurements perpendicular to the boundaries. If there are no buildings, so state. Proper street numbers shall be shown where available.

13. All easements evidenced by a Record Document which have been delivered to the surveyor shall be shown, both those burdening and those benefiting the property surveyed, indicating recording information. If such an easement cannot be located, a note to this affect shall be included. Observable evidence of easements and/or servitudes of all kinds, such as those created by roads, rights- of-ways, water courses, drains, telephone, telegraph, or electric lines, water, sewer, oil or gas pipelines on or across the surveyed property and on adjoining properties if they appear to affect the surveyed property, shall be located and noted. Surface indications, if any, or of underground easements and/or servitudes shall also be shown.

14. The character and location of all walls, buildings, fences, and other visible improvements within five feet of each side of the boundary lines shall be noted. Without expressing a legal opinion, physical evidence of all encroaching structural appurtenances and projections, such as fire escapes, bay windows, windows and doors that open out, flue pipes, stoops, eaves, cornices, areaways, stoops, trip, etc., by or on adjoining property or on abutting streets, on any easement or over setback lines shown by Record Documents shall be indicated with the extent of such encroachment or projection.

15. Driveways and alleys on or crossing the property must be shown. Where there is evidence of use by other than the occupants of the property, the surveyor must so indicate on the plat or map. Where driveways or alleys on adjoining properties encroach, in whole or in part, on the property being surveyed, the surveyor must so indicate on the plat or map with appropriate measurements.

16. Location, alignment and dimensions of all roads, curbs, walks, parking and paved areas abutting the subject land. Indicate road centerlines with true bearings and lengths by 50 foot stationing. Describe curves by designating the points of curvature and tangency by station. Include all curve data as well a location of radius and vertex points. Elevations on 50' centers on centerline of roads, edges of roads and top and bottom of curbs.

17. As accurately as the evidence permits, the location of cemeteries and burial grounds disclosed in the process of researching title to the premises or observed in the process of performing the field work for the survey, shall be shown.

18. Ponds, lakes, springs, or rivers bordering on or running through the premises being surveyed shall be shown. When a property surveyed contains a natural water boundary, the surveyor shall measure the location of the boundary according to appropriate surveying methods and note on the plat or map the date of the measurement and the caveat that the boundary is subject to change due to natural causes and that it may or may not represent the actual location of the limit of title. When the surveyor is aware of changes in such boundaries, the extent of those changes shall be identified.
19. Contours at a minimum interval of 1 foot. if not applicable to project. Base vertical control on the permanent (not assumed) National Geodetic Survey or VA Medical Center Bench Mark. Note location, description and datum.
20. Identify and show if possible, setback, height, and floor space area restrictions of record or disclosed by applicable zoning or building codes (in addition to those recorded in subdivision maps). If none, so state.
21. Exterior dimensions of all buildings at ground level. Show square footage of exterior footprint of all buildings at ground level and gross floor area of all buildings.
22. Measured height of all buildings above grade at a defined location. If no defined location is provided, the point of measurement shall be shown.
23. Elevations at each entrance to buildings, service docks, building corners, steps, ramps and grade slabs.
24. Substantial, visible improvements (in addition to buildings) such as signs, parking areas, swimming pools, etc.
25. Parking areas and, if striped, the striping and the type (eg. handicapped, motorcycle, regular, etc.) and number of parking spaces.
26. Indication of access to a public way such as curb cuts and driveways.
27. Location of utilities existing on or serving the surveyed property as determined by observed evidence together with plans and markings provided by utility companies, and other appropriate sources (with references as to the source of information. Locate and show all fire hydrants located within 500 feet of the subject property.
28. Railroad tracks and sidings.
29. Manholes, catch basins, valve vaults or other surface indications of subterranean uses.
30. Wires and cables (including their function) crossing the survey premises, all poles on or within ten feet of the surveyed premises, and the dimensions of all cross-wires or overhangs affecting the surveyed premises.
31. Utility company installations on the surveyed premises.
32. Names of adjoining owners of platted lands.
33. Observable evidence of earth moving work, building construction or building additions within recent months.

34. Any changes in street right-of-way lines either completed or proposed, and available from the controlling jurisdiction. Observable evidence of recent street or sidewalk construction or repairs.

35. Observable evidence of site use as a solid waste dump, sump or sanitary landfill.

36. All trees with a minimum diameter of 6" measured at 48" above the base of the tree. Perimeter outline only of thickly wooded areas with description of predominant vegetation.

- - - E N D - - -

SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies demolition and removal of buildings, portions of buildings, utilities, other structures and debris from trash dumps shown.

1.2 RELATED WORK:

A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING.

B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.

C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.

D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.

E. Asbestos Removal: Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.

F. Lead Paint: Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.

G. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

H. Construction Waste Management: Section 01 74 19 Construction Waste Management

I. Infectious Control: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7, INFECTION PREVENTION MEASURES.

1.3 PROTECTION:

A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.

B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.

C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.

D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.

E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:

1. No wall or part of wall shall be permitted to fall outwardly from structures.

2. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.

3. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.

G. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center property; any damaged items shall be repaired or replaced as approved by the Resident Engineer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this Contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have Resident Engineer’s approval.

H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

I. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

1.4 UTILITY SERVICES:

A. Demolish and remove outside utility service lines shown to be removed.

B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DEMOLITION:

A. Completely demolish and remove buildings and structures, including all appurtenances related or connected thereto, as noted below:

1. As required for installation of new utility service lines.

2. To full depth within an area defined by hypothetical lines located 1500

mm (5 feet) outside building lines of new structures.

B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Medical Center property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Resident Engineer. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.

C. In removing buildings and structures of more than two stories, demolish work story by story starting at highest level and progressing down to third floor level. Demolition of first and second stories may proceed simultaneously.

D. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of Contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500 mm (5 feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.

E. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Resident Engineer. When Utility lines are encountered that are not indicated on the drawings, the Resident Engineer shall be notified prior to further work in that area.

3.2 CLEAN-UP:

A. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to Resident Engineer. Clean-up shall include off the Medical Center property disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

---END---

SECTION 024116

STRUCTURE DEMOLITION

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings and site improvements.
2. Removing below-grade construction.
3. Disconnecting, capping or sealing, and removing site utilities.
4. Salvaging items for reuse by Owner.

B. Related Sections:

1. Division 01 Section "Summary" for use of the premises and phasing requirements.
2. Division 01 Section "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
3. Division 02 Section "Selective Structure Demolition" for partial demolition of buildings, structures, and site improvements.
4. Division 23 Sections for demolishing or relocating site mechanical items.
5. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.
6. Division 33 Section "Common Work Results for Utilities" for shutting off, disconnecting, removing, and sealing or capping utilities.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 SUBMITTALS

A. Proposed Protection Measures: Submit informational report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection. Indicate proposed locations and construction of barriers.

1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain.

B. Schedule of Building Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.

2. Shutoff and capping or re-routing of utility services.

C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

D. Pre-demolition Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Division 01 Section "Photographic Documentation". Submit before the Work begins.

1.6 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Pre-demolition Conference: Conduct conference at Project site.

1. Review procedures for noise control.

1.7 PROJECT CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.

2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for buildings and structures to be demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

2. Before building demolition, Owner will remove the following items:

a. Security Wiring Loop.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.

2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Hazardous Materials: Hazardous materials are present in buildings and structures to be demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.

2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

3. Owner will provide material safety data sheets for materials that are known to be present in buildings and structures to be demolished because of building operations or processes performed there.

F. On-site storage or sale of removed items or materials is not permitted.

1.8 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Division 31 Section "Earth Moving."

PART 3 - EXECUTION

3.1 DEMOLITION CONTRACTOR

A. Demolition Contractor:

1. .

3.2 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Inventory and record the condition of items to be removed and salvaged. Provide video of conditions that might be misconstrued as damage caused by salvage operations. Comply with Division 01 Section "Photographic Documentation."

D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

1. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.3 PREPARATION

A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.

B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off indicated utilities when requested by Contractor.

2. Arrange to shut off indicated utilities with utility companies.

3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.

4. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.

C. Existing Utilities: See Divisions 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of demolition.

E. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.

4. Transport items to storage area designated by Owner.

5. Protect items from damage during transport and storage.

3.4 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.

a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 01 Section "Temporary Facilities And Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.

2. Protect existing site improvements, appurtenances, and landscaping to remain.

3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.

6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.

7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.

2. Maintain fire watch during and for at least <**Insert number**> hours after flame cutting operations.

3. Maintain adequate ventilation when using cutting torches.

4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.

C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

D. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Salvage: Items to be removed and salvaged are indicated below:

1. Doors and door hardware.

2. Windows.

3. Cabinets.

4. Mirrors.

5. Chalkboards.

6. Tackboards.

7. Marker boards.

8. Plumbing fixtures.

9. <**Insert items to be salvaged**>.

D. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction flush with grade.

E. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet outside footprint indicated for new construction. Abandon below-grade construction outside this area.

1. Remove below-grade construction, including basements, foundation walls, and footings, completely .

F. Below-Grade Construction: Demolish foundation walls and other below-grade construction.

1. Remove below-grade construction, including basements, foundation walls,

and footings, completely.

G. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.

H. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet outside footprint indicated for new construction. Abandon utilities outside this area.

1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Division 31 Section "Earth Moving."

2. Piping: Disconnect piping at unions, flanges, valves, or fittings.

3. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

I. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

1. Piping: Disconnect piping at unions, flanges, valves, or fittings.

2. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

3.7 DEMOLITION BY EXPLOSIVES

A. Explosives: Perform explosive demolition according to governing regulations.

1. Obtain written permission from authorities having jurisdiction before bringing explosives to, or using explosives on, Project site.

2. Do not damage adjacent structures, property, or site improvements when using explosives.

B. Comply with recommendation in specialty explosives consultant's report.

3.8 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Division 31 Section "Earth Moving."

C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.9 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.10 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction. See Division 01 Section "Construction Waste Management and Disposal" for recycling and disposal of demolition waste.

1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.11 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

1. Clean roadways of debris caused by debris transport.

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DIVISION 2

02 82 00 **Asbestos Remediation**

02 82 13 Summary of the Work – Asbestos Abatement

02 82 14 Cutting and Patching – Asbestos Abatement

02 82 15 Definitions and Standards – Asbestos Abatement

02 82 16 Codes and Regulations – Asbestos Abatement

02 82 17 Submittals and Procedures – Asbestos Abatement

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02 82 21 Work Area Clearance

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02 82 27 Respiratory Protection

02 82 28 Decontamination Units

02 82 29 Project Decontamination

02 82 30 Cleaning and Decontamination Procedures

02 82 31 Minor Removals

02 82 32 Removal of Asbestos-Containing Materials

02 82 33 Disposal of Asbestos-Containing Waste Material

02 82 34 Removal of Asbestos-Contaminated Soil

02 83 00 **Lead Remediation**

02 83 13 Lead-Based Paint (LBP) Disturbance and Waste Disposal

List of Drawings

-- Drawing No. ASB-01 – Asbestos Abatement - Alternate Bid #1 - Building Number 26

SECTION 02 82 13

SUMMARY OF THE WORK – ASBESTOS ABATEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The asbestos abatement sections of the specifications were prepared by SSM Group, Inc. (ENVIRONMENTAL CONSULTANT) and are dated April 27, 2012.

B. The Project Manual indicates the WORK of the CONTRACT and related requirements and conditions that have an impact on the project such as:

Applicable codes and regulations.

Notices and permits.

Alterations and coordination with existing work.

Work to be performed concurrently by separate CONTRACT.

Work to be performed subsequent to work under this CONTRACT.

Alternates.

C. **SCOPE OF WORK – ASBESTOS ABATEMENT (Alternate Bid #1)**

Lebanon VA Medical Center – Existing Building No. 26 - ALTERNATE BID #1
As part of Alternate Bid #1 (demolition of existing building), CONTRACTOR is responsible for the removal and disposal of all asbestos-containing **pipe insulation** as indicated on Drawing ASB-01. Some of the pipe insulation is assumed to be located inside of walls and chases (as indicated on drawings), based upon visual observations and as-built mechanical/plumbing drawings. In these locations, CONTRACTOR is responsible for the means and methods necessary to access the pipe insulation, including demolition of the substrate as needed. Quantities are **estimated** at:

Basement – Approximately 1,500 linear feet of asbestos-containing pipe insulation located throughout the existing rooms, corridor and crawlspace. The majority of pipe insulation is located in the large crawlspace, and CONTRACTOR is also responsible for the removal/disposal, clean-up and decontamination of general locations with existing debris associated with the pipe insulation. See General Requirements for removal procedures.

First Floor – Approximately 1,100 linear feet of asbestos-containing pipe insulation located throughout the First Floor. The pipe insulation is assumed to be located inside of walls and chases (as indicated on drawings), and consists of heating pipe (supply/return) to feed existing heating units and domestic water pipe to feed existing sinks, tubs, toilets, etc. See General Requirements for removal procedures.

Second Floor – Approximately 200 linear feet of asbestos-containing pipe insulation located throughout the Second Floor. The pipe insulation is assumed to be located inside of walls and chases (as indicated on drawings), and consists of domestic water pipe to feed existing sinks, tubs, toilets, etc. See General Requirements for removal procedures.

Quantities provided in the scope of work are **estimated.** Contractor is responsible for removal and disposal of all asbestos-containing materials as indicated on the asbestos abatement drawings; and shall verify quantities of accessible pipe insulation prior to bidding.

Lebanon VA Medical Center – Existing Building No. 28 - ALTERNATE BID #1
There were no asbestos-containing materials found in Building Number 28 (existing Garage). Refer to SSM's report dated August 24, 2011 for information on the asbestos building inspection, sampling, etc. **Note**: The existing roofing material was also sampled on May 11, 2012. No asbestos was detected in the roofing materials; reference SSM's report dated May 14, 2012 for sampling results.

General Requirements – Asbestos Abatement

Any contractor performing asbestos abatement activities must be licensed as an asbestos abatement contractor by the Pennsylvania Department of Labor and Industry. CONTRACTOR will provide proof of such licensing prior to mobilizing on the site.

Asbestos Abatement Workers and Supervisors must be licensed as such by the Pennsylvania Department of Labor and Industry. Workers and Supervisors will provide proof of such licensing and will have current licenses on-site at all times.

Contractor will be responsible for preparing and submitting in a timely manner proper notifications to governing agencies, including EPA, DEP, PaDLI.

Contractor will be responsible for means and methods to access asbestos containing materials (ACM) that are enclosed behind walls, in chases, and above ceilings.

All asbestos abatement activities, removal procedures, etc… will be performed in strict accordance with the most stringent governing regulations, including, but not limited to the following:

Pennsylvania Dept. of Labor and Industry – Accreditation and Licensing Acts
EPA's AHERA Regulation
EPA's NESHAP's Regulation
OSHA's Asbestos in Construction Standard

Where a conflict arises between specifications and regulations, the most stringent takes precedence.

Pipe Insulation Removal
At a minimum, removal of asbestos-containing pipe insulation will be performed with critical barriers in place, under negative pressure, with a decontamination unit installed (3-stage decon for work areas containing >25 L.F. of ACM), and utilizing the glovebag procedure (see section 02 82 31). CONTRACTOR will be required to install a poly drop-cloth extending a minimum of 6 feet in all directions from the glovebag area. Any alternate method will require written approval by ENVIRONMENTAL CONSULTANT. Wet removal techniques are required. For pipe insulation located in the dirt crawlspace, CONTRACTOR will be

responsible for the removal and disposal of any associated debris located on the ground; and shall also clean and decontaminate the immediate area where the debris was located (including soil removal if necessary). See Section 02 82 34 for procedures on removing asbestos-contaminated soil, if necessary. CONTRACTOR shall field verify the existing crawlspace for debris prior to bidding.

After gross removal and final cleaning are complete, ENVIRONMENTAL CONSULTANT will conduct a visual inspection. Upon passing visual inspection, CONTRACTOR shall apply a lockdown encapsulant to the exposed piping. ENVIRONMENTAL CONSULTANT will then conduct air clearance testing.

Where a conflict arises between specifications and regulations, the most stringent takes precedence.

Wastewater
Water generated and utilized in the gross removal process and fine cleaning procedures will be disposed of as asbestos-containing waste. CONTRACTOR is not allowed to filter such water and discharge into sanitary sewer system. If CONTRACTOR wishes to filter and discharge water from a decontamination shower into the sanitary sewer, CONTRACTOR must obtain a permit from the local authority prior to the start of work. A copy of such permit must be submitted to ENGINEER prior to the start of WORK.

General Requirements - Lead-Based Paint (LBP)

All Contractor(s) are hereby advised that the following LBP and lead-containing surface coatings are present at the work site, in existing Building 26 and 28.

Existing Building 26 (Former Residents Quarters)

Basement
Throughout – Sanitary and Asbestos Piping (cream-colored)

First Floor
Room 107 and Lounge - Wood Ceiling Molding/Trim
Vestibule – Main Door, Interior Door and all Associated Door Frame/Trim (wood)

Throughout Building
Green 4” x 4” Ceramic Wall Tiles (throughout bathrooms, custodial closets, and 2 walls in kitchen)
Wood Shelving and Coat Hangers (cream-colored, throughout closets and Room 107)

Stairwell
All Metal Stair Stringers, Risers and Handrails

Attic
Structural Beams and Ductwork (painted gray, possibly located throughout in concealed locations)
Access Ladder and Framework

Exterior
Metal Window Sashes (basement windows only)
Metal Window Grates (crawlspace)
Black Metal Railing (terrace)

Wood Door and Frame/Trim (main entrance)

Existing Building 28 (Former Personnel Garage)

Throughout Garages
Interior Concrete Window Sills
Metal Garage Door Frames

Exterior
Metal Parking Guards (located on exterior brick wall for protection)

Work performed under this contract as described in the specifications and drawings may cause the disturbance of lead containing surface coatings. The Occupational Safety and Health Administration (OSHA) regulates worker lead exposure and has assigned a lead permissible exposure limit (PEL) of 50 micrograms per cubic meter (ug/m^3) and an action level of 30 ug/m^3 as an 8-hour time weighted average.

All Contractors are responsible for the proper work procedures, worker protection and sampling, and proper disposal (including TCLP hazardous waste characterization testing) of all lead-based paint (LBP) containing materials and components impacted during demolition. See General Requirements and Section 02 83 13 for proper procedures for handling LBP containing materials and components and for guidelines for Toxicity Characteristic Leachate Procedure (TCLP) testing.

Contractor is solely responsible for the health and safety of its workers during the execution of this contract. Work shall be conducted under the assumption that all surface coatings contain some amount of lead and, in accordance with all applicable local, state, and federal regulations, including, but not limited to, 29 CFR 1926.62 Lead Exposure in Construction, 1926.103 and 1910.134 Respiratory Protection, and U.S. EPA and PA DEP regulations applicable to this work effort.

Contractor shall handle, contain, store, test, transport and dispose of demolition debris with lead-containing surface coating in accordance with applicable local, state and federal regulations. The Contractor shall be responsible for collecting and having analyzed representative samples of the waste, and sampling shall be performed by a competent person familiar with sampling procedures, requirements, protocols, etc. Samples shall be tested for toxicity using the Toxicity Characteristics Leaching Procedure (TCLP) for lead sufficient to determine whether the debris is a hazardous waste as defined in 40 CFR 261.3, or a residual waste, as defined in 25 PA Code 287.1, and shall include such analysis as required by the disposal facility. Analysis shall be performed by a qualified environmental laboratory acceptable to the ENVIRONMENTAL CONSULTANT, and a copy of all testing results forwarded to the ENVIRONMENTAL CONSULTANT and OWNER. The Contractor shall be responsible for the costs of sample collection and laboratory analysis. Alternately, Contractor can assume lead waste generated is a hazardous waste and TCLP testing is not required, but the waste must then be disposed of and transported as hazardous waste.

If, based on testing, there is any hazardous waste generated and transferred to a hazardous waste disposal facility, Contractor shall provide all waste manifests to the OWNER immediately upon receipt for all stages of the disposal, including transportation and confirmation of receipt at the disposal facility. A final waste manifest shall be

provided within the timeframe required by regulation, which identifies the disposal facility name and address, EPA Identification Number (if applicable), the identity of the waste material, and a statement certifying that the waste was disposed at that facility, including the date. A copy should be forwarded to ENVIRONMENTAL CONSULTANT, but the OWNER must receive the original document for recordkeeping.

Where a conflict arises between specifications and regulations, the most stringent takes precedence.

D. Unit Pricing

(Deleted)

1.2 SEPARATE CONTRACTS

(Deleted)

1.3 WORK PLAN

A. Submit a detailed work plan which shall include procedures proposed for use in complying with the requirements of all federal, state, and local regulations applicable to the WORK performed.

B. Include in the plan the location and layout of decontamination areas, the sequencing of environmental remediation work, methods to be used to assure the safety of workers and visitors to the site, disposal plan including location of approved disposal/recycling site(s), and a detailed description of the methods to be employed to control pollution.

C. Include qualifications of CONTRACTOR and all personnel that will be working on this project.

D. Include qualifications of all waste transporter and disposal/recycling sites to be used on this project to ensure regulatory requirements are met.

E. The plan must be approved by the ENVIRONMENTAL CONSULTANT prior to commencement of The WORK.

F. CONTRACTOR shall include in the work plan a schedule for the environmental remediation work, including time durations and sequencing of the work.

1.4 INSPECTION

(Deleted)

1.5 POTENTIAL HAZARDS

A. The uncontained disturbance or dislocation of hazardous materials may create a potential health hazard to workmen and building occupants.

B. Apprise all workers, supervisory personnel, SUBCONTRACTORS and CONSULTANTS who will be at the job site of the seriousness of the hazards involved and of proper work procedures that must be followed.

C. Where in the performance of the WORK, workers, supervisory personnel, subcontractors, or consultants may encounter, disturb, or otherwise function in the immediate vicinity of any identified hazardous materials, take appropriate continuous measures as necessary to protect all building occupants from the potential hazard of exposure to contaminants.

1.6 STOP WORK

A. If the OWNER presents a written stop work order immediately and automatically stop all work. Do not recommence work until authorized in writing by ENVIRONMENTAL CONSULTANT.

1.7 HAZARDOUS MATERIALS

A. The following asbestos-containing materials are known to be present at the worksite. If any other materials are found, which are suspected of containing asbestos, immediately notify ENVIRONMENTAL CONSULTANT.

Material Description
Pipe Insulation

1.8 SUBMITTALS

A. Work Plan.

B. Pre-work inspection report

PART 2 PRODUCT

(Not Applicable)

PART 3 EXECUTION

(Not Applicable)

END OF SECTION

SECTION 02 82 14

CUTTING AND PATCHING – ASBESTOS ABATEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

Cutting and Patching of hazardous materials as indicated on the drawings, and noted in Section 02 82 13.

1.2 DELETED

PART 2 PRODUCTS

2.1 Provide local exhaust ventilation systems that comply with ANSI Z9.2-79.

PART 3 EXECUTION

3.1 GENERAL

A. Perform cutting, drilling, abrading, or otherwise penetrating any hazardous material in a manner to minimize the dispersal of contaminants into the air.

B. Provide adequate local exhaust to capture fibers produced by cutting, drilling, or abrading by means of an approved High Efficiency Particulate Air (HEPA) filter vacuum.

C. Use specialized equipment such as drills or saws having integral ventilation hoods which are connected to a HEPA vacuum with a flexible hose.

D. Handle and dispose of HEPA filters as contaminated material. See Section 02 82 33.

E. Thoroughly saturate absorbent surfaces of material to be penetrated with a penetrating type encapsulant. Allow encapsulant to penetrate to substrate before working on materials.

F. Seal edges of material exposed with two (2) coats of an approved encapsulant applied in accordance with manufacturer's printed instructions.

END OF SECTION

SECTION 02 82 15

DEFINITIONS AND STANDARDS – ASBESTOS ABATEMENT

PART 1 GENERAL

1.1 DEFINITIONS

A. Definitions in this article are not complete but general to the extent they are not defined elsewhere.

B. Indicated: The term "Indicated" is a cross-reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements in contract documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for purpose of helping reader locate cross- reference, and no limitation of location is intended except as specifically noted.

C. Directed: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by ENGINEER," "requested by "ENGINEER," and similar phrases. However, no such implied meaning will be interpreted to extend ENGINEER responsibility into CONTRACTOR'S responsibility for construction supervision.

D. Approve: Where used in conjunction with ENGINEER response to submittals, requests, applications, inquiries, reports and claims by CONTRACTOR, the meaning of term "approved" will be held to limitations of ENGINEER responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by ENGINEER be interpreted as a release of CONTRACTOR from responsibilities to fulfill requirements of contract documents.

E. Project Site: The term "project site" is defined as the space available to CONTRACTOR for performance of the WORK, either exclusively or in conjunction with others performing other work as part of the project. The extent of project site is shown on the drawings, and may or may not be identical with the description of land upon which the project is to be built.

F. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing protecting, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

I. Installer: The term "installer" is defined as the entity (person or firm) engaged by CONTRACTOR, or its subcontractor or sub-subcontractor for performance of a particular

unit of work at project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.

J. Testing Laboratory: The term "testing laboratory" is an entity engaged to perform specific inspections or tests of the WORK, either at project site or elsewhere; and to report and (if required) interpret results of those inspections or tests.

K. ENVIRONMENTAL CONSULTANT: The ENVIRONMENTAL CONSULTANT will represent the OWNER for asbestos and other environmental-related issues during construction and until final payment is due. The ENVIRONMENTAL CONSULTANT will advise and consult with the OWNER. The OWNER'S instructions to the CONTRACTOR shall be forwarded through the ENVIRONMENTAL CONSULTANT.

L. General Superintendent: is the CONTRACTOR'S representative at the work site. This person is the competent person required by OSHA in 29 CFR 1926.

1.2 RELATIVE TO ABATEMENT

A. Aerosol: A system consisting of particles, solid or liquid, suspended in air.

B. Air Cell: Insulation normally used on pipes and duct work that is comprised of corrugated cardboard which is frequently comprised of asbestos combined with cellulose or refractory binders.

C. Air Monitoring: The process of measuring the fiber content of a specific volume of air.

D. Amended Water: Water to which a surfactant has been added.

E. Asbestos: The asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite, anthophyllite, and actinolite-tremolite. For purposes of determining respiratory and worker protection both the asbestiform and non-asbestiform varieties of the above minerals and any of these materials that have been chemically treated and/or altered shall be considered as asbestos.

F. Asbestos-Containing Material (ACM): Any material containing more than 1% by weight of asbestos of any type or mixture of types.

G. Asbestos-Containing Waste Material: Any material which is or is suspected of being or any material contaminated with an asbestos- containing material which is to be removed from a work area for disposal.

H. Authorized Visitor: The OWNER, the ENVIRONMENTAL CONSULTANT, testing lab personnel, the ARCHITECT/ENGINEER or a representative of any federal, state and local regulatory or other agency having authorization over the project.

I. Barrier: Any surface that seals off the work area to inhibit the movement of fibers.

J. Breathing Zone: A hemisphere forward of the shoulders with a radius of approximately 6 to 9 inches.

K. Ceiling Concentration: The concentration of an airborne substance that shall not be exceeded.

L. Certified Industrial Hygienist (C.I.H.): An industrial hygienist certified by the American Board of Industrial Hygiene.

M. Demolition: The wrecking or taking out of any building component, system, finish or assembly of a facility together with any related handling operations.

N. Disposal Bag: A properly labeled 6 mil thick leak-tight plastic bags used for transporting asbestos waste from work and to disposal site.

O. Encapsulant: A material that surrounds or embeds asbestos fibers in an adhesive matrix, to prevent release of fibers.

Bridging encapsulant: an encapsulant that forms a discrete layer on the surface of an in situ asbestos matrix.

Penetrating encapsulant: an encapsulant that is absorbed by the in situ asbestos matrix without leaving a discrete surface layer.

Removal encapsulant: a penetrating encapsulant specifically designed for removal of asbestos-containing materials rather that for in situ encapsulation.

P. Encapsulation: Treatment of asbestos-containing materials, with an encapsulant.

Q. Enclosure: Abatement of ACM by the construction of an airtight, impermeable, permanent barrier around asbestos-containing material to control the release of asbestos fibers into the air.

R. Filter: A media component used in respirators to remove solid or liquid particles from the inspired air.

S. Friable Asbestos Material: Material that contains more than 1.0% asbestos by weight, and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

T. Glovebag: A sack (typically constructed of 6 mil transparent polyethylene or polyvinylchloride plastic) with two inward projecting longsleeve gloves, which are designed to enclose an object from which an asbestos-containing material is to be removed.

U. HEPA Filter: A High Efficiency Particulate Air (HEPA) filter capable of trapping and retaining 99.97% of asbestos fibers greater than 0.3 microns in length.

V. HEPA Filter Vacuum Collection Equipment (or vacuum cleaner): High efficiency particulate air filtered vacuum collection equipment with a filter system capable of collecting and retaining asbestos fibers. Filters should be 99.97% efficiency for retaining fibers of 0.3 microns or larger.

W. High-Efficiency Particulate Air Filter (HEPA): A filter which removes from air 99.97% or more of monodisperse dioctyl phthalate (DOP) particles having a mean particle diameter of 0.3 micrometer.

X. Negative Pressure Respirator: A respirator in which the air pressure inside the respiratory-inlet covering is positive during exhalation in relation to the air pressure of the outside atmosphere and negative during inhalation in relation to the air pressure of the outside atmosphere.

Y. Negative Pressure Ventilation System: A pressure differential and ventilation system.

Z. Personal Monitoring: Sampling of the asbestos fiber concentrations within the breathing zone of an employee.

AA. Protection Factor: The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of the degree of protection provided by a respirator to the wearer.

BB. Repair: returning damaged ACM to an undamaged condition to prevent fiber release.

CC. Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.

DD. Surfactant: A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.

EE. Time Weighted Average (TWA): The average concentration of a contaminant in air during a specific time period.

FF. Visible Emissions: Any emissions containing particulate asbestos material that are visually detectable without the aid of instruments. This does not include condensed uncombined water vapor.

GG. Wet Cleaning: The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with amended water or diluted removal encapsulant and afterwards thoroughly decontaminated or disposed of as asbestos contaminated waste.

HH. Work Area: The area where asbestos related work or removal operations are performed which is defined and/or isolated to prevent the spread of asbestos dust, fibers or debris, and entry by unauthorized personnel. Work area is a Regulated Area as defined by 29 CFR 1926.

1.3 GENERAL APPLICABILITY OF STANDARDS

A. Except to the extent that more explicit or more stringent requirements are written directly into the CONTRACT DOCUMENTS, applicable standards of the construction industry have the same force and effect (and are made a part of contract documents by reference) as if copied directly into CONTRACT DOCUMENTS, or as if published copies were bound herewith.

B. Refer to the other CONTRACT DOCUMENTS for resolution of overlapping and conflicting requirements which result from the application of several different industry standards to the same unit of work.

C. Refer to individual unit of work sections for indications of which specialized codes and standard the CONTRACTOR must keep at the project site, available for reference.

D. References Standards (referenced directly in CONTRACT DOCUMENTS or by governing regulations) have precedence over non-referenced standards which are recognized in industry for applicability to work.

E. Except as otherwise indicated, where compliance with an industry standard is required, comply with the standard in effect as of date of the CONTRACT DOCUMENTS.

1.4 COPIES OF STANDARDS

A. The CONTRACT DOCUMENTS require that each entity performing work be experienced in that part of the WORK being performed.

B. Each entity is also required to be familiar with recognized industry standards applicable to that part of the WORK.

C. Where copies of standards are needed for proper performance of the WORK, the CONTRACTOR is required to obtain such copies directly from the publication source.

D. Although certain copies of standards needed for enforcement of the requirements may be required submittals, the ENVIRONMENTAL CONSULTANT reserves the right to require the CONTRACTOR to submit additional copies of these standards as necessary for enforcement of the requirements.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

(Not Applicable)

END OF SECTION

SECTION 02 82 16

CODES AND REGULATIONS – ASBESTOS ABATEMENT

PART 1 GENERAL

1.1 DESCRIPTION OF THE WORK

A. Governmental regulations and industry standards which are included and incorporated herein by reference and made a part of the specification.

B. Notices and permits which are known to the OWNER and which either must be applied for and received, or which must be given to governmental agencies before start of work.

1.2 CODES AND REGULATIONS

A. Except to the extent that more explicit or more stringent requirements are written directly into the CONTRACT DOCUMENTS, all applicable codes, regulations, and standards have the same force and effect (and are made a part of the CONTRACT DOCUMENTS by reference) as if copied directly into the CONTRACT DOCUMENTS, or as if published copies are bound herewith.

B. The CONTRACTOR shall assume full responsibility and liability for the compliance with all applicable federal, state, and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site.

C. The CONTRACTOR is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable federal, state, and local regulations.

D. The CONTRACTOR shall hold the OWNER and ENVIRONMENTAL CONSULTANT harmless for failure to comply with any applicable work, hauling, disposal, safety, health or other regulation on the part of himself, his employees, or his SUBCONTRACTORS.

1.3 FEDERAL REQUIREMENTS

A. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), including but not limited to:

Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules
Title 29, Part 1910, Section 1001 and Part 1926, Section 58 of the Code of Federal Regulations

Respiratory Protection
Title 29, Part 1910, Section 134 of the Code of Federal Regulations

Construction Industry
Title 29, Part 1926, of the
Code of Federal Regulations

Access to Employee Exposure and Medical Records Title 29, Part 1910, Section 20 of the
Code of Federal Regulations

Hazard Communication
Title 29, Part 1910, Section 1200 of the
Code of Federal Regulations

Specifications for Accident Prevention Signs and Tags Title 29, Part 1910, Section 145 of the
Code of Federal Regulations

B. U.S. Department of Transportation
Hazardous Substances
Title 29, Parts 171 and 172 of the
Code of Federal Regulations

C. U.S. Environmental Protection Agency (EPA) including but not limited to:

Asbestos Abatement Projects; Worker Protection Rule
Title 40 Part 763, Sub-part G of the
Code of Federal Regulations

Asbestos Hazard Emergency Response Act (AHERA) Regulation
Asbestos Containing Materials in Schools Final Rule & Notice
Title 40, Part 763, Sub-part E of the
Code of Federal Regulations

Training Requirements of (AHERA) Regulation Asbestos Containing Materials in Schools Final Rule & Notice
Title 40, Part 763, Sub-part E, Appendix C of the Code of Federal Regulations

National Emission Standard for Hazardous Air Pollutants (NESHAPS)
National Emission Standard for Asbestos
Title 40, Part 61, Sub-part A, and Sub-part M (Revised Sub-part B) of the
Code of Federal Regulations

D. Lead-Based Paint and Hazardous Waste

29 CFR 1910.134	Respiratory Protection
29 CFR 1910.1200	Hazard Communication
29 CFR 1926.62	Lead in the Construction Industry
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste

	Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 178	Shipping Container Specification

1.4 STATE REQUIREMENTS

PENNSYLVANIA -

Pennsylvania Department of Environmental Protection
Notification prior to removal as required

Pennsylvania Department of Labor and Industry
Notification prior to removal as required

1.5 LOCAL REQUIREMENTS

A. Abide by all local requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials.

B. If CONTRACTOR elects to filter shower water and discharge filtered shower water into the sanitary sewer system, CONTRACTOR is responsible for obtaining a permit from the local sewer authority prior to commencing work.

1.6 STANDARDS

A. ANSI Z9.2-79: Fundamentals Governing the Design and Operations of Local Exhaust Systems Publication

B. ANSI Z88.2-80: Practices for Respiratory Protection Publication

C. Simplified Sampling Scheme for Friable Surfacing Materials.

D. Laboratories with Polarized Light Microscopy Capabilities for bulk asbestos identification.

E. Respiratory Protection for the Asbestos Abatement Industry. EPA-560-OPTS-86-001

F. ASTM E849: Safety and Health Requirements Relating to Occupational Exposure

1.7 NOTICES

A. U.S. Environmental Protection Agency

Send written notification as required by US EPA National Emission Standards for Hazardous Air Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61, Subpart M) to the regional

Asbestos NESHAPS Contact at least 10 days prior to beginning any work on asbestos-containing materials. Send notification to the following address; send copies to ENGINEER and OWNER.

REGION 3:
Asbestos NESHAPS Contact
Air & Waste Management Division
USEPA
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-6552

B. Include the following information in the notification sent to the NESHAPS Contact:

Name and address of OWNER or operator.
Description of the facility being demolished or renovated, including the size, age, and prior use of the facility.

Estimate of the approximate amount of friable asbestos material present in the facility in terms of linear feet of pipe, and surface area on other facility components.

Location of the facility being demolished or renovated.
Scheduled starting and completion dates of demolition or renovation. Nature of planned demolition or renovation and method(s) to be used. Procedures to be used to comply with the requirements of USEPA National Emission Standards for Hazardous Air Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61 Subpart M).

Name and location of the waste disposal site where the friable asbestos waste material will be deposited.

For facilities being demolished under an order of a state or local governmental agency, issued because the facility is structurally unsound and in danger of imminent collapse, the name, title, and authority of the state or local governmental representative who has ordered the demolition.

1.8 STATE AND LOCAL AGENCIES

Send written Notification as required by state and local agencies prior to beginning any work on asbestos-containing materials. Send copies to OWNER and ENGINEER including copies of receipts showing that notification was received by the agencies and the date received.

1.9 PERMITS

An annual "Industrial waste hauler permit" specifically for asbestos- containing materials, is required for transporting of waste asbestos- containing materials to a disposal site.

1.10 LICENSES

A. Maintain current licenses as required by applicable state or local jurisdictions for the removal, transporting, disposal or other regulated activity relative to the work of this CONTRACT.

B. Maintain two (2) copies of applicable federal, state and local regulations above. Post one copy of each at the job site. Keep on file in CONTRACTOR'S office one copy of each.

1.11 SUBMITTALS

A. Before Start of WORK submit the following to the ENVIRONMENTAL CONSULTANT for review.

1. Notices required by federal, state and local regulations together with proof of timely transmittal to agency requiring the notice.

2. Copies of current valid permits required by state and local regulations.

3. Copies of all state and local licenses and permits necessary to carry out the work of this CONTRACT.

4. Copies of notices required by federal, state, and local agencies together with proof of timely transmittal to the agency.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

(Not Applicable)

END OF SECTION

SECTION 02 82 17

SUBMITTALS AND PROCEDURES – ASBESTOS ABATEMENT

SUBMITTAL CHECKLIST - ABATEMENT

The submittals required from the CONTRACTOR may include, but are not limited to the following:

02 82 13 - Summary of the Work – Asbestos Abatement

Before Start of WORK:

Work Plan
Pre-construction Inspection

02 82 16 - Codes and Regulations – Asbestos Abatement

Before Start of WORK:

State Regulations

Local Regulations

Licenses

Notifications

Permits

02 82 17 - Submittals and Procedures – Asbestos Abatement

Before Start of WORK:

Submittal Schedule

02 82 22 – Pressure Differential & Air Circulation System

Before Start of WORK:

Differential Pressure System Design

HEPA Filtered Fan Units: Product data

Monitoring Equipment: Product data

Auxiliary Generator: Product data

Power Switch: Product data

02 82 23 - Temporary Enclosures

Before Start of WORK:

Strippable Coatings: Product data, test report on ASTM E84 test, manufacturer's installation instructions, Material Safety Data Sheet.

Spray Cement: Product data, manufacturer's installation instructions, Material Safety Data Sheet

Sheet Plastic: Test reports on NFPA Standard 701 Test.

Signs: Samples

02 82 24 - Regulated Areas

Before Start of WORK:

HEPA Filtered Vacuum Cleaners: Product data

Signs: Samples

Warning Tape: Samples

02 82 25 - Worker Protection

Before Start of WORK:

AHERA Accreditation or equivalent: for each worker

State and Local Licenses: for each worker

Historical Airborne Fiber Data

Training Program: course outline

Report from Medical Examination: for each worker

Notarized Certifications

02 82 26 - Worker Protection - Repair & Maintenance

Before Start of WORK:

AHERA Accreditation or equivalent: for each worker

State and Local Licenses: for each worker

Historical Airborne Fiber Data

Certificate Worker Acknowledgement: for each worker

Training Program: course outline

Report from Medical Examination: for each worker

Notarized Certifications

02 82 28 - Decontamination Units

Before Start of WORK:

Filters: Product data

Signs: Samples

02 82 32 - Removal of Asbestos-Containing Materials

Before Start of WORK:

Surfactant: Product data

Removal Encapsulant: Product data

NESHAPS Certification: on surfactant and/or removal encapsulant

Material Safety Data Sheet: for each surfactant and/or encapsulant

02 82 33 - Disposal of Asbestos-Containing Waste Material

Before Start of WORK:

Waste Hauler State License

Waste Hauler Local License

Name and address of landfill

Landfill contact person and telephone number

Name and address of processor

Processor contact person and telephone number

EPA letter on process as a NESHAPS alternative

Process parameters or operating conditions

Chain of Custody Form

Waste Manifest Form

Disposal bag: samples

Label Samples

Periodically During WORK:

As received: copies of manifests and disposal site receipts

END OF SUBMITTAL CHECKLIST

SECTION 02 82 18

AIR MONITORING - TEST LABORATORY SERVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air monitoring that may be carried out by the ENVIRONMENTAL CONSULTANT to verify that the building beyond the WORK AREA and the outside environment remain uncontaminated.

B. Establish airborne fiber levels both inside and outside the WORK AREA as action levels.

C. Action required by the CONTRACTOR if an action level is met or exceeded.

1.2 WORK BY OTHERS

Air monitoring required by OSHA is the CONTRACTOR'S responsibility and is not covered in this section.

1.3 DELETED

1.4 AIR MONITORING (if requested by OWNER)

A. The purpose of the air monitoring by the ENVIRONMENTAL CONSULTANT will be to detect faults in the WORK AREA isolation such as:

1. Contamination of the building outside of the WORK AREA with airborne asbestos fibers,

2. Failure of filtration or rupture in the negative pressure system,

3. Contamination of the exterior of the building with airborne asbestos fibers.

B. Should any of the above occur the CONTRACTOR shall immediately cease asbestos abatement activities until the fault is corrected. WORK shall not recommence until authorized by the ENVIRONMENTAL CONSULTANT.

C. The ENVIRONMENTAL CONSULTANT will monitor airborne fiber counts in the WORK AREA to detect airborne fiber counts which may significantly challenge the ability of the WORK AREA isolation procedures.

D. WORK AREA clearance to determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to an acceptable level, the ENVIRONMENTAL CONSULTANT will sample and analyze air per Section 02 82 21.

E. The ENVIRONMENTAL CONSULTANT will be conducting air monitoring throughout the course of the project.

1.5 STOP ACTION LEVELS

A. Maintain an average airborne count in the WORK AREA of less than 0.5 fibers per cubic centimeter. If the fiber counts rise above this figure for any sample taken, revise work procedures to lower fiber counts.

B. If the Time Weighted Average (TWA) fiber count for any work shift or 8 hour period exceeds 0.5 fibers per cubic centimeter, stop all WORK, leave negative air system in operation and notify ENVIRONMENTAL CONSULTANT. Do not recommence WORK until subsequent testing indicates acceptable fiber counts.

C. If airborne fiber counts exceed 1.0 fibers per cubic centimeter for any period of time cease all WORK until fiber counts fall below 0.5 fibers per cubic centimeter and notify ENVIRONMENTAL CONSULTANT. Do not recommence WORK until subsequent testing indicates acceptable fiber counts.

D. If any air sample taken outside of the WORK AREA exceeds the base line established below, immediately and automatically stop all WORK. If this reading was taken inside the building but outside the critical barriers immediately erect new critical barriers to isolate the affected area from the balance of the building.

Decontaminate the affected area in accordance with Section 02 82 30 Cleaning & Decontamination Procedures. Follow all protective measures as outlined in other sections of this Specification.

E. The CONTRACTOR shall be responsible for costs for all additional air monitoring and clearance testing required due to the contamination.

1.6 FIBERS COUNTED

A. The following procedure will be used to resolve any disputes regarding fiber types when a project has been stopped due to excessive airborne fiber counts. "Airborne Fibers" referred to above include all fibers regardless of composition as counted in the NIOSH 7400 Procedures.

B. If WORK has stopped due to high airborne fiber counts, the CONTRACTOR may request that air samples be secured by the ENVIRONMENTAL CONSULTANT for analysis by Transmission Electron Microscopy. "Airborne Fibers" counted in samples analyzed by Transmission Electron Microscopy shall be only asbestos fibers, but of any diameter and length.

C. If Transmission Electron Microscopy is used to arrive at the basis for determining "Airborne Fiber" counts in accordance with the above paragraph, and if the average of airborne asbestos fibers in all samples taken exceeds 0.5 fibers per cubic centimeter, or if any one sample exceeds 1.0 fibers per cubic centimeter, then the cost of such analysis will be borne by the CONTRACTOR, at no additional cost to the OWNER.

D. Transmission Electron Microscopy will be performed using the analysis method set forth in the AHERA regulation 40 CFR Part 763 Appendix A.

1.7 AIR SAMPLE

A. The number and volume of air samples taken by the ENVIRONMENTAL CONSULTANT will be in accordance with the following schedule. Sample volumes given may vary depending upon the analytical method used.

B. Samples will be collected on 25 mm cassettes with 50 mm extension cowls.

PCM: 0.8 micrometer mixed cellulose ester.

TEM: 0.45 micrometer polycarbonate.

1.8 BACKGROUND SAMPLES

A. The ENVIRONMENTAL CONSULTANT may secure air samples to establish a baseline before start of WORK.

Location Sample	Number of Samples	Analysis Method	Sampling Sensitivity fibers/cc.	Rate LPM	Minimum Volume (Liters)
Each WORK AREA	5	PCM	0.002	1 - 10	1,200

1.9 DAILY SAMPLES

A. From start of WORK of Section 02 82 23 "Temporary Enclosures" through the WORK of Section 02 82 29, "Project Decontamination", the ENVIRONMENTAL CONSULTANT may be taking the following samples on a daily basis.

Location Sampled	Number of Samples	Analysis Method	Detection Limit fibers/cc.	Rate LPM	Minimum Volume (Liters)
Each WORK AREA	2	PCM	0.002	1 - 10	240
			OR AS REQUIRED BY CONDITIONS		
Outside Each WORK AREA at Critical Barrier	1	PCM	0.002	1 - 10	240
Clean Room	1	PCM	0.002	1 - 10	240
Outside Building	1	PCM	0.002	1 - 10	240

B. Additional samples may be taken at ENVIRONMENTAL CONSULTANT'S discretion. If airborne fiber counts exceed allowed limits additional samples will be taken as necessary to monitor fiber levels.

1.10 LABORATORY TESTING

The services of a testing laboratory will be employed by the OWNER to perform laboratory analysis of the air samples. A technician will be at the job site, and samples will be sent daily so that verbal reports on air samples can be obtained within 24 hours.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

3.1 ADDITIONAL TESTING

The CONTRACTOR may conduct his own air monitoring and laboratory testing. If he elects to do this the cost of such air monitoring and laboratory testing shall be included in the Contract Sum.

3.2 PERSONAL MONITORING

The CONTRACTOR shall perform air monitoring as required to meet OSHA Requirements for maintenance of Time Weighted Average (TWA) fiber counts for types of respiratory protection provided. ENVIRONMENTAL CONSULTANT will not be performing air monitoring to meet these OSHA requirements.

END OF SECTION

SECTION 02 82 19

MATERIALS AND EQUIPMENT – ASBESTOS ABATEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Administrative and procedural requirements governing the CONTRACTOR'S selection of products.

B. Administrative procedures for handling requests for substitutions made after award of the CONTRACT.

1.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products in accordance with the manufacturers' recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

B. Schedule delivery to minimize long-term storage at the site and overcrowding of construction spaces.

C. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

D. Deliver products to the site in the manufacturers' original sealed containers or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.

E. Inspect products upon delivery to ensure compliance with the CONTRACT DOCUMENTS, and to ensure that products are undamaged and properly protected.

F. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.

G. Store heavy materials away from the project structure in a manner that will not endanger the supporting construction.

H. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturers' instructions.

1.3 PROCEDURES

A. Requests for changes in the products, materials, equipment and methods of construction required by the CONTRACT DOCUMENTS are considered requests for "substitutions", and are subject to the requirements specified herein. Following are not considered as substitutions:

1. Revisions to the CONTRACT DOCUMENTS, where requested by the OWNER, or ENVIRONMENTAL CONSULTANT are considered as "changes" not substitutions.

2. Specified CONTRACTOR options on products and construction methods included in the CONTRACT DOCUMENTS are not subject to the requirements for substitutions as herein specified.

3. Except as otherwise provided in the CONTRACT DOCUMENTS, the CONTRACTOR's determination of and compliance with governing regulations and orders as issued by governing authorities do not constitute "substitutions" and do not constitute a basis for change orders.

1.4 QUALITY ASSURANCE

A. To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.

B. Compatibility of products is a basis requirements of product selection.

C. When the CONTRACTOR is given the option of selecting between two or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also CONTRACTOR options.

1.5 SUBMITTALS

A. Submit 3 copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related specification section and drawing numbers, and complete documentation showing compliance with the requirements for substitutions.

B. Within one week of receipt of the CONTRACTOR'S request for substitution, the ENVIRONMENTAL CONSULTANT will request additional information or documentation as may be needed for evaluation of the request.

C. Within 2 weeks of receipt of the request, or within one week of receipt of the requested additional information or documentation, which ever is later, the ENVIRONMENTAL CONSULTANT will notify the CONTRACTOR of either the acceptance or rejection of the proposed substitution.

PART 2 PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCE

A. Requirements for individual products are indicated in the CONTRACT DOCUMENTS; compliance with these requirements is in itself a contract requirement.

B. Where some particular product or device is specified by brand name or manufacturer it is to be considered a standard.

C. If approved equal, items of other manufacturer than those mentioned may be used, unless specifically noted otherwise for purposes of standardization.

D. Any substitution must receive the written approval of the ENVIRONMENTAL CONSULTANT.

2.2 SUBSTITUTIONS

A. The CONTRACTOR'S request for a substitution will be received and considered when extensive revisions to the CONTRACT DOCUMENTS are not required, and one or more of the following conditions are met.

B. Request is directly related to an "or equal" clause or similar language in the contract documents.

C. Specified product or method cannot be provided within the CONTRACT time. However, the request will not be considered if the product or method cannot be provided as a result of the CONTRACTOR'S failure to pursue the work promptly or to coordinate the various activities properly.

D. Specified product or method cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

E. Substantial advantage is offered the OWNER, in terms of cost, time, energy conservation or other considerations of merit, after deducting of offsetting responsibilities the OWNER may be required to bear.

F. Specified product or method cannot be provided in a manner which is compatible with other materials of the work, and where the CONTRACTOR certifies that the substitution will overcome the incompatibility.

G. Specified product or method cannot be properly coordinated with other materials in the work, and where the CONTRACTOR certifies that the proposed substitution can be properly coordinated.

H. Specified product or method cannot receive a warranty as required by the contract documents and where the CONTRACTOR certifies that the proposed substitution includes the required warranty.

2.3 GENERAL PRODUCT REQUIREMENTS

A. Provide products that comply with the requirements of the CONTRACT DOCUMENTS that are undamaged and, unless otherwise indicated, unused at the time of installation.

B. Provide products that are complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

C. Where they are available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

D. Where, because of the nature of its application, the OWNER is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair or replacement, provide standard, domestically produced products for which the manufacturer

has published assurances that the products and its parts are likely to be available to the OWNER at a later date.

PART 3 EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Except as otherwise indicated in individual sections of these specifications, comply with the manufacturers' instructions and recommendations for installation of the products in the applications indicated.

B. Anchor each product securely in place, accurately located and aligned with other work.

C. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.

END OF SECTION

SECTION 02 82 20

PROJECT CLOSEOUT – ASBESTOS ABATEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures

B. Project Record Documents

C. Warranties

D. Final Cleaning

1.2 DELETED

1.3 CLOSEOUT PROCEDURES

A. Submit written certification that CONTRACT DOCUMENTS have been reviewed, WORK has been inspected and that WORK is completed in accordance with the CONTRACT DOCUMENTS and ready for ENVIRONMENTAL CONSULTANT'S inspection.

B. Remove all temporary facilities, tools and accessories installed for the project and restore to original condition all permanent facilities used as temporary facilities.

C. Obtain and submit releases enabling OWNER'S full unrestricted use of the site and access to services and utilities.

D. Submit specific warranties, bonds and guarantees.

E. Complete final cleaning requirements.

F. Touch up and otherwise repair and restore marred exposed finishes to original condition.

G. Conduct a final inspection with the OWNER, ENVIRONMENTAL CONSULTANT and CONTRACTOR'S Representatives to examine condition of remaining surfaces.

1.4 RECORD DOCUMENT SUBMITTALS

A. Specific requirements for record documents are indicated in the individual sections of these specifications.

B. Maintain a record set of blue or black line white- prints of contract drawings in a clean, undamaged condition. Mark-up the set of record documents to show the actual installation where the installed WORK varies substantially from the WORK as originally shown.

C. Mark record sets with red erasable pencil and, where feasible, use other colors to distinguish between variations in separate categories of WORK.

D. Note related change-order number where applicable.

E. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on cover of each set.

F. Maintain one complete copy of the Project Manual, including specifications and addenda, and one copy of other written construction documents such as change orders and similar modifications issued in printed form during construction. Mark these documents to show substantial variations in the actual WORK performed in comparison with the text of the specifications and modifications as issued.

G. Maintain one copy of each product data submittal. Mark these documents to show significant variations in the actual WORK performed in comparison with the submitted information.

1.5 WARRANTIES

A. Provide duplicate copies of all specified warranties, bonds and guarantees.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

3.1 FINAL CLEANING

A. Provide final cleaning of the WORK at the time indicated. Clean each surface or unit of work to the condition expected from a normal, commercial building cleaning and maintenance program. Comply with the manufacturers' instructions for operations.

B. Complete all cleaning operations before requesting the ENVIRONMENTAL CONSULTANT final inspection.

C. Remove exposed labels in finished spaces which are not required as permanent labels on materials supplied as part of the WORK, except for "Asbestos", "Asbestos Free", or Thermal Insulation Labels specified elsewhere.

D. Clean transparent materials, affected by the WORK including mirrors and window/door glass, to a polished condition, removing substances which are noticeably vision-obscuring materials. Replace broken glass and damaged transparent materials.

E. Deleted.

F. Clean exposed hard-surfaced finishes affected by the WORK, to a dirt-free condition, free of dust, stains, films and similar distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective condition.

G. Vacuum clean with HEPA vacuum carpeted surfaces and similar soft surfaces and/or professionally clean to remove staining caused by WORK of this CONTRACT.

H. Clean plumbing fixtures affected by the WORK to a sanitary condition, free of stains including those resulting from water exposure.

I. Deleted.

J. Clean light fixtures and lamps which have been affected by the WORK so as to function with full efficiency. Replace lamps where inoperable.

K. Clean project site (yard and grounds), including landscaped areas, of litter and foreign substances left during the course of the WORK. Sweep paved areas which have been affected by the work to a broom-clean condition; remove stains, petrochemical spills and other foreign deposits left by the work. Rake grounds which are neither planted nor paved, to a smooth, even-textured surface where they have been disturbed by the WORK.

L. Except as otherwise indicated or requested by the ENVIRONMENTAL CONSULTANT, remove temporary protection devices and facilities which were installed during the course of the WORK to protect previously completed WORK.

M. Comply with safety standards and governing regulations for cleaning operations. Do not burn waste materials at the site. Do not bury debris or excess materials on the OWNER'S property. Do not discharge volatile or other harmful, dangerous or unpermitted materials into drainage systems.

END OF SECTION

SECTION 02 82 21

WORK AREA CLEARANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section describes work performed by the ENVIRONMENTAL CONSULTANT to measure post-abatement fiber levels.

1.2 CONTRACTOR RELEASE CRITERIA

The WORK is Complete when the WORK AREA is visually clean and airborne fiber levels have been reduced to the level specified in items 1.06 and 1.07 of this Section.

1.3 AIR MONITORING

A. To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to the specified level, the ENVIRONMENTAL CONSULTANT will secure samples and analyze them according to the following procedures.

B. Fibers Counted: "Fibers" referred to in this section shall be either all fibers regardless of composition as counted in the NIOSH 7400, or asbestos fibers of any size as counted using a Transmission
Electron Microscope.

1.4 AGGRESSIVE SAMPLING

A. Before sampling pumps are started the exhaust from forced air equipment (such as a leaf blower with at least 1 horsepower electric motor) will be swept against all walls, ceilings, floors, ledges and other surfaces in the room. This procedure will be continued for 5 minutes per 10,000 cubic feet of WORK AREA volume.

B. One 20 inch diameter fan per 10,000 cubic feet of room volume will be mounted in a central location, directed toward ceiling and operated at low speed for the entire period of sample collection.

C. Air samples will be collected in areas subject to normal air circulation away from room corners, obstructed locations, and sites near windows, doors of vents.

D. After air sampling pumps have been shut off, fans will be shut off.

1.5 SCHEDULE OF AIR SAMPLES

A. The number and volume of air samples taken and analytical methods used by the ENVIRONMENTAL CONSULTANT will be in accordance with one of the following schedules in compliance with federal regulations. Sample volumes given may vary depending upon the analytical instruments used.

1.6 PHASE CONTRAST MICROSCOPY (PCM)

A. In each homogenous WORK AREA after completion of all cleaning work, a minimum of 7 samples will be taken and analyzed as follows:

Location Sampled	Number of Samples	Filter Media	Acceptance Level Limit Fibers/cc	Rate LPM	Volume Liters
					Min Max
Each WORK AREA	5	Cellulose Ester	0.01	2-12	1200 1800
WORK AREA Blank	1	Cellulose Ester	0.01	0	- -
Laboratory Blank	1	Cellulose Ester	0.01	0	- -

B. Fibers on each filter will be counted and measured using the NIOSH Method 7400 procedures.

C. One work area sample may be split and both halves analyzed separately for duplicate analysis.

D. Decontamination of the work site is complete when every WORK AREA sample is equal to or below the applicable Acceptance Level. If any sample is above the Acceptance Level, then the decontamination is incomplete and recleaning is required.

1.7 TRANSMISSION ELECTRON MICROSCOPY (TEM)

(Deleted).

1.8 FAILED CLEARANCE TESTS

A. If the release criteria are not met and the area must be recleaned and retested the CONTRACTOR will be responsible for all costs associated with retesting, including labor and laboratory costs.

1.9 PHASE CONTRAST MICROSCOPY

A. The services of a testing laboratory, accredited by A.I.H.A. or E.P.A., will be employed by the OWNER to perform laboratory analysis of the air samples.

B. Air samples will be obtained and be sent for PCM analysis daily, so that verbal reports on air samples can be obtained within 24 hours.

C. A complete record, certified by the testing laboratory, of all air monitoring tests and results will be furnished to the OWNER.

1.10 TRANSMISSION ELECTRON MICROSCOPY

(Deleted).

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

(Not Applicable)

END OF SECTION

SECTION 02 82 22

PRESSURE DIFFERENTIAL AND AIR CIRCULATION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Establishing, operating and maintaining a differential pressure ventilation system.

1.2 SUBMITTALS

A. Number of HEPA filtered fan units required and the calculations necessary to determine the number of machines.

B. Description of projected air flow within work area and methods required to provide adequate air flow in all portions of the WORK AREA.

C. Manufacturer's product data on the HEPA filtered fan units to be used.

D. Location of the machines in the work space.

E. Method of supplying adequate power to the machines and designation of building electrical panel(s) which will be supplying the power.

F. Description of work practices to ensure that airborne fibers travel downstream from workers.

1.3 QUALITY ASSURANCE

A. Monitor pressure differential across Decontamination Unit with a differential pressure meter equipped with a strip chart recorder.

B. Meter shall be equipped with a warning buzzer which will sound if pressure differential drops below 0.02" of water.

PART 2 PRODUCTS

2.1 HEPA FILTERED FAN UNITS

A. Cabinet shall be factory sealed to prevent asbestos-containing dust from being released during use, transport, or maintenance. Access to and replacement of all air filters shall be from intake end.

B. Rate capacity of fan according to usable air-moving capacity under actual operating conditions.

C. The final filter shall be the HEPA type. The filter media (folded into closely pleated panels) must be completely sealed on all edges with a structurally rigid frame.

D. A continuous rubber gasket shall be located between the filter and the filter housing to form a tight seal.

E. Testing shall be in accordance with Military Standard Number 282 and Army Instruction Manual 136-300-175A.

F. Each filter shall bear a UL586 label to indicate ability to perform under specified conditions.

G. Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test air flow.

H. Two stages of prefilters, which protect the final filter by removing the larger particles, are required to prolong the operating life of the HEPA filter.

I. Each unit shall be equipped with a Magnahelic gauge or manometer to measure the pressure drop across filters and indicate when filters have become loaded and need to be changed. A table indicating the usable air-handling capacity for various static pressure readings on the Magnahelic gauge shall be affixed near the gauge for reference, or the Magnahelic reading indicating at what point the filters should be changed, noting Cubic Feet per Minute (CFM) air delivery at that point.

J. Provide units equipped with an elapsed time meter to show the total accumulated hours of operation.

K. The unit shall have an electrical (or mechanical) lockout to prevent fan from operating without a HEPA filter. Units shall be equipped with automatic shutdown system to stop fan in the event of a major rupture in the HEPA filter or blocked air discharge.

L. Warning lights are required to indicate normal operation, too high a pressure drop across the filters (i.e., filter overloading), and too low of a pressure drop (i.e., major rupture in HEPA filter or obstructed discharge).

M. Electrical components shall be approved by the National Electrical Manufacturers Association (NEMA) and Underwriter's Laboratories (UL).

N. Each unit shall be equipped with overload protection sized for the equipment. The motor, fan, fan housing, and cabinet shall be grounded.

2.2 ACCEPTABLE MANUFACTURERS

Aerospace America, Inc. 900 Truman Parkway P. O. Box 189 Bay City, Michigan 48707	"Aero-Clean 2000"
Asbestos Control Technology, Inc. P. O. Box 183 Maple Shade, NJ 08052	"Micro-Trap"
Control Resource Systems, Inc. 670 Mariner Drive Michigan City, Indiana 46360	"Hog" 2000

Global Consumer Services, Inc. 1721 N. Highland Avenue Los Angeles, CA 90028	"Red Baron"
Trim-Dim Filter Corporation 1431 West Lake Street Chicago, Illinois 60607	"ACCU-2M"

PART 3 EXECUTION

3.1 PRESSURE DIFFERENTIAL

A. Provide a fully operational differential pressure and air circulation system within the WORK AREA maintaining continuously a pressure differential across WORK AREA enclosures.

B. Demonstrate to the ENVIRONMENTAL CONSULTANT the pressure differential by use of a pressure differential meter or a manometer, before disturbance of any asbestos containing materials.

C. Continuously monitor and record the pressure differential between the WORK AREA and the building outside of the WORK AREA with a monitoring device incorporating a strip chart recorder.

3.2 PREPARATION OF THE WORK AREA

A. Provide fully operational HEPA filtered fan units supplying a minimum of one air change every 15 minutes.

B. Add one (1) additional unit as a backup in case of equipment failure or machine shutdown for filter changing.

C. Locate exhaust unit(s) so that makeup air enters WORK AREA primarily through decontamination facilities and traverses WORK AREA as much as possible.

D. Place end of unit or its exhaust duct through an opening in the plastic barrier or wall covering. The plastic around the unit or duct shall then be sealed with tape.

E. Vent to outside of building, unless authorized in writing by the ENVIRONMENTAL CONSULTANT.

F. Provide supplemental inlets where required for proper air flow through the work space in location approved by the ENVIRONMENTAL CONSULTANT by making openings in the plastic sheeting that allow air from outside the building into the WORK AREA.

G. Locate auxiliary makeup air inlets as far as possible from the exhaust unit(s), off the floor (preferably near the ceiling), and away from barriers that separate the WORK AREA from occupied clean areas.

H. Cover with flaps to reseal automatically if the negative pressure system should shut down for any reason. Spray flap and around opening with spray adhesive so that flap seals if it closes.

3.3 START UP OF THE PRESSURE DIFFERENTIAL AND AIR CIRCULATING SYSTEM

A. Each unit shall be serviced by a dedicated circuit with overload device tied into an existing building electrical panel which has sufficient spare capacity to accommodate the load of all negative pressure units connected.

B. Before any asbestos-containing material is wetted or removed, and after the WORK AREA has been prepared, the decontamination facility set up, and the HEPA filtered fan unit(s) installed, start the unit(s) (one at a time) to demonstrate the system.

C. Proper operation of the system will exhibit, the following:

Plastic barriers and sheeting move slightly in toward WORK AREA,

Curtain of decontamination units move slightly in toward WORK AREA,

There is a noticeable movement of air through the decontamination unit.

Use smoke tubes to demonstrate a positive motion of air.

Use a differential pressure meter or manometer to demonstrate a pressure difference of at least 0.02 inches of water across every barrier separating the WORK AREA from the balance of the building or outside.

D. Modify the system as necessary to successfully demonstrate the above.

3.4 USE OF SYSTEM DURING ABATEMENT OPERATIONS

A. Start HEPA filtered fan units before beginning work.

B. After abatement work has begun, run units continuously to maintain a constant negative pressure until decontamination of the WORK AREA is complete and final air tests indicate that the WORK AREA clearance criteria of Section 02 82 21 has been met.

C. Do not turn off units at the end of the work shift or when abatement operations temporarily stop.

D. Do not shut down system during encapsulating procedures, unless authorized by the ENVIRONMENTAL CONSULTANT in writing.

E. Start abatement work at a location farthest from the exhaust units and proceed toward them.

F. If an electric power failure occurs, immediately stop all abatement work and do not resume until power is restored and exhaust units are operating again.

G. At completion of abatement work, allow exhaust units to run as specified under Section 02 82 29, to remove airborne fibers that may have been generated during abatement work and cleanup and to purge the WORK AREA with clean makeup air.

3.5 DISMANTLING THE SYSTEM

A. When a final inspection and the results of final air tests indicate that the area has met the WORK AREA clearance criteria of Section 02 82 21, the exhaust units may be shut down and removed from the WORK AREA.

B. Before removal from the WORK AREA, remove and properly dispose of pre-filter, and seal intake to the machine with 6 mil polyethylene to prevent environmental contamination from the filters. The machine shall be cleaned and wrapped with 6 mil polyethylene prior to removing from the WORK AREA.

END OF SECTION

SECTION 02 82 23

TEMPORARY ENCLOSURES

PART 1 GENERAL

1.1 SUBMITTALS

A. Contingency Plans

B. Strippable Coatings: product data, MSDS

C. Spray Cement: product data, MSDS

D. Sheet Plastic: product data, MSDS

E. Signs: samples

PART 2 PRODUCTS

2.1 POLYETHYLENE SHEET

A. A single polyethylene film in the largest sheet size possible to minimize seams, 6.0 mils thick, clear, frosted, or black as indicated.

B. Provide flame resistant polyethylene film for all work to be done where hot pipes or equipment are present or where there is a potential for fire, that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-Resistant Textiles and Films.

2.2 SPRAY PLASTIC

A. Spray plastic which is formulated to adhere to surfaces and peel off cleanly at the completion of the WORK may be used if approved.

B. Damages to finish caused by application or removal of the spray plastic must be repaired and refinished to the satisfaction of the OWNER at no additional cost to the OWNER.

2.3 DUCT TAPE

A. Provide duct tape in 2" or 3" widths as required, with an adhesive which is formulated to tenaciously stick to sheet polyethylene.

B. Damages to finish caused by application or removal of the spray plastic must be repaired and refinished to the satisfaction of the OWNER at no additional cost to the OWNER.

2.4 SPRAY CEMENT

A. Provide spray adhesive which is specifically formulated to stick tenaciously to sheet polyethylene.

B. Damages to finish caused by application or removal of the spray plastic must be repaired and refinished to the satisfaction of the OWNER at no additional cost to the OWNER.

PART 3 EXECUTION

3.1 GENERAL

A. A "WORK AREA" is considered contaminated during the WORK, and must be isolated from the balance of the building, and decontaminated at the completion of the asbestos-control work.

B. Completely isolate the WORK AREA from other parts of the building so as to prevent asbestos-containing dust or debris from passing beyond the isolated area.

C. Should the area beyond the WORK AREA(s) become contaminated with asbestos-containing dust or debris as a consequence of the WORK, those areas shall be isolated and cleaned in accordance with the procedures indicated for WORK AREAS at no additional cost to OWNER.

D. Place all tools, scaffolding, staging, etc. necessary for the WORK in the area to be isolated prior to erection of the plastic sheeting temporary enclosures.

E. Remove all removable furniture, equipment and supplies that are designated as non-contaminated.

F. Clean all immovable or attached furniture, equipment and fixtures and completely cover with two (2) layers of polyethylene sheeting, at least 6 mil in thickness, securely taped in place with duct tape. Such furniture and equipment shall be considered outside the WORK AREA unless covering plastic or seal is breeched.

G. Disable Ventilating Systems or any other system bringing air into or out of the WORK AREA.

H. Lockout power to WORK AREA by switching off all breakers serving power or lighting circuits in WORK AREA.

I. Lockout power to circuits running through WORK AREA wherever possible by switching off all breakers or removing fuses serving these circuits.

J. Install inspection windows in locations shown on the plans or as directed by the ENVIRONMENTAL CONSULTANT. Each inspection window is to have a 24" x 24" viewing area fabricated from 1/4" acrylic or polycarbonate sheet.

3.2 EMERGENCY EXITS

A. Arrange exit door so that it is secure from outside the WORK AREA but permits egress from the WORK AREA.

B. Mark outline of door on primary and critical barriers with luminescent paint at least 1" wide. Hang a razor knife on a string beside outline. Paint words "EMERGENCY EXIT" inside outline with luminescent paint in letters at least one foot high and 2" wide.

C. Utilize existing emergency lighting signs.

3.3 CONTROL ACCESS

A. Isolate the WORK AREA to prevent entry by building occupants into WORK AREA or surrounding controlled areas.

B. Submit to ENVIRONMENTAL CONSULTANT a list of doors and other openings that must be secured to isolate WORK AREA. Include on list notation if door or opening is in an indicated exit route.

C. After receiving written authorization from the ENVIRONMENTAL CONSULTANT lock all doors into WORK AREA, or, if doors cannot be locked, chain shut. Cover any signs that direct emergency exiting, either outside or inside of WORK AREA, to locked doors.

D. Do not obstruct doors required for emergency exits from WORK AREA or from building.

E. Construct partitions or closures across any opening into WORK AREA. Partitions are to be a minimum of 8 feet high.

F. Modify elevator controls to prevent elevators from stopping at doors in WORK AREA(s). This WORK is to be performed by a qualified elevator technician.

G. Replace passage sets on doors required for exiting from WORK AREA with temporary locksets for duration of the project. Use entry type locksets that are key lockable from one side and always operable from inside. After meeting release criteria set forth in Section 02 82 21 WORK AREA Clearance reinstall original passage sets and adjust for proper operation.

H. Arrange WORK AREA so that the only access into WORK AREA is through lockable doors to personnel and equipment decontamination units. If necessary, install temporary doors with entrance type locksets that are key lockable from the outside and always unlocked and operable from the inside. Do not use deadbolts or padlocks.

I. Where the WORK AREA is immediately adjacent to or within view of occupied areas, provide a visual barrier of opaque polyethylene sheeting at least 6 mil in thickness so that the work procedures are not visible to building occupants. The visual barrier is in addition to critical primary and secondary barriers. Where this visual barrier would block natural light, substitute frosted or woven rip-stop sheet plastic in locations approved by the ENVIRONMENTAL CONSULTANT.

J. Provide Warning Signs at each locked door leading to WORK AREA reading as follows:

KEEP OUT

CONSTRUCTION

WORK AREA

PROTECTIVE CLOTHING REQUIRED
BEYOND THIS POINT

K. Immediately inside door and outside critical barriers post an approximately 20 inch by 14 inch manufactured caution sign displaying the following legend with letter sizes and styles of a visibility required by 29 CFR 1926:

DANGER

ASBESTOS
CANCER AND LUNG DISEASE HAZARD
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED
IN THIS AREA

Provide spacing between respective lines at least equal to the height of the respective upper line.

3.4 ALTERNATE METHODS OF ENCLOSURE

A. Alternate methods of containing the WORK AREA may be substituted to the ENVIRONMENTAL CONSULTANT for approval in accordance with procedures set forth in Section 02 82 19 Materials and Equipment - Asbestos Abatement.

B. Do not proceed with any such method(s) without prior written approval of the ENVIRONMENTAL CONSULTANT.

C. Use of strippable coatings must be submitted in accordance with this section.

3.5 RESPIRATORY AND WORKER PROTECTION

Before proceeding beyond this point in providing Temporary Enclosures:

Provide Worker Protection per Section 02 82 25

Provide Respiratory Protection per Section 02 82 27

Provide Decontamination Units per Section 02 82 28

3.6 CRITICAL BARRIERS

A. Completely separate the WORK AREA from other portions of the building, and the outside by closing all openings with two separate sheet plastic barriers each at least 6 mil in thickness.

B. Sealing cracks leading out of WORK AREA with duct tape.

C. Individually seal all ventilation openings (supply and exhaust), lighting fixtures, clocks, doorways, windows, convectors and speakers, and other openings into the WORK AREA with polyethylene sheeting at least 6 mil in thickness, taped securely in place with duct tape.

D. Maintain seal until all work including Project Decontamination is completed.

E. Take care in sealing of lighting fixtures to avoid melting or burning of sheeting.

F. Provide sheet plastic barriers at least 6 mil in thickness as required to seal openings completely from the WORK AREA into adjacent areas. Seal the perimeter of all sheet plastic barriers with duct tape or spray cement.

G. Mechanically support sheet plastic independently of duct tape or spray cement seals so that seals do not support the weight of the plastic, if the tape/glue comes loose.

H. Provide pressure differential and air circulation system per Section 02 82 22.

I. Clean housings and ducts of all overspray materials prior to erection of an Critical Barrier that will restrict access.

3.7 PREPARE AREA

A. If fixed scaffolding is to be used to provide access HEPA vacuum and wet clean area prior to scaffolding installation.

B. Remove all electrical and mechanical items, such as lighting fixtures, clocks, diffusers, registers, escutcheon plates, etc. which cover any part of the surface to be worked on with the WORK.

C. Remove all general construction items such as cabinets, casework, door and window trim, moldings, ceilings, trim, etc., which cover the surface of the WORK as required to prevent interference with the WORK.

D. Clean, decontaminate and reinstall all such materials, upon completion of all removal work with materials, finishes, and workmanship to match existing installations before start of work.

E. Clean all contaminated furniture, equipment and or supplies with a HEPA filtered vacuum cleaner or by wet cleaning, as specified in Section 02 82 30 Cleaning and Decontamination Procedures, prior to being moved or covered.

F. All equipment furniture, etc. is to be deemed contaminated unless specifically declared as uncontaminated on the drawings or in writing by the ENVIRONMENTAL CONSULTANT.

G. Clean all surfaces in WORK AREA with a HEPA filtered vacuum or by wet wiping prior to the installation of primary barrier.

3.8 PRIMARY BARRIER

A. Protect building and other surfaces in the WORK AREA from damage from water and high humidity or from contamination from asbestos-containing debris, slurry or high airborne fiber levels by covering with a primary barrier as described below:

Cover shelving, clocks, light fixtures and other equipment with one (1) layer of 6 mil sheet plastic.

Cover fabric, paper, cork wall coverings or unpainted gypsum board with one layer of 6 mil sheet plastic.

Tape over any cracks that are larger than 1/16".

Tape over electrical outlets, switches, door locks, etc.

Cover wood paneling in WORK AREA with one layer of 6 mil sheet plastic.

Cover carpeting with three (3) layers of polyethylene sheeting at least 6 mil in thickness. Place corrugated cardboard sheets between the top and middle layers of polyethylene.

Cover windows with one (1) layer of 6 mil sheet plastic.

If requested by the ENVIRONMENTAL CONSULTANT, cover windows with one (1) layer of black 6 mil plastic.

B. Cover floor of WORK AREA with two (2) individual layers of clear polyethylene sheeting, each at least 6 mil in thickness, turned up walls at least 12 inches. Form a sharp right angle bend at junction of floor and wall so that there is no radius which could be stepped on causing the wall attachment to be pulled loose. Both spray-glue and duct tape all seams in floor covering. Locate seams in top layer six feet from, or at right angles, to, seams in bottom layer. Install sheeting so that top layer can be removed independently of bottom layer.

C. Cover carpeting with three (3) layers of polyethylene sheeting at least 6 mil in thickness. Place corrugated cardboard sheets between the top and middle layers of polyethylene.

D. Cover sheet plastic in areas where scaffolding is to be used with a single layer of 1/2" CDX plywood or 1/4" tempered hardboard. Wrap edges and corners of each sheet with duct tape. At completion of abatement work wrap plywood or hardboard with two (2) layers of 6 mil polyethylene and move to next WORK AREA or dispose of as an asbestos-contaminated waste material.

E. Cover all walls in WORK AREA including "Critical Barrier" sheet plastic barriers with one layer of polyethylene sheeting, at least 6 mil in thickness, mechanically supported and sealed with duct tape or spray-glue in the same manner as "Critical Barrier" sheet plastic barriers. Tape all joints including the joining with the floor covering with duct tape or as

otherwise indicated on the CONTRACT DOCUMENTS or in writing by the ENVIRONMENTAL CONSULTANT.

F. Cover walls, floor and ceiling of elevator with two (2) layers of 6 mil polyethylene. Arrange entry to WORK AREA so that elevator door is in positively pressurized space outside the clean room of the decontamination unit. At completion of WORK clean elevator as set forth in Section 02 82 29.

G. Do not cover stairs or ramps with unsecured sheet plastic. Where stairs or ramps are covered with plastic, provide 3/4" exterior grade plywood treads securely held in place, over plastic. Do not cover rungs or rails with any type of protective materials.

H. Remove and replace plastic sheeting which has been damaged by removal operations or where seal has failed allowing water to seep between layers. Remove affected sheeting and wipe down entire area. Install new sheet plastic only when area is completely dry.

3.9 ISOLATION AREA

Maintain isolation areas between the WORK AREA and adjacent building area:

In locations shown on the plans.

In unoccupied rooms located between WORK AREA and adjacent occupied portions of the building.

In locations where separation between WORK AREA and occupied portions of the building is formed by sheet plastic and/or temporary barriers.

Floor below WORK AREA.

Form isolation area by controlling access to the space in the same manner as a WORK AREA. Physically isolate the space from the WORK AREA and adjacent areas. Accomplish physical location by:

Installing critical barriers in unoccupied space.

Erecting a second Critical Barrier a minimum of 3'-0" away from WORK AREA.

3.10 STOP WORK

If the critical or primary barrier falls or is breached in any manner stop work immediately. Do not start work until authorized in writing by the ENVIRONMENTAL CONSULTANT.

3.11 EXTENSION OF WORK AREA

If the Critical Barrier is breached in any manner that could allow the passage of asbestos debris or airborne fibers, then add affected area to the WORK AREA, enclose it as required by this Section of the specification and decontaminate it as described in Section 02 82 29 Project Decontamination.

3.12 SECONDARY BARRIER

Secondary layer of plastic as a drop cloth to protect the primary layer from debris generated by the asbestos abatement work is specified in the appropriate work sections.

3.13 EXTERIOR ENCLOSURES

Construct exterior enclosures as necessary to completely enclose the WORK. Fabricate from reinforced polyethylene sheeting and 2" x 4" wood framework. Attach to existing building components or brace as necessary for lateral stability. Construct walls to meet all state and local regulations for construction of temporary buildings. Construct to resist a wind, slope ceiling to permit drainage of rain water. Exterior enclosures shall be completely separate from other required barriers or protective layers.

END OF SECTION

SECTION 02 82 24

REGULATED AREAS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparation of a Regulated Area for work.

1.2 DELETED

1.3 SUBMITTALS

A. HEPA Filtered Vacuum Cleaners: Submit product data.

B. Signs: Submit samples of each type of sign to be used.

C. Warning Tape: Submit samples.

PART 2 EQUIPMENT

2.1 HEPA FILTERED VACUUM CLEANERS

Subject to compliance with requirements, manufacturers offering products which may be incorporated in the WORK include, but are not limited to, the following:

Nilfisk of America Inc. 225 Great Valley Parkway Malvern, PA 19355	HEPA filtered Vacuums
Clayton Associates, Inc. P.O. Box 589 30 Southard Avenue Farmingdale, NJ 07727	ACE Model HEPA Vacuum
Hako Minuteman 111 South Route 53 Addison, IL 60101	Hako Minuteman HEPA Vacuums
Vactagon Pneumatic Systems, Inc. 18 Homestead Place Bergenfield, NJ 07621	Vaculoader HEPA Vacuum
Pullman-Hold (White) Corporation P.O. Box 277 Fultonville, NY 12072	HEPA Filtered Vacuums

2.2 PLASTIC SHEET

A. A single polyethylene film in the largest sheet size possible to minimize seams, 6.0 mil thick as indicated, clear, frosted, or black as indicated.

PART 3 EXECUTION

3.1 SECURING WORK AREA

Secure WORK AREA from access by occupants, staff or users of the building. Accomplish this where possible, by locking doors, windows, or other means of access to the area, or by constructing temporary wood stud and plywood barriers.

3.2 DEMARCATION OF REGULATED AREA

A. Demarcate each Regulated Area with a sheet plastic drop sheet as described below.

B. Post warning signs in both English and Spanish that carry the following legends:

C. First Sign

Provide warning signs at each locked door leading to the controlled area reading as follows:

Legend	Notation
KEEP OUT	3 inch Block

D. Second Sign

Immediately inside the locked door and outside the controlled area post an approximately 20 inch by 14 inch manufactured caution sign displaying the following legend with letter sizes and styles of a visibility required by 29 CFR 1926:

Legend:

DANGER

ASBESTOS

CANCER AND LUNG DISEASE HAZARD

RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

E. Where the controlled area is in a large area such as on part of a boiler room or open office area, delineate area with 3 inch wide polyethylene ribbon with the printed warning, "CAUTION ASBESTOS REMOVAL". Install this ribbon at between 3 and 4 feet above the floor.

3.3 SCHEDULING

A. Work may be carried out during normal working hours in those areas which can be completely secured by lockable doors from access by building occupants and staff, and which have HVAC equipment that can be shut down and locked off.

B. Otherwise, work is to be carried out after building occupants and cleaning staff have left.

3.4 GENERAL PROCEDURES

A. Setup and management of the controlled area is to be under the supervision of an OSHA Competent Person.

B. Before start of work comply with requirement for worker protection in Section 02 82 25, and respiratory protection in Section 02 82 27.

C. Do not allow eating, drinking, smoking, chewing tobacco or gum, or apply cosmetics in the Regulated Area.

D. Shut down any air handling equipment bringing air into or out of the Regulated Area.

E. Clean any existing dust or debris from the floor and walls, and other surface in the immediate location of the WORK prior to commencing work by damp-mopping or by use of a High Efficiency Particulate Air (HEPA) filtered vacuum.

F. Cover floor in vicinity of WORK AREA and six (6) feet beyond, with 6 mil polyethylene drop sheet. Where WORK is adjacent to wall, extend drop sheet up wall and secure at ceiling with duct tape. This drop sheet demarcates the boundary of the Regulated Area.

G. Seal all openings, supply and exhaust vents, and convectors within ten (10) feet of the WORK AREA with 6 mil polyethylene sheeting secured and completely sealed with duct tape.

H. Perform the WORK per the appropriate specification section while on plastic drop sheet.

I. Immediately remove any asbestos-containing debris which collects on the drop sheet either by using a HEPA vacuum or by spraying with amended water or removal encapsulant, collecting with wet paper towels, placing in a disposal bag while still wet, and cleaning surface of plastic sheet with wet paper towels.

J. Complete the following at completion of work in an area before stepping off drop sheet.

While standing on plastic sheet thoroughly HEPA vacuum ladder and any tools used and pass to worker standing off sheet.

Worker standing off the sheet HEPA vacuum thoroughly the worker standing on the sheet.

Worker on the sheet thoroughly HEPA vacuum all surfaces of the plastic sheet, bags, and any other items on the sheet including his own feet.

K. If moving to the next WORK AREA in the same secure area: Worker on the drop sheet is to don clean foot covers, placing each foot, in turn, off the sheet as the foot cover is put on. Remove clean foot covers at the next WORK AREA while standing on the sheet. Dispose of the used foot covers along with the plastic sheet at completion of work in that area. Do not reuse foot covers to move off the sheet.

L. If work day is complete or if next WORK AREA is in another secured area: all workers remove paper suits turning them inside out while doing so. The person on the sheet step with each foot off the sheet as the foot covers are removed.

M. Fold sheet and all its contents toward the center.

N. Place the sheet in a properly labeled disposal bag.

O. Neck down the bag and collapse it with the HEPA vacuum.

P. Twist the bag shut, bend over and seal with duct tape by wrapping around bag neck at least 3 times.

Q. Clean all surfaces of the WORK AREA by use of a HEPA filter vacuum until no visible residue remains.

R. At completion of work require all workers to complete wet decontamination procedures in accordance with Section 02 82 25 Workers Protection - Asbestos-Abatement.

END OF SECTION

SECTION 02 82 25

WORKER PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

This section describes the equipment and procedures required for protecting workers against asbestos contamination and other workplace hazards except for respiratory protection.

1.2 DELETED

1.3 WORKER TRAINING

A. Train all workers in accordance with 29 CFR 1926 in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and area protective measures.

B. AHERA accredited or equivalent Abatement Workers as required by the AHERA regulation 40 CFR 763 Appendix C to Subpart E, April, 30, 1987.

C. State and local certification as required by regulations.

1.4 MEDICAL EXAMINATIONS

A. Provide medical examinations for all workers who may encounter an airborne fiber level of 0.1 f/cc or greater for an 8 hour time weighted average.

B. In the absence of specific airborne filter data provide medical examination for all workers who will enter the WORK AREA for any reason.

C. Examination shall as a minimum meet OSHA requirements as set forth in 29 CFR 1926.

D. In addition, provide an evaluation of the individuals ability to work in environments capable of producing heat stress in the worker.

1.5 SUBMITTALS

A. Submit a course outline of the worker training course. Include date and time course was given, name and title of teacher, attendance sheet listing all attendees of the course.

B. Report from Medical Examination conducted within last 12 months as part of compliance with OSHA medical surveillance requirements for each worker who is to enter the WORK AREA.

C. Submit notarized certification signed by an officer of the abatement contracting firm and notarized that exposure measurements, medical surveillance, and worker training records are being kept in conformance with 29 CFR 1926.

PART 2 EQUIPMENT

2.1 PROTECTIVE CLOTHING

A. Provide disposable full-body coveralls and disposable head covers, and require that they be worn by all workers in the WORK AREA.

B. Provide work boots with non-skid soles, and where required by OSHA, foot protectives, for all workers. Dispose of boots as asbestos contaminated waste at the end of the work. Disposable foot covers may be provided in lieu of disposing of work shoes where permitted by site conditions.

C. Provide head protectives (hard hats) as required by OSHA for all workers, and provide spares for use by others. Label hats with same warning labels as used on disposal bags. Thoroughly clean, decontaminate and bag hats before removing them from WORK AREA at the end of the WORK.

D. Provide eye protectives (goggles) as required by OSHA for all workers involved in scraping, spraying, or any other activity which may potentially cause eye injury.

E. Provide work gloves to all workers and require that they be worn at all times in the WORK AREA. Do not remove gloves from WORK AREA. Dispose of as asbestos contaminated waste at the end of the WORK.

2.2 ADDITIONAL PROTECTIVE EQUIPMENT

A. Respirators, disposable coveralls, head covers, and footwear covers shall be provided by the CONTRACTOR for the OWNER, ENVIRONMENTAL CONSULTANT, and other authorized representatives who may inspect the job site.

B. Provide two (2) respirators, six (6) complete coveralls and, six (6) respirator filter changes per day.

PART 3 EXECUTION

3.1 GENERAL

A. Provide worker protection as required by the most stringent OSHA and/or EPA standards applicable to the WORK.

B. The following procedures are minimums to be adhered to regardless of fiber count in the WORK AREA.

C. Each time WORK AREA is entered remove all street clothes in the Changing Room of the Personnel Decontamination Unit and put on new disposable coverall, new head cover, and a clean respirator.

D. Proceed through shower room to equipment room and put on work boots.

3.2 DECONTAMINATION PROCEDURES

Require all workers to adhere to the following applicable personal decontamination procedures whenever they leave the WORK AREA as a minimum:

3.2.1 Type C Supplied Air or Powered Air-Purifying Respirators:

A. When exiting area, remove disposable coveralls, disposable head covers, and disposable footwear covers or boots in the equipment room, and dispose of as contaminated waste.

B. Still wearing respirators, proceed to showers. Showering is mandatory, unless noted otherwise.

C. Thoroughly wet body including hair and face. If using a Powered Air-Purifying Respirator (PAPR) hold blower unit above head to keep canisters dry.

D. With respirator still in place thoroughly wash body, hair, respirator face piece, and all parts of the respirator except the blower unit and battery pack on a PAPR.

E. Pay particular attention to seal between face and respirator and under straps.

F. Take a deep breath, hold it and/or exhale slowly, completely wet hair, face, and respirator. While still holding breath, remove respirator and hold it away from face before starting to breathe.

G. Carefully wash facepiece of respirator inside and out.

H. If using PAPR; shut down in the following sequence, first cap inlets to filter cartridges, then turn off blower unit. Thoroughly wash blower unit and hoses. Carefully wash battery pack with wet rag. Shower as above.

I. Rinse shower room walls and floor prior to exit.

J. Proceed from shower to Changing Room and change into street clothes or into new disposable work items.

3.2.2 Air Purifying-Negative Pressure Respirators:

A. When exiting area, remove disposable coveralls, disposable headcovers, and disposable footwear covers or boots in the equipment room, and dispose of as contaminated waste.

B. Still wearing respirators, proceed to showers. Showering is mandatory, unless noted otherwise.

C. Thoroughly wet body from neck down.

D. Wet hair as thoroughly as possible without wetting the respirator filter if using an air purifying type respirator.

E. Take a deep breath, hold it and/or exhale slowly, complete wetting of hair, thoroughly wetting face, respiratory and filter (air purifying respirator). While still holding breath, remove

respirator and hold it away from face before starting to breathe.

F. Dispose of wet filters from air purifying respirator.

G. Carefully wash facepiece of respirator inside and out. Shower completely with soap and water.

H. Rinse thoroughly.

I. Rinse shower room walls and floor prior to exit.

J. Proceed from shower to Changing Room and change into street clothes or into new disposable work items.

3.3 WITHIN WORK AREA

Require that workers NOT eat, drink, smoke, and chew gum or tobacco in the WORK AREA. To eat, chew, drink or smoke, workers shall following the procedure described above, then dress in street clothes before entering the non-work areas of the building.

END OF SECTION

CERTIFICATE OF WORKER'S ACKNOWLEDGEMENT

PROJECT NAME _____ DATE _____

PROJECT ADDRESS _____

CONTRACTOR'S NAME _____

WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCER. IF YOU SMOKE AND INHALE ASBESTOS FIBERS THE CHANCE THAT YOU WILL DEVELOP LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's CONTRACT with the OWNER for the above project requires that: You be supplied with the proper respirator and be trained in its use. You be trained in safe work practices and in the use of the equipment found on the job. You receive a medical examination. These things are to have been done at no cost to you. By signing this certification you are assuring the OWNER that your employer has met these obligations to you.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators, and informed of the type respirator to be used on the above referenced project. I have a copy of the written respiratory protection manual issued by my employer. I have been equipped at no cost with the respirator to be used on the above project.

TRAINING COURSE: I have been trained in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and area protective measures. The topics covered in the course included the following:

Physical characteristics of asbestos
Health hazards associated with asbestos
Respiratory protection
Use of protective equipment
Negative air systems
Work practices including hands on or on-job training
Personal decontamination procedures
Air monitoring, personal and area

MEDICAL EXAMINATION: I have had a medical examination within the past 12 months which was paid for by my employer. This examination included: health history, pulmonary function tests and may have included an evaluation of a chest x-ray.

Signature _____

Printed Name _____

Social Security Number _____

Witness _____

SECTION 02 82 26

WORKER PROTECTION - REPAIR AND MAINTENANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Equipment and procedures for protecting workers against asbestos contamination and other workplace hazards.

B. This section applies only where the airborne fiber counts as measured in accordance with 29 CFR 1926 are below 0.1 fibers per cubic centimeter for an 8 hour Time Weighted Average (TWA).

1.2 DELETED

1.3 WORKER TRAINING

A. Workers are to be accredited as Abatement Workers as required by the AHERA regulation 40 CFR 763 Appendix C to Subpart E, April 30, 1987 or equivalent.

B. Workers are to be trained, certified and accredited as required by state or local code or regulation.

C. Workers are to be trained in accordance with 29 CFR 1926 in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and area protective measures.

D. Workers are to be trained in the purpose, proper use, fitting, instructions, and limitations of respirators as required by 29 CFR 1910.134.

1.4 MEDICAL EXAMINATIONS

A. Provide medical examinations for all workers who may encounter an airborne fiber level of 0.1 f/cc or greater for an 8 hour Time Weighted Average.

B. In the absence of specific airborne fiber data provide medical examination for all workers who will enter the WORK AREA for any reason.

C. Examination shall as a minimum meet OSHA requirements as set forth in 29 CFR 1926.

D. In addition, provide an evaluation of the individuals ability to work in environments capable of producing heat stress in the worker.

1.5 SUBMITTALS

A. Copies of certificates from an EPA-approved AHERA Abatement Workers Course for each worker as evidence that each asbestos abatement worker is accredited as required by the AHERA Regulation 40 CFR 763 Appendix C to Subpart E, April 30, 1987.

B. Evidence that all workers have been trained, certified and accredited as required by state or local code or regulation.

C. Airborne asbestos fiber count data from an independent air monitoring firm to verify that work procedures will result in an airborne fiber level as measured in accordance with 29 CFR 1926 below 0.1 fibers per cubic centimeter as an 8 hour Time Weighted Average (TWA).

D. A course outline of the worker training course. Include date and time course was given, name and title of teacher, attendance sheet listing all attendees of the course.

E. Report from Medical Examination conducted within last 12 months as part of compliance with OSHA medical surveillance requirements for each worker who is to enter the WORK AREA.

F. Certification signed by an officer of the abatement contracting firm and notarized that exposure measurements, medical surveillance, and worker training records are being kept in conformance with 29 CFR 1926.

PART 2 EQUIPMENT

2.1 PROTECTIVE CLOTHING

A. Disposable full-body coveralls and disposable head covers, and required that they be worn by all workers in the WORK AREA.

B. Insulated jacket, pants, gloves, and hat. Require that cold weather gear be removed in Equipment Room of Personnel Decontamination Unit. Dispose of cold weather gear as asbestos waste at completion of all work.

C. Disposable latex boot covers with non-skid soles, and where required, OSHA approved foot protectives, for all workers. Boot covers shall not be worn out of the WORK AREA or off the sheet plastic drop layer for any reason. Boot covers may be decontaminated, bagged and carried from one WORK AREA to another.

D. Head protectives (hard hats) as required by OSHA for all workers. Label hats with same warning labels as used on disposal bags. Require hard hats to be worn at all times that work is in progress that may potentially cause head injury.

E. Eye protectives (goggles) as required by OSHA for all workers involved in scraping, spraying, or any other activity which may potentially cause eye injury.

F. Work gloves to all workers and require that they be worn at all times in the WORK AREA.

PART 3 EXECUTION

3.1 GENERAL

A. Work and Decontamination procedures involve a minimum of one person in the WORK AREA on the plastic sheet and one off the sheet.

B. The person on the sheet carries out the WORK and never leaves the sheet until the WORK is complete and dry decontamination procedures are completed.

C. The person off the sheet supplies materials to and accepts material from the on-sheet person.

D. Off sheet person never enters the WORK AREA.

E. Do not eat, drink, smoke, chew gum or tobacco, or apply cosmetics in the WORK AREA. To eat, drink, chew, or smoke, workers shall follow the procedures described below and leave the WORK AREA.

F. Provide worker protection as required by the most stringent OSHA and/or EPA standards applicable to the WORK.

3.2 AIR MONITORING

A. Collect a personal air sample on the on-sheet person at 2 liters per minute for the entire time that work is being carried out.

B. Collect one area sample of 1,200 liters in each secure area at completion of the work at a pumping rate of 10-12 liters per minute.

Transmit samples to testing laboratory for analysis.

3.3 RESPIRATORS

A. Instruct and train each worker in proper respirator use and require that each worker always wear a respirator, properly fitted on the face, in the WORK AREA.

3.4 COVERALLS

A. Put on new disposable coveralls, new head covers, new footwear covers over street clothes, and put on a clean respirator.

B. Wear disposable, full-body coveralls and disposable head and footwear covers in the WORK AREA.

C. Follow procedures under "Dry Decontamination" whenever leaving a WORK AREA.

3.5 ADDITIONAL PROTECTIVE EQUIPMENT

A. At the work site maintain 2 complete sets of protective equipment including respirators, disposable coveralls, head covers, and footwear covers for use by the ENVIRONMENTAL CONSULTANT or the OWNER.

3.6 DECONTAMINATION PROCEDURES

A. Each person HEPA vacuum thoroughly the other person. Use brush attachment on the HEPA vacuum.

B. While still wearing respirator each person remove their paper suit, turning it inside out while removing it. Roll up suit and pack in hood.

C. Place suits in a disposal bag.

D. Evacuate air from the bag with HEPA vacuum.

E. Twist the bag shut, bend over and seal with duct tape by wrapping around bag neck at least 3 times.

F. Each person HEPA vacuum area of respirator seal to face on the other person.

G. Remove respirator and, HEPA vacuum face at respirator seal and all surfaces of the respirator. HEPA vacuum any parts of hair or head covered by respiratory straps.

H. If using PAPR: shut down in the following sequence, first cap inlets to filter cartridges, then turn off blower unit (this sequence will help keep debris which has collected on the inlet side of filter from dislodging and contaminating the outside of the unit). Thoroughly wash blower unit and hoses. Carefully wash battery pack with wet rag. Be extremely cautious of getting water in battery pack as this will short out and destroy battery.

I. Wash respirator facepiece inside and outside.

J. At completion of above, thoroughly wash face and hands with soap and water.

END OF SECTION

SECTION 02 82 27

RESPIRATORY PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Use respiratory protection appropriate for the fiber level encountered in the work place or as required for other toxic or oxygen-deficient situations encountered.

1.2 STANDARDS

A. Where there is a conflict in requirements set forth in these regulations and standards, meet the more stringent requirement.

B. OSHA - U.S. Department of Labor Occupational Safety and Health Administration, Safety and Health Standards 29 CFR 1910, Section 1001 and Section 1910.134. 29 CFR 1926.

C. CGA - Compressed Gas Association, Inc., New York, Pamphlet G-7, "Compressed Air for Human Respiration", and Specification G-7.1 "Commodity Specification for Air".

D. CSA - Canadian Standard Association, Rexdal, Ontario, Standard Z180.1-1978, "Compressed Breathing Air".

E. ANSI - American National Standard Practices for Respiratory Protection, ANSI Z88.2-1980.

F. NIOSH - National Institute for Occupational Safety and Health

G. MSHA - Mine Safety and Health Administration

1.3 SUBMITTALS

A. Manufacturer's product information for each component used, including NIOSH and MSHA Certifications for each component in an assembly and/or for entire assembly.

B. When a Type "C" supplied air respiratory system is required by the work, submit drawing showing assembly of components into a complete supplied air respiratory system. Include diagram showing location of compressor, filter banks, backup air supply tanks, hose line connections in work area(s), routing of air lines to work area(s) from compressor.

C. Level of respiratory protection intended for each operation required by the project.

D. Airborne asbestos fiber count data from an independent air monitoring firm to substantiate selection of respiratory protection proposed.

1.4 AIR QUALITY FOR SUPPLIED AIR RESPIRATORY SYSTEMS

Provide air used for breathing in Type "C" supplied air respiratory systems that meets or exceeds standards set for C.G.A. type 1 (Gaseous Air) Grade D.

PART 2 EQUIPMENT

2.1 AIR PURIFYING RESPIRATORS

A. Half face or full face type respirators.

B. Equip full face respirators with a nose cup or other anti-fogging device.

C. HEPA type filters labeled with NIOSH and MSHA Certification for "Radionuclides, Radon Daughters, Dust, Fumes, Mists including Asbestos-Containing Dusts and Mists" and color coded in accordance with ANSI Z228.2 (1980).

D. A chemical cartridge section may be added, if required, for solvents, etc., in use. In this case, provide cartridges that have each section of the combination canister labeled with the appropriate color code and NIOSH/MSHA Certification.

2.2 SUPPLIED AIR RESPIRATOR SYSTEMS

A. Provide equipment capable of producing air of the quality and volume required by the above reference standards applied to the job site conditions and crew size.

B. Full face piece and hose by same manufacturer that has been certified by NIOSH/MSHA as an approved Type "C" respirator assembly operating in pressure demand mode with a positive pressure.

C. In atmospheres which contain sufficient oxygen (greater than or equal to 19.5% oxygen) provide a pressure- demand full face piece supplied air respirator equipped with an emergency back up HEPA filter.

D. In atmospheres which are oxygen deficient (less than 19.5% oxygen) provide a pressure-demand full face piece supplied air respirator incorporating an auxiliary self-contained breathing apparatus (SCBA) which automatically maintains an uninterrupted air supply in pressure demand mode with a positive pressure face piece.

E. Provide a reservoir of compressed air located outside the work area which will automatically maintain a continuous uninterruptable source of air automatically available to each connected face piece and hose assembly in the event of compressor shutdown, contamination of air delivered by compressor, power loss or other failure. Provide sufficient capacity in the back-up air supply to allow a minimum escape time of one-half hour times the number of connections available to the WORK AREA.

F. Provide a warning device that will operate independently of the building's power supply. Locate so that alarm is clearly audible above the noise level produced by equipment and work procedures in use, in all parts of the work area and at the compressor. Connect alarm to warn of:

Compressor shut down or other fault requiring use of backup air supply,

Carbon Monoxide (CO) levels in excess of 5 PPM/V.

G. Interconnect monitors, alarms and compressor so that compressor is automatically shut down and the alarms sounded if any of the following occur:

Carbon Monoxide (CO) concentrations exceed 5 PPM/v in the air line between the filter bank and backup air supply.

Compressor temperature exceeds normal operating range.

H. Provide a compressor driven by an electric motor. Ensure that electrical supply available at the work site is adequate to energize motor.

I. Locate compressor outside of building in location that will not impede access to the building, and that will not cause a nuisance by virtue of noise or fumes to occupied portions of the building.

J. Locate air intake remotely from any source of automobile exhaust or any exhaust from motors, or buildings.

K. Provide an aftercooler at entry to filter system which is capable of reducing temperatures to outside ambient air temperatures.

L. Configure system to permit the recharging of 1/2 hour 2260 PSI SCBA cylinders.

PART 3 EXECUTION

3.1 GENERAL

A. Comply with ANSI Z88.2 - 1980 "Practices for Respiratory Protection" and OSHA 29 CFR 1910 and 1926.

B. Require that respiratory protection be used at all times that there is any possibility of disturbance of asbestos-containing materials whether intentional or accidental.

C. Require that a respirator be worn by anyone in a work area at all times, regardless of activity.

3.2 FIT TESTING

A. Provide initial fitting of respiratory protection during a respiratory protection course of training set up and administered by a Certified Industrial Hygienist.

B. Fit types of respirator to be actually worn by each individual.

C. Allow an individual to use only those respirators for which he has been trained and fitted.

D. On a Weekly Basis, check the fit of each worker's respirator by having irritant smoke blown onto the respirator from a smoke tube.

E. Each time an air-purifying respirator is put on, it must be checked for fit with a positive and negative pressure fit test in accordance with the manufacturer's instructions or ANSI Z88.2 (1980).

F. All fit testing shall be done in accordance with Appendix C of 29 CFR 1926.58.

3.3 TYPE OF RESPIRATORY PROTECTION REQUIRED

A. Respiratory protection which supplies an airborne fiber level inside the respirator, at the breathing zone of the wearer, at or below the permissible exposure limit (PEL) is the minimum level of protection allowed.

3.4 PERMISSIBLE EXPOSURE LIMIT (PEL)

A. 8-Hour Time Weighted Average (TWA) of asbestos fibers to which any worker may be exposed shall not exceed 0.10 fibers/cubic centimeters.

B. Fibers are defined as all fibers regardless of composition as counted in the NIOSH 7400 procedure, or asbestos fibers of any size as counted using either a scanning or transmission electron microscope.

3.5 RESPIRATORY PROTECTION FACTORS

Assigned Protection Factors (29 CFR 1910.134 (d)(3)(i)(A) - Effective 11-22-06)

Type of Respirator *, **	Quarter Mask	Half Mask	Full Facepiece	Helmet / Hood	Loose-fitting facepiece
1. Air-Purifying Respirator	5	10 ***	50	-	-
2. Powered Air-Purifying Respirator (PAPR)	-	50	1000	25 / 1000 ****	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
- Demand Mode	-	10	50	-	-
- Continuous Flow Mode	-	50	1000	25 / 1000 ****	25
- Pressure Demand or Positive Pressure	-	50	1000	-	-
4. Self-Contained Breathing Apparatus (SCBA)					
- Demand Mode	-	10	50	50	-
- Pressure Demand or Positive Pressure mode	-	-	10000	10000	-

NOTES:

* Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

** The assigned protection factors in this table are only effective when the employer implements a continuing, effective Respirator program as required by 29 CFR 1910.134, including training, fit testing, maintenance, and use requirements.

*** This APF category includes filtering face-pieces, and half-masks with elastomeric face-pieces.

**** The employer must have evidence provided by the respirator manufacturer that the testing of these respirators demonstrates performance at a level of protection of 1000 or greater to receive an APF of 1000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Without such testing, all other PAPRs and SARs with helmets or hoods are to be treated as loose fitting face-piece respirators, and do not receive an APF of 25.

3.6 NEGATIVE PRESSURE RESPIRATORS - half or full face mask:

A. Supply a sufficient quantity of respirator filters approved for asbestos, so that workers can change filters during the work day.

B. Require that respirators be wet-rinsed, and filters discarded, each time a worker leaves the WORK AREA.

C. Store respirators and filters at the job site in the changing room and protect totally from exposure to asbestos prior to their use.

3.7 POWERED AIR PURIFYING - half or full face mask:

A. Supply a sufficient quantity of high efficiency respirator filters approved for asbestos so that workers can change filters at any time that flow through the face piece decreases to the level at which the manufacturer recommends filter replacement.

B. Require that HEPA elements in filter cartridges be protected from wetting during showering.

C. Require entire exterior housing of respirator including blower unit, filter cartridges, hoses, battery pack, face mask, belt, and cords to be washed each time a worker leaves the WORK AREA.

D. Caution should be used to avoid shorting battery pack during washing. Provide an extra battery pack for each respirator so that one can be charging while one is in use.

3.8 TYPE "C" RESPIRATOR

A. Continuously monitor the air system operation including compressor operation, filter system operation, backup air capacity and all warning and monitoring devices at all times that system is in operation.

B. Assign an individual trained, by manufacturer of the equipment in use or by a Certified Industrial Hygienist, in the operation and maintenance of the system to provide this monitoring.

3.9 RESPIRATORY PROTECTION PROGRAM

A. Submit a Respiratory Protection Program, indicating type of respiratory protection proposed for each portion of the WORK.

END OF SECTION

SECTION 02 82 28

DECONTAMINATION UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Personnel and equipment decontamination facilities.

B. Personnel Decontamination Unit is the only means of ingress and egress for the work area.

C. Materials exit the work area through the Equipment Decontamination Unit.

1.2 DELETED

PART 2 PRODUCTS

2.1 PLASTIC SHEET AND ACCESSORIES

A. Polyethylene Sheet: A single polyethylene film in the largest sheet size possible to minimize seams, 6.0 mils thick, as indicated, clear, frosted, or black as indicated.

B. Where plastic sheet is the only separation between the work area and building exterior, provide translucent, nylon reinforced, laminated, flame resistant, polyethylene sheeting that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films. Provide largest size possible to minimize seams, 6.0 mils thick as indicated, clear, frosted or black as indicated.

C. Duct tape in 2" or 3" widths as indicated, with an adhesive which is formulated to stick tenaciously to sheet polyethylene.

D. Spray adhesive which is specifically formulated to stick tenaciously to sheet polyethylene.

2.2 SHOWER

A. One piece waterproof shower pan, with rigid, impervious, waterproof walls. Structurally support as necessary for stability.

B. Factory made shower head producing a spray of water which can be adjusted for spray size and intensity. Arrange so that control of water temperature, flow rate, and shut off is from inside shower.

C. Cascaded filter units on drain lines from showers with disposable filter elements as indicated below.

Primary Filter - Pass particles 20 microns and smaller

Secondary Filter - Pass particles 5 microns and smaller

D. Heavy bronze angle type hose bib with wheel handle, vacuum breaker, and 3/4" National Standard male hose outlet.

2.3 SUMP PUMP

Provide totally submersible waterproof sump pump with integral float switch and proper size for application. Provide unit capable of pumping debris, sand, plaster or other materials washed off during decontamination procedures without damage to mechanism of pump.

PART 3 EXECUTION

3.1 PERSONNEL DECONTAMINATION UNIT

A. A serial arrangement of connected rooms or spaces, Changing Room, Drying Room, Shower Room, Equipment Room, that all persons pass through for entry into and exiting from the work area for any purpose.

B. Provide temporary lighting within decontamination units as necessary to reach a lighting level of 100 foot candles.

3.2 CHANGING ROOM

A. Physically and visually separated from the rest of the building for the purpose of changing into protective clothing.

B. Construct using polyethylene sheeting, at least 6 mil in thickness, to provide an airtight seal between the Changing Room and the rest of the building.

C. Locate so that access to WORK AREA from Changing Room is through Shower Room.

D. Separate Changing Room from the building by a two sheet polyethylene flapped doorway.

E. Do not allow asbestos contaminated items to enter this room. Require workers to enter this room either from outside the area dressed in street clothes, or naked from the showers.

F. An existing room may be utilized as the Changing Room if it is suitably located and approved by ENVIRONMENTAL CONSULTANT. Protect all surfaces of room with sheet plastic as set forth in Section 02 82 23 Temporary Enclosures.

G. Maintain changing room dry and clean at all times. Do not allow overflow water from shower to wet floor in changing room.

H. Damp wipe all surfaces twice after each shift change with a disinfectant solution.

I. Provide a continuously adequate supply of disposable bath towels.

J. Provide posted information for all emergency phone numbers and procedures.

K. Provide 1 storage locker per employee.

3.3 DRYING ROOM

A. A place for workers to dry after showering.

B. Arrange so floor drains to shower room.

C. Separate from the rest of the building with airtight walls of 6 mil polyethylene sheeting.

D. Separate from change room with a sheet plastic flapped doorway.

3.4 SHOWER ROOM

A. A completely water tight operational shower to be used for transit by cleanly dressed workers heading for the WORK AREA from the Changing Room, or for showering by workers headed out of the WORK AREA after undressing in the Equipment Room.

B. Separate this room from the rest of the building with air tight walls fabricated of 6 mil polyethylene sheeting.

C. Separate this room from the Changing and Equipment Rooms with air tight walls fabricated of 6 mil polyethylene sheeting.

D. Provide splashproof entrances to Changing and Equipment Rooms with 2 doors.

E. Arrange so that water from showering does not splash into the Changing or Equipment Rooms.

F. Arrange water shut off and drain pump operation controls so that a single individual can shower without assistance.

G. Pump waste water to drain and provide 20 micron and 5 micron waste water filters in line to drain. Change filters daily or more often if necessary.

H. If CONTRACTOR elects to filter shower water and discharge filtered shower water into the sanitary sewer system, CONTRACTOR is responsible for obtaining a permit form the local sewer authority prior to commencing work.

3.5 EQUIPMENT ROOM

A. Work equipment, footwear and additional contaminated work clothing to be left here. This is a change and transit area for workers.

B. Separate this room from the WORK AREA by a 6 mil polyethylene flap doorway.

C. Separate this room from the rest of the building with air tight walls fabricated of two separate layers of 6 mil polyethylene.

D. Separate this room from the Shower Room with airtight walls fabricated of two separate layers of 6 mil polyethylene.

3.6 WORK AREA

A. Separate WORK AREA from the Equipment Room by polyethylene sheeting barriers.

B. If the airborne asbestos level in the WORK AREA is expected to be high, add an intermediate cleaning space between the Equipment room and the WORK AREA.

C. Damp wipe clean all surfaces after each shift change.

D. Repair and replace damaged floor sections as required.

3.7 CONSTRUCTION OF DECONTAMINATION UNIT

A. Construct air tight walls and ceiling using polyethylene sheeting, at least 6 mil in thickness. Attach to existing building components or a temporary framework.

B. Use 2 layers (minimum) of 6 mil, polyethylene sheeting to cover floors in the Equipment, Shower (underneath shower pan), and Changing Rooms.

C. Provide an additional layer in the Equipment Room for every shift change expected.

D. Roll one (1) layer of plastic from Equipment Room into WORK AREA after each shift change. Provide a minimum of two (2) layers of plastic at all times. Use only clear plastic to cover floors.

E. Fabricate doors from overlapping sheets with openings a minimum of three feet (3') wide. Configure so that sheeting overlaps adjacent surfaces. Weight sheets at bottoms as required so that they quickly close after being released. Put arrows on sheets to indicate direction of overlap and/or travel.

F. If the decontamination area is located within an area containing friable asbestos on overhead ceilings, ducts, piping, etc., provide the area with a minimum 1/2 inch plywood "ceiling" with polyethylene sheeting, at least 6 mil in thickness covering the top of the "ceiling".

G. Visual barriers of opaque polyethylene sheeting at least 6 mil in thickness so that work privacy is maintained and work procedures are not visible to building occupants.

H. Where the area adjacent to the decontamination area is accessible to the public, construct a solid barrier on the public side of the sheeting to protect the sheeting. Construct barrier with wood or metal studs covered with minimum 1/2 inch plywood. Where the solid barrier is provided, sheeting need not be opaque.

I. Provide subpanel at Changing Room to accommodate all removal equipment. Power subpanel directly from a building electrical panel. Connect all electrical branch circuits in decontamination unit and particularly any pumps in shower room to a ground-fault circuit protection device.

3.8 DECONTAMINATION SEQUENCE

A. Before leaving the WORK AREA, remove all gross contamination and debris from overalls and feet.

B. The worker than proceeds to the Equipment Room and removes all clothing except respiratory protection equipment.

C. Extra work clothing may be stored in contaminated end of the Equipment Room. Disposable coveralls are placed in a bag for disposal with other material.

D. Decontamination procedures found in Section 02 82 25 shall be followed by all individuals leaving the WORK AREA.

E. After showering, the worker moves to the Changing Room and dresses in either new coveralls for another entry or street clothes if leaving.

3.9 EQUIPMENT DECONTAMINATION UNITS

A. A serial arrangement of rooms, Clean Room, Holding Room, Wash Room constructed with 6 mil polyethylene sheeting, supported as necessary for removal of equipment and material from WORK AREA, not personnel.

B. Provide an enclosed shower unit located in WORK AREA just outside Wash Room as an equipment, bag and container cleaning station.

C. Provide Wash Room for cleaning of bagged or containerized asbestos-containing waste materials passed from the WORK AREA after being wiped clean can be passed to the Holding Room. Separate this room from the work area by a single flap of 6 mil polyethylene sheeting.

D. Provide Holding Room as a drop location for bagged asbestos-containing materials passed from the Wash Room located so that bagged materials cannot be passed from the Wash Room through the Holding Room to the Clean Room. Separate this room from the adjacent rooms by double flaps fabricated from 6 mil polyethylene.

E. Provide Clean Room to isolate the Holding Room from the building exterior. Separate this room from the exterior by a single flap of 6 mil polyethylene sheeting.

3.10 EQUIPMENT DECONTAMINATION SEQUENCE

A. At washdown station, thoroughly wet-clean contaminated equipment or sealed polyethylene bags and pass into Wash Room.

B. When passing equipment or containers into the Wash Room, close all doorways of the Equipment Decontamination Unit, other than the doorway between the Washdown Station and the Wash Room.

C. Wet-clean the bags and/or equipment.

D. Pass items into Holding Room. Close all doorways except the doorway between the Holding Room and the Clean Room.

E. Workers from the building exterior enter Holding Area and remove decontaminated equipment and/or containers for disposal.

F. Require these workers to wear full protective clothing and appropriate respiratory protection.

G. At no time is a worker from an uncontaminated area to enter the enclosure when a removal worker is inside.

3.11 CLEANING OF DECONTAMINATION UNITS

A. Clean debris and residue from inside of Decontamination Units on a daily basis.

B. Damp wipe or hose down all surfaces after each shift change.

C. If the Changing Room of the Personnel Decontamination Unit becomes contaminated with asbestos-containing debris, abandon the entire decontamination unit and erect a new decontamination unit. Use the former Changing Room as an inner section of the new Equipment Room.

3.12 SIGNS

A. Post an approximately 20 inch by 14 inch manufactured caution sign at each entrance to the WORK AREA as required by 29 CFR 1926.

B. Post an approximately 10 inch by 14 inch manufactured sign at each entrance to each WORK AREA displaying the following legend:

LEGEND

No Food, Beverages or Tobacco Permitted

All Persons Shall Don Protective
Clothing (Coverings) Before
Entering the WORK AREA

All Persons Shall Shower Immediately
After Leaving WORK AREA and Before
Entering the Changing Area

END OF SECTION

SECTION 02 82 29

PROJECT DECONTAMINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of the primary barrier plastic prior to its removal.

B. Cleaning of the room surfaces to remove any new or existing contamination.

C. Operation of the pressure differential and air circulation system is used to remove airborne fibers.

1.2 DELETED

1.3 SUBMITTALS

A. Evidence of suitability and compatibility of encapsulants with proposed finish materials.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

A. WORK of this section includes the decontamination of air in the WORK AREA which has been, or may have been contaminated by the elevated airborne asbestos fiber levels generated during abatement activities.

B. Cleaning, decontamination, and removal of temporary facilities installed prior to abatement work.

C. Cleaning, and decontamination of all surfaces (ceiling, walls, floor) of the WORK AREA, and all furniture or equipment in the WORK AREA.

3.2 PRIMARY BARRIER CLEANING

A. Carry out a first cleaning of all surfaces of the WORK AREA including items of remaining sheeting, tools, scaffolding and/or staging by use of damp-cleaning and mopping, and a High Efficiency Particulate Air (HEPA) filtered vacuum. (Note: A HEPA vacuum will fail if used with wet material.)

B. Do not perform dry dusting or dry sweeping.

C. Use each surface of a cleaning cloth one time only and then dispose of as contaminated waste.

D. Continue this cleaning until there is no visible debris from removed materials or residue on plastic sheeting or other surfaces.

E. Remove all Filters in Airhandling System(s) and dispose of as asbestos containing waste in accordance with requirements of Section 02 82 33.

F. Wait 24 hours to allow the HEPA filtered fan units to clean air and remove airborne asbestos fibers. Use oscillating fans as necessary to assure circulation of air in all parts of WORK AREAS during this period.

G. Maintain pressure differential and air circulation system in operation until WORK AREA passes air clearance testing.

H. Have ENVIRONMENTAL CONSULTANT visually inspect the WORK AREA to review initial cleaning efforts.

I. As soon as the work area passes ENVIRONMENTAL CONSULTANT'S inspection, spray the primary barriers with encapsulant and remove all primary barrier sheeting, leaving only the critical barriers, decontamination units and pressure differential and air circulation system.

3.3 FINAL CLEANING

A. Carry out a final cleaning of all surfaces in the WORK AREA in the same manner as the first cleaning immediately after removal of primary barrier. This cleaning is being applied to existing room surfaces and critical barriers.

B. At the completion of cleaning of all surfaces except carpeting, HEPA vacuum carpeting designated to remain in WORK AREAS. Use a passive (non power brush type) floor attachment with rubber floor seals and adjustable above-floor height.

C. Completely clean carpeting in one direction with each pass of the floor attachment overlapping the previous pass by one-half the attachment width. At the completion of one such cleaning, vacuum clean in the same manner in a direction at right angles to the initial cleaning.

D. Wait 24 hours to allow HEPA filtered fan units to clean air and remove airborne asbestos fibers. Use oscillating fans as necessary to assure circulation of air in all parts of work areas during this period. Maintain pressure differential and air circulation system in operation until work area passes air clearance testing.

3.4 VISUAL INSPECTION

A. After 24 Hours the ENVIRONMENTAL CONSULTANT will perform a complete visual inspection of the entire WORK AREA including: decontamination unit, all plastic sheeting, seals over ventilation openings, doorways, windows, and other openings; look for debris from any sources, residue on surfaces, dust or other matter.

B. If any such debris, residue, dust or other matter is found repeat final cleaning and continue decontamination procedure from that point.

3.5 FINAL AIR SAMPLING

A. After the WORK AREA is found to be visually clean by ENVIRONMENTAL CONSULTANT, air samples will be taken and analyzed in accordance with the procedure for Phase Contrast Microscopy (PCM) set forth in Section 02 82 21.

B. If Release Criteria are not met, repeat Final Cleaning and continue decontamination procedure from that point.

C. If Release Criteria are met, proceed with completion of the WORK.

3.6 COMPLETION OF ABATEMENT WORK

A. Shutdown and remove the Pressure Differential and Air Circulation System. Seal HEPA filtered fan units with 6 mil polyethylene sheet and duct tape to form a tight seal at intake end before being moved from WORK AREA.

B. Remove all critical barriers and critical barrier sheeting.

C. Remove decontamination units.

D. Remove all equipment, materials, debris from the work site.

E. Dispose of all asbestos containing waste material as specified in Section 02 82 33 and provide receipts and chain of custody forms documenting proper disposal.

F. Reinspect all surfaces and finishes and reclean as needed to remove all signs of stains, water marks, duct tape residue, smudges, smears and other visible marks. All interior finishes and surfaces shall be left in a condition suitable for application of wax or polish by the OWNER. Glass surfaces shall be left sparkling clean.

G. Repair or replace all interior finishes damaged during the course of asbestos abatement work.

H. Fulfill Project Closeout Requirements of Section 02 82 20.

END OF SECTION

SECTION 02 82 30

CLEANING AND DECONTAMINATION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning and decontamination of areas specified.

B. Removal and disposal of visible debris.

C. Decontamination of carpeting in the area of the debris and in a 3 foot radius beyond any visible debris.

D. Removal, cleaning and reshelving of books within the above area.

1.2 DELETED

PART 2 PRODUCTS

(NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

A. Complete the following before start of work of this section:

01527 Regulated Areas

01561 Worker Protection - Repair and Maintenance

01562 Respiratory Protection

3.2 WET CLEANING

A. Accomplish wet cleaning during decontamination with paper towels or disposable rags and amended water. Wipe surface once and refold to a fresh face of cloth until all available faces have been used then dispose of paper towel or rag.

3.3 REMOVAL OF ASBESTOS-CONTAINING DEBRIS

A. Cleanup of amassed debris which has fallen from an architectural finish, fireproofing, or thermal insulation on pipes, boilers and other thermal equipment.

B. Shut down all ventilation into room.

C. Seal entry to WORK AREA with 6 mil polyethylene. Slit polyethylene for entry. Install a flap to cover the slit automatically; tape slit closed after entry.

D. Start HEPA vacuum before entering the area. Use the HEPA vacuum to clean a path at least 6 feet wide from the entry point of the WORK AREA to the site of the fallen material. Remove all small debris with the HEPA vacuum.

E. HEPA vacuum surfaces for all pieces too large to be removed by the suction of the HEPA vacuum, pick up such pieces, wet with amended water and place in the bottom of a 6 mil polyethylene disposal bag conforming to the requirements of Section 02 82 33.

F. Remove all remaining visible debris with HEPA vacuum. HEPA vacuum an area 3 feet beyond the location in which any visible debris was found.

G. Place a 6 mil polyethylene drop cloth in accordance with Section 02 82 24, Regulated Area, immediately on top of the HEPA vacuumed area before performing any repair work on site from which fallout occurred.

H. HEPA vacuum the site from which material fell removing all loose material which can be removed by the vacuum's suction.

I. Repair or remove remaining material.

J. HEPA vacuum ladder and/or any tools used and pass out of the WORK AREA.

K. HEPA vacuum all surfaces in the room starting at the top of wall and working downward to the floor. Then start at corner of floor farthest from WORK AREA entrance and work towards entrance.

L. HEPA vacuum the floor using a floor attachment with rubber floor seals and adjustable floor to attachment height. Adjust the height so that the rubber seals just touch the floor if carpeted and are within 1/16" of hard surface floors. Vacuum the floor in parallel passes with each pass overlapping the previous by one-half the width of the floor attachment. At the completion of one cleaning vacuum the floor a second time at right angles to the first.

M. Secure area from occupancy until air monitoring results per Section 02 82 21 WORK AREA Clearance indicate that area has met the requirements for reoccupancy.

3.4 CLEANING AND DECONTAMINATING OBJECTS

A. Perform all work of decontaminating objects wherever possible on a plastic drop sheet installed in conformance with Section 02 82 24.

B. HEPA vacuum all surfaces of object and immediate area before moving the object. Pick-up object, if possible, and HEPA vacuum all surfaces.

C. Hand to off-sheet worker who will wet-clean object, if possible, and place in storage location.

D. Decontaminate area where object was located by HEPA vacuuming twice, in perpendicular directions. Wet clean if necessary to remove any debris.

E. Return object to its original location.

3.5 DECONTAMINATION OF ROOMS

A. Shut down all ventilation into space.

B. Seal entry to WORK AREA with 6 mil polyethylene. Slit polyethylene for entry. Install a flap to cover the slit automatically; tape slit closed after entry.

C. Install Differential Pressure and Air Circulation System in accordance with Section 02 82 22.

D. HEPA vacuum all surfaces in the room starting at the ceiling, then top of wall and working downward to the floor.

E. HEPA vacuum the floor using a floor attachment with rubber floor seals and adjustable floor to attachment height. Adjust the height so that the rubber seals just touch the floor if carpeted and are within 1/16" of hard surface floors. Vacuum the floor in parallel passes with each pass overlapping the previous one by one half the width of the floor attachment. At the completion of one cleaning, vacuum the floor a second time at right angles to the first.

F. Operate HEPA filtered fan unit in space for 24 hours minimum.

G. At completion of Decontamination WORK workers decontaminate in accordance with Section 02 82 26 Worker Protection - Repair and Maintenance.

H. Secure area from occupancy until air monitoring results per Section 02 82 21 WORK AREA Clearance indicate area has met the requirements for reoccupancy.

END OF SECTION

SECTION 02 82 31

MINOR REMOVALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal of friable asbestos containing materials with less than full containment.

B. Glovebag removals

C. Mini-enclosures

1.2 SUBMITTALS

A. Surfactant: product data, use instructions and recommendations from manufacturer of surfactant intended for use. Include data substantiating that material complies with requirements.

B. Removal Encapsulant product data, use instructions and recommendations from manufacturer of removal encapsulant intended for use. Include data substantiating that material complies with requirements.

C. NESHAPS Certification: certification from manufacturer of surfactant or removal encapsulant that, the material, if used in accordance with manufacturer's instructions, will wet asbestos-containing materials to which it is applied as required by the National Emission Standard for Hazardous Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61, Subpart M).

D. Material Safety Data Sheet: Material Safety Data Sheet, or equivalent, in accordance with the OSHA Hazard Communication Standard (29 CFR 1910.1200) for each surfactant and encapsulating material proposed for use. Include a separate attachment for each sheet indicating the specific worker protective equipment proposed for use with the material indicated.

E. Historical Airborne Fiber Data: Submit airborne asbestos fiber count data from an independent air monitoring firm to demonstrate the ability to perform work of this section while maintaining an airborne fiber count below 0.1 fibers per cubic centimeter in the breathing zone of the individual performing the work.

F. Spray Cement: Product description including major components and solvents. Manufacturer's installation instructions. Indicate portions applicable to the project.

G. Sheet Plastic: For fire retardant plastic submit test reports on NFPA 701 test.

H. Glovebags: Product data.

I. Signs: Samples.

J. Mini-enclosure: Provide shop drawings of mini-enclosure arrangement to be used.

1.3 DELETED

1.4 QUALITY ASSURANCE

A. Air monitoring will be conducted during the course of the minor removals to monitor potential fiber release.

B. If any sample analyzed exceeds 0.1 fibers/cc the regulated area must be sealed off, decontaminated and cleared in accordance with applicable sections of this specification.

C. WORK AREA clearance tests when required must also meet the release criteria described in Section 02 82 21.

PART 2 PRODUCTS

2.1 POLYETHELENE FILM SHEETING

A. Polyethylene film sheeting in the largest sheet size possible to minimize seams, 6.0 mil thick, clear, frosted, or black as indicated.

B. Flame resistant polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films. Provide largest size possible to minimize seams, 6.0 mil thick, clear, frosted or black as indicated.

C. Where plastic sheet constitutes the only barrier between the WORK AREA and the building exterior, provide translucent, nylon reinforced or woven polyethylene, laminated, flame resistant, polyethylene sheeting that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films. Provide largest size possible to minimize seams, 6.0 mil thick, frosted or black as indicated.

2.2 MISCELLANEOUS MATERIALS

A. Duct tape in 2" or 3" widths as indicated, with an adhesive which is formulated to stick tenaciously to sheet polyethylene.

B. Spray adhesive which is specifically formulated to stick tenaciously to sheet polyethylene.

C. Provide water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the asbestos-containing material and retardation of fiber release during disturbance of the material equal to or greater than that provided by water amended with a surfactant consisting of one ounce of a solution of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.

D. Provide a penetrating type encapsulant designed specifically for removal of asbestos-containing material. Use a material which results in wetting of the asbestos-containing material and retardation of fiber release during disturbance of the material equal

to or greater than that provided by water amended with a surfactant consisting of one ounce of a solution of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.

2.3 GLOVE BAG

A. A minimum 6 mil polyethylene, polyvinylchloride or equivalent plastic sack

B. With two sealed inward projecting longsleeved gloves or mittens

C. Preprinted with same warning notice as a disposal bag

D. Equipped with a pouch for storage of tools

E. Designated location for spray wand or HEPA vacuum wand

F. Sufficient capacity to hold removed materials and permit sealing as specified.

2.4 GARDEN SPRAYER

A. Hand pump type pressure-can garden sprayer fabricated out of either metal or plastic, equipped with a metal wand at the end of a hose that can deliver a stream or spray of liquid under pressure.

PART 3 EXECUTION

3.1 PREPARATION

A. Isolate area and provide worker protection as outlined in referenced sections.

3.2 REMOVALS

A. Check pipe where the work will be performed. Wrap damaged area of pipe with 6 mil plastic and "candy-stripe" with duct tape. Place one layer of duct tape around undamaged pipe at each end where the glove bag will be attached.

B. Slit top of the glove bag open (if necessary) and cut down the sides to accommodate the size of the pipe.

C. Place necessary tools into pouch located inside glove bag.

D. Place one strip of duct tape along the edge of the open top slit of glove bag for reinforcement.

E. Place the glove bag around section of pipe to be worked on and staple top together through reinforcing duct tape. Next, duct tape the ends of glove bag to pipe itself, where previously covered with plastic or duct tape.

F. Use smoke tube and aspirator bulb to test seal. Place tube into water sleeve squeezing bulb and filling bag with visible smoke. Remove smoke tube and twist water sleeve closed.

While holding the water sleeve tightly, gently squeeze glove bag and look for smoke leaking out. If leaks are found, tape closed using duct tape and re-test.

G. Insert wand from garden sprayer through water sleeve. Duct tape water sleeve tightly around the wand to prevent leakage.

H. Thoroughly wet material to be worked on with amended water or removal encapsulant and allow to soak in. Wet adequately to penetrate and soak material through to substrate.

I. One person places his hands into the long-sleeved gloves while the second person directs garden sprayer at the work.

J. Cut insulation at each end of the section to be removed. While spraying amended water or removal encapsulant on the cutting area to keep dust to a minimum.

K. Remove insulation using putty knives or other tools. Place pieces in bottom of bag without dropping.

L. Rinse all tools with water inside the bag and place back into pouch.

M. Scrub and wipe down the exposed pipe.

N. Remove water wand from water sleeve and attach the small nozzle from HEPA-filtered vacuum. Turn on the vacuum briefly to collapse the bag.

O. Remove the vacuum nozzle, twist water sleeve closed and seal with duct tape.

P. From outside the bag, pull the tool pouch away from the bag. Place duct tape over twisted portion and then cut the tool bag from the glove bag, cutting through the twisted/taped section. Contaminated tools may then be placed directly into next glove bag without cleaning. Alternatively, tool pouch with the tools can be placed in a bucket of water, opened underwater, and tools cleaned and dried.

Q. With removed insulation in the bottom of the bag, twist the bag several times and tape it to keep the material in the bottom during removal of the glove bag from the pipe.

R. Slip a 6 mil disposal bag over the glove bag (still attached to the pipe). Remove tape or cut bag and open the top of the glove bag and fold it down into disposal bag.

S. Clean all surfaces in the WORK AREA using disposable cloths wetted with water with surfactant or removal encapsulant added. When these surfaces have dried, clean with a HEPA filtered vacuum. Material adhered to a surface with removal encapsulant may require the application of additional removal encapsulant to facilitate cleaning.

T. Seal exposed ends of remaining pipe insulation.

U. Remove disposable suits and place these into bag with waste.

V. Collapse the bag with a HEPA vacuum twist top of bag, seal with at least 3 wraps of duct tape, bend over and seal again with at least 3 wraps of duct tape.

3.3 MODIFIED GLOVEBAG PROCEDURES

A. Any modifications to above process must be submitted in writing as a substitution and approved by the ENVIRONMENTAL CONSULTANT.

3.4 MINI-ENCLOSURES

A. Construct Work Room in the same manner as Primary Barrier fabricated from 6 mil sheet plastic. Arrange so that Primary Barrier provides both a Critical and Primary Barrier. Line walls and floor of Work Room with a continuous Secondary Barrier.

B. Provide an approximately 3'-0" by 3'-0" Change Room, with additional space as required for storage, attached to each Work Room. Fabricate Change Room from 6 mil sheet plastic in the same manner as a Primary Barrier. Locate so that access to WORK AREA is through Change Room.

C. Cover floor in front of entry to Change Room with one layer of 6 mil sheet plastic. Securely anchor sheet plastic to prevent slipping.

D. Provide flapped door as entry to Change Room and entry from Change Room to Work Room. Fabricate each flapped door from overlapping contacting layers of sheet plastic. Fasten each layer on the top and one side. Each flap is to be 3" longer than door opening. Reinforce free side and bottom of each sheet with duct tape. Alternate sides that are fastened on each layer. Form arrows pointing to entry side from duct tape on inside and outside of door.

E. At entry to Change Room post an approximately 20 inch by 14 inch manufactured caution sign displaying the legend with letter sizes and styles of a visibility required by 29 CFR 1926.

F. Provide worker and respiratory protection as specified in Section 02 82 27.

G. HEPA filtered vacuum cleaner with vacuum in space outside Mini-Enclosure may be used to provide a minimum of 8 air changes per hour in the Work Room.

H. Outside of Change Room remove all street clothes and don clean coveralls and respirator. A swim suit or second disposable suit may be worn beneath outer coveralls. Enter Change Room be sure that entry is completely closed. Enter Work Room be sure that entry is completely closed.

I. Worker Decontamination

1. Remove contaminated suit inside the WORK AREA. Leave respirator in place.

2. Wash hands, face and surface of respirator with water and wet paper towels. Use caution to avoid breaking seal between respirator face-piece and face.

3. Proceed with respirator in place to Change Room.

4. Be sure that entry to WORK AREA is completely closed.

5. In Change Room don clean disposable suit leaving respirator in place.

6. Exit change room be sure that entry to Change Room is completely closed. Proceed to next Mini-Enclosure, or a remote shower.

7. At end of work day decontaminate fully in accordance with procedures in appropriate specification section describing Worker Protection.

J. Material Decontamination

1. Three workers are required. One in the Work Room, one in the Change Room, and one on Step Off Area.

2. Worker in Work Room cleans equipment and bagged debris and hands one piece of equipment or one bag of debris at a time to worker in Change Room.

3. Worker in Change Room wet cleans each piece of equipment or bag and stores them in Change Room. Equipment is sealed completely in 6 mil sheet plastic in the Change Room.

4. When the amount of stored material in the Change Room becomes large enough that the worker cannot clean incoming material without contacting previously cleaned material the door between the WORK and Clean Room is closed.

5. The worker in the Changing Room then passes each item into a new disposal bag held open in the doorway between the Changing Room and Step Off Area by the work on the Step Off Area. The Worker on the Step Off Area places each bag in a sealed cart for transport to the load out area. No bags are to be stored outside of the Mini-Enclosure.

6. All bags are to be transported through the building in clean sealed containers that have never been in an asbestos WORK AREA, Mini-Enclosure or Decontamination Unit.

K. At completion of all work decontaminate the WORK and Changing Rooms as set forth in Section 02 82 29 Project Decontamination.

END OF SECTION

SECTION 02 82 32

REMOVAL OF ASBESTOS-CONTAINING MATERIALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Secondary Barriers

B. Removal of ACM

C. Clean of Surfaces Previously Covered by ACM

D. Encapsulants

1.2 DELETED

1.3 SUBMITTALS

A. Submit product data, use instructions and recommendations from manufacturer of surfactant intended for use. Include data substantiating that material complies with requirements.

B. Submit product data, use instructions and recommendations from manufacturer of removal encapsulant intended for use. Include data substantiating that material complies with requirements.

C. Submit certification from manufacturer of surfactant or removal encapsulant that, the material, if used in accordance with manufacturer's instructions, will wet asbestos containing materials to which it is applied as required by the National Emission Standard for Hazardous Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61, Subpart M).

PART 2 PRODUCTS

2.1 AMENDED WATER

A. Provide water to which a surfactant has been added.

B. Use a mixture of surfactant and water which results in wetting of the asbestos containing material and retardation of fiber release during disturbance of the material equal to or greater than that provided by the use of one ounce of a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.

2.2 REMOVAL ENCAPSULANT

A. Provide a penetrating type encapsulant designed specifically for removal of asbestos containing material.

B. Use a material which results in wetting of the asbestos-containing material and retardation of fiber release during disturbance of the material equal to or greater than that provided by water amended with a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.

2.3 POLYETHYLENE FILM SHEETING

A. Polyethylene film sheeting in the largest sheet size possible to minimize seams, 6.0 mils thick, clear, frosted, or black as indicated.

B. Flame resistant polyethylene film sheeting that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films. Provide largest size possible to minimize seams, 6.0 mils thick, clear, frosted or black as indicated.

2.4 MISCELLANEOUS MATERIALS

A. Duct tape in 2" or 3" widths as indicated, with an adhesive which is formulated to stick tenaciously to sheet polyethylene.

B. Spray adhesive which is specifically formulated to stick tenaciously to sheet polyethylene.

C. Provide 6 mil thick leak-tight polyethylene bags labeled as indicated in the specifications.

PART 3 EXECUTION

3.1 SECONDARY BARRIER

A. A drop cloth of clear 6 mil sheet plastic in all areas where asbestos removal work is to be carried out. Completely cover floor with sheet plastic.

B. Where the WORK is within 10'-0" of a wall extend the Secondary Barrier up wall to ceiling.

C. Support sheet plastic on wall with duct tape, seal top of Secondary plastic to Primary Barrier with duct tape so that debris is unable to get behind it.

D. Provide cross strips of duct tape at wall support as necessary to support sheet plastic and prevent its falling during removal operations.

E. Install Secondary Barrier at the beginning of each work shift.

F. Remove Secondary Barrier at end of each work shift or as work in an area is completed. Fold plastic toward center of sheet and pack in disposal bags. Keep material on sheet continuously wet until bagged.

G. Install Walkways of black 6 mil plastic between active removal areas and decontamination units to protect Primary layer from tracked material. Install walkways at the beginning of, and remove at the end of each work shift.

3.2 WET REMOVAL

A. Thoroughly wet asbestos-containing materials to be removed prior to removal to reduce fiber dispersal into the air. Accomplish wetting by a fine spray (mist) of amended water or removal encapsulant.

B. Saturate material sufficiently to wet to the substrate without causing excess dripping. Allow time for water or removal encapsulant to penetrate material thoroughly.

C. When amended water is used, spray material repeatedly during the work process to maintain a continuously wet condition. When a removal encapsulant is used, apply in strict accordance with manufacturer's written instructions.

D. Perforate outer covering of any installation which has been painted and/or jacketed in order to allow penetration of amended water or removal encapsulant, or where necessary, carefully strip away while simultaneously spraying amended water or removal encapsulant on the installation to minimize dispersal of asbestos fibers into the air.

E. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels.

F. Remove saturated asbestos-containing material in small sections from all areas. As it is removed, pack material while still wet into disposal bags.

G. Evacuate air from disposal bags with a HEPA filtered vacuum cleaner. Twist neck of bags, bend over and seal with minimum three wraps of duct tape. Clean outside and move to washdown station adjacent to material decontamination unit.

3.3 FIREPROOFING OR ARCHITECTURAL FINISH ON SCRATCH COAT

A. Spray asbestos-containing fireproofing or architectural acoustic finish with a fine mist of amended water or removal encapsulant. Allow time for amended water or removal encapsulant to saturate materials to substrate.

B. Scrape materials from substrate. Remove materials in manageable quantities and control the decent to staging or floor below.

C. If using amended water, spray mist surface continuously during work process. If using removal encapsulant follow manufacturer's written instructions.

D. Remove residue remaining on scratch coat after scraping using stiff nylon bristled hand brush, or high pressure washer.

E. If a removal encapsulant is used remove residue completely before encapsulant dries. If substrate dries before complete removal of residue re-wet with amended water or removal encapsulant.

F. Double bag or containerize the material for disposal.

3.4 FIREPROOFING OR ARCHITECTURAL FINISH ON WIRE LATH

A. Spray asbestos-containing fireproofing or architectural acoustic finish with a fine mist of amended water or removal encapsulant. Allow time for amended water or removal encapsulant to completely saturate material.

B. If surface of material has been painted or otherwise coated cut small holes as required and apply amended water or removal encapsulant from above.

C. Cut wire lath into sections and cut hanger wires. Roll up complete with asbestos-containing material and hand place in disposal bag. Do not drop on floor.

D. After removal of lath and asbestos-containing material remove any overspray on decking and structure above.

E. Deposit the sections of plaster and lath in double bags as required for disposal, being careful to prevent jagged edges of lath from tearing disposal bags. If bags continue to tear double bags then boxes or drums must be used and sealed as directed by the OWNER'S REPRESENTATIVE.

3.5 PIPE INSULATION

A. Spray with a mist of amended water or removal encapsulant. Allow amended water or removal encapsulant to saturate material to substrate. If a removal encapsulant is used, use in strict accordance with manufacturer's instructions.

B. Cut bands holding performed pipe insulation, slit jackets at seams, remove and hand-place in a disposal bag. Remove job molded fitting insulation in chunks and hand place in a disposal bag. Do not drop to floor.

C. Remove any residue on pipe or fitting with stiff bristle nylon hand brush.

D. Where pipe fitting insulation is removed from pipe with straight runs insulated with fibrous glass or other non-asbestos containing fibrous material, remove fibrous material 3" from the point where it contacts the asbestos-containing insulation.

3.6 ENCAPSULATION

Upon completion of removal and cleaning of surfaces, have surfaces visually inspected by the OWNER'S REPRESENTATIVE. When surfaces have passed the visual inspection, they shall be sprayed with an approved encapsulant.

3.7 PRESSURE DIFFERENTIAL AND AIR CIRCULATION SYSTEM

A. Provide pressure differential and air circulation systems as described below for each area where asbestos-containing material is being removed or otherwise disturbed.

B. Provide HEPA filtered fan units, one for each scraping activity, in addition to those required by section 02 82 22, in the vicinity of the work. Arrange so that exhaust is into the work area

oriented in a direction away from the work. Extend a 12" diameter flexible non-collapsing duct from the intake end to a point no more than 4'-0 from any scraping or wire brushing activity.

3.8 AIRBORNE FIBER COUNTS

A. Use work procedures that result in an 8 hour Time Weighted Average (TWA) airborne fiber count less than that indicated in Section 02 82 18 Air Monitoring - Test Laboratory Services.

B. If airborne fiber counts exceed this level immediately mist the area with amended water to lower fiber counts and revise work procedures to maintain airborne fiber levels at or less than the required limit.

END OF SECTION

SECTION 02 82 33

DISPOSAL OF ASBESTOS-CONTAINING WASTE MATERIAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Disposal of Asbestos-Containing Materials.

B. Packaging of asbestos-containing waste materials.

1.2 SUBMITTALS

A. Copy of state or local license for waste hauler.

B. Name and address of landfill where asbestos-containing waste materials are to be buried. Include contact person and telephone number.

C. Name and address of processor where asbestos-containing waste materials are to be process into non-asbestos waste. Include contact person and telephone number.

D. Product data on process to be used.

E. Letters or other documents from the United States Environmental Protection Agency relative to the process; indicating compliance with Section 61.152(a) of NESHAP regulations.

F. Chain of Custody form and form of waste manifest proposed.

G. Sample of disposal bag and any added labels to be used.

PART 2 PRODUCTS

2.1 DISPOSAL BAGS

A. Provide 6 mil thick leak-tight polyethylene bags labeled with four labels with text as follows:

First Label:

CAUTION
CONTAINS ASBESTOS FIBERS
AVOID OPENING OR BREAKING CONTAINER
BREATHING ASBESTOS IS HAZARDOUS TO YOUR HEALTH

Second Label: Provide in accordance with 29 CFR 1910.1200(f) of OSHA's Hazard Communication standard:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
BREATHING AIRBORNE ASBESTOS, TREMOLITE, ANTHOPHYLLITE, OR
ACTINOLITE FIBERS IS HAZARDOUS TO YOUR HEALTH

Third Label: Provide in accordance with U.S. Department of Transportation regulation on hazardous waste marking. 49 CFR Parts 171 and 172. Hazardous Substances: Final Rule. Published November 21, 1986 and revised February 17, 1987:

RQ HAZARDOUS
SUBSTANCE,
SOLID, NOS,
ORM-E, NA 9188
(ASBESTOS)

Fourth Label:

NAME OF GENERATOR
NAME OF CONTRACTOR

PART 3 EXECUTION

3.1 GENERAL

A. All waste is to be hauled by a waste hauler with all required licenses form all state and local authority with jurisdiction.

B. Load all asbestos-containing waste material in disposal bags or leak-tight drums.

C. Protect interior of truck or dumpster with Critical and Primary Barriers as described in Section 02 82 23 Temporary Enclosures.

D. Carefully load containerized waste in fully enclosed dumpsters, trucks or other appropriate vehicles for transport. Exercise care before and during transport, to ensure that no unauthorized persons have access to the material.

E. Advise the landfill operator or processor, at least ten days in advance of transport, of the quantity of material to be delivered.

3.2 DISPOSAL

A. Sealed plastic bags must be carefully unloaded from the truck. If bags are broken or damaged, return to work site for rebagging. Clean entire truck and contents using procedures set forth in Section 02 82 29 Project Decontamination.

B. At a processing site truck and loading dock are arranged as a controlled work area and containerized waste is transferred to storage area by site personnel. All bags including broken ones will be transferred. Clean truck, using procedures set forth in Section 02 82 29 Project Decontamination.

C. Retain receipts from landfill or processor for materials disposed of.

D. Contractor shall provide all waste manifests to the OWNER immediately upon receipt for all stages of the disposal, including transportation and confirmation of receipt at the disposal facility. A final waste manifest shall be provided within the timeframe required by regulation, which identifies the disposal facility name and address, EPA Identification Number (if applicable), the identity of the waste material, and a statement certifying that the waste was disposed at that facility, including the date. A copy should be forwarded to

ENVIRONMENTAL CONSULTANT, but the OWNER must receive the original document for recordkeeping.

END OF SECTION

SECTION 02 82 34

REMOVAL OF ASBESTOS-CONTAMINATED SOIL

PART 1 GENERAL

(Not Used)

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

3.1 WET SOILS

A. After removal of the Secondary Barrier and floor layer of Primary Barrier, remove the top one inch (1") of soils which are damp or wet and place in disposal bags.

B. Start removal at the point of work farthest from the entrance to the soil floor area and proceed toward the entrance.

C. Arrange HEPA filtered fan units so that air flow enters the WORK AREA through the decon and flows across the WORK.

D. After the entire first layer of soil is removed completely change coveralls and at the entrance to the soil removal area don clean boot covers. Remove the second one inch (1") of soil in the same manner as the first.

E. Carry out the decontamination procedures set forth in the "Project Decontamination" section of this specification.

F. At the end of project decontamination remove the third one inch (1") of soil in the same manner as the previous two inches (2").

3.2 DRY SOILS

A. Use the same procedure for dry soils, except saturate soil with amended water or a removal encapsulant as specified in other sections of the specification. If a removal encapsulant is used, use in accordance with manufacturer's instructions.

B. Saturate soil beyond the inch of soil currently being removed. When amended water is used keep the surface of the soil continuously wet throughout removal and decontamination.

END OF SECTION

SECTION 02 83 13

LEAD-BASED PAINT (LBP) DISTURBANCE AND WASTE DISPOSAL

PART 1 GENERAL

1.1 REFERENCES

The procedures specified in this section are guidelines for minimum performance. The contractor is responsible for its own methods of operations and execution. Conform to all pertinent regulatory codes, rules and guidelines. Obtain all permits, licenses, notifications and approvals to perform work. The standards and guidelines listed below form a part of this specification to the extent referenced.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.134	Respiratory Protection
29 CFR 1910.1200	Hazard Communication
29 CFR 1926.62	Lead in the Construction Industry
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 178	Shipping Container Specification

PENNSYLVANIA DEPARTMENT OF LABOR AND INDUSTRY (PaDLI)

34 PA CODE CH. 203	Lead Occupation Accreditation and Certification

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH OSHA Booklet 3142	Lead in Construction

1.2 SUBMITTALS

The following items shall be submitted to the Environmental Consultant prior to the start of the project:

A. Lead-Based Paint (LBP) Management Plan:

The Contractor shall prepare a detailed LBP Management Plan that identifies the work procedures, health, and safety measures to be used during demolition and proper disposal of LBP-coated components. The plan shall include the following key elements:

1. Work practices and procedures for performing LBP-impacting activities.

2. Training requirements as required by Federal, state and local regulations.

3. Personnel protective equipment; respiratory protection program and controls.

4. Engineering controls and safety measures used to prevent environmental releases.

5. Worker exposure assessment procedures.

6. Work Practice controls.

7. Housekeeping.

8. Sampling, testing and analytical methods to include personal air sampling requirements of 29 CFR 1926 Section .62. Procedures must include frequency, locations, and sampling and analytical methods to be used.

B. Hazardous Waste Management Plan (if applicable):

A Hazardous Waste Management Plan shall be prepared that complies with applicable requirements of Federal, state, and local hazardous waste regulations and addresses:

1. Estimated quantities of wastes to be generated and disposed of.

2. Names and qualifications of each contractor that will be transporting, storing, and disposing of the wastes; the facility location, phone number, and name of a 24-hour point of contact shall be included. Provide two copies of EPA, state, and local hazardous waste permit applications, permits, and EPA identification numbers.

3. Names and qualifications (experience and training) of personnel who will be working onsite with hazardous waste.

4. List of waste handling equipment to be used in performing the work to include cleaning, volume reduction, and transport equipment.

5. Spill prevention, containment, and clean-up contingency measures to be implemented.

6. Work plan and schedule for waste containment, removal and disposal. Waste shall be cleaned up and containerized daily.

7. Cost for hazardous waste disposal according to this plan.

C. Waste Disposal Plan (if applicable):

A Waste Disposal Plan shall be prepared that will include but not be limited to the following:

a. A written confirmation that the debris will be treated and disposed of in accordance with the requirements of 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 264 and 40 CFR 268.

b. A written confirmation that transportation of the debris will be in accordance with 40 CFR 263.

c. Waste subcontractor's name, address, telephone number, and landfill location, including copies of licenses and signed agreements.

d. Landfill name, address and telephone number. A copy of the landfill's state and locally issued license, and a signed agreement that the landfill will accept the lead hazardous wastes.

e. Detailed delivery tickets prepared, signed and dated by an agent of the landfill, certifying the amount of LBP containing materials delivered to the landfill.

The following items shall be submitted to the Owner and Environmental Consultant during the progress of the project, on a regular basis:

D. Air Monitoring Results:

A daily log of the personal air monitoring results shall be posted onsite. The log shall list each sample result, sampling time and date, sample type, identification of personnel monitored, flow rate and duration, air volume sampled, yield of lead, cassette size, analytical method used, analyst's name and company, and interpretation of results. Results shall be reported in micrograms of lead per cubic meter of air. Documentation of results that exceed specified limits (personal air samples that exceed 30 micrograms per cubic meter) or as required by Federal, state or local requirements shall be highlighted in the log in such a manner to make them easily distinguishable from monitoring results that do not exceed specified or regulatory limits. Submit results to the Owner within three working days, signed by the laboratory performing the analysis.

E. Waste Documentation:

Submit copies of waste shipment records, signed by the hauler before the waste was removed from the site, and waste manifests from an EPA or state-approved landfill, as the Contractor obtains these documents.

1.3 TCLP TESTING

A. All Contractor(s) are hereby advised that there are LBP and lead-containing surface coatings present at the work site. See Section 02 82 13 for a summary.

B. Contractor shall handle, contain, store, test, transport and dispose of demolition debris with lead-containing surface coating in accordance with applicable local, state and federal regulations. The Contractor shall be responsible for collecting and having analyzed representative samples of the waste, and sampling shall be performed by a competent person familiar with sampling procedures, requirements, protocols, etc. Samples shall be tested for toxicity using the Toxicity Characteristics Leaching Procedure (TCLP) for lead sufficient to determine whether the debris is a hazardous waste as defined in 40 CFR 261.3, or a residual waste, as defined in 25 PA Code 287.1, and shall include such analysis as required by the disposal facility. Analysis shall be performed by a qualified environmental laboratory acceptable to the ENVIRONMENTAL CONSULTANT, and a copy of all testing results forwarded to the ENVIRONMENTAL CONSULTANT and OWNER. The Contractor shall be responsible for the costs of sample collection and laboratory analysis. Alternately, Contractor can assume lead waste generated is a hazardous waste and TCLP testing is not required, but the waste must then be disposed of and transported as hazardous waste.

If, based on testing, there is any hazardous waste generated and transferred to a hazardous waste disposal facility, Contractor shall provide all waste manifests to the OWNER immediately upon receipt for all stages of the disposal, including transportation and confirmation of receipt at the disposal facility. A final waste manifest shall be provided within the timeframe required by regulation, which identifies the disposal facility name and address, EPA Identification Number (if applicable), the identity of the waste material, and a statement certifying that the waste was disposed at that facility, including the date. A copy should be forwarded to ENVIRONMENTAL CONSULTANT, but the OWNER must receive the original document for recordkeeping.

1.4 SAFETY AND HEALTH REGULATORY REQUIREMENTS

Work shall be performed in accordance with requirements of applicable regulations including, but not limited to 29 CFR 1910, 29 CFR 1926, especially Section .62. Matters of interpretation of the standards shall be submitted to the appropriate agency for resolution before starting work. Where these requirements vary, the most stringent shall apply.

1.5 RESPIRATORY PROTECTION PROGRAM

A respiratory protection program shall be established as required by 29 CFR 1926 Section .103 and .62 and in accordance with 29 CFR 1910 Section .134. If required, an approved respirator shall be furnished to each employee and a fit test shall be conducted in accordance with 29 CFR 1926 Section .62, Appendix D.

1.6 HAZARD COMMUNICATION PROGRAM

A Hazard Communication Program shall be implemented in accordance with 29 CFR 1926 Section .59.

1.7 TRAINING, LICENSING AND PERMITS

A. Waste Hauler must be an EPA and PA DEP licensed Hazardous Waste Transporter and must provide proof of such licensing prior to transporting waste from the jobsite.

B. CONTRACTOR will be responsible for obtaining all applicable federal, state and local permits.

1.8 AIR SAMPLING

CONTRACTOR will be responsible to perform daily OSHA personal air monitoring in accordance with OSHA standard 1926.62, as required. Personal air monitoring results will determine the adequacy of Personal Protective Equipment (PPE), and determine if proper work practices are being employed. The Environmental Consultant shall be notified if any personal air monitoring result equals or exceeds the Action Level for lead of 30 micrograms per cubic meter of air, and the contractor shall take steps to reduce the concentration of airborne lead.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

(Not Applicable)

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies cast-in-place structural concrete and materials and mixes for other concrete.

1.2 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 TESTING AGENCY FOR CONCRETE MIX DESIGN:

A. Testing agency retained and reimbursed by the Contractor and approved by Resident Engineer.

B. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology. Accompany request for approval of testing agency with a copy of Report of Latest Inspection of Laboratory Facilities by CCRL.

C. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

1.4 TOLERANCES:

A. Formwork: ACI 117, except the elevation tolerance of formed surfaces before removal of shores is +0 mm (+0 inch) and -20 mm (-3/4 inch).

B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 10, 13, and 16 (Nos. 3, 4, and 5) (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 mm (+0 inch) and -13 mm (-1/2 inch) where gross bar length is less than 3600 mm (12 feet), or +0 mm (+0 inch) and -20 mm (-3/4 inch) where gross bar length is 3600 mm (12 feet) or more.

C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +20 mm (+3/4 inch) and - 6 mm (-1/4 inch). Tolerance of thickness of beams more than 300 mm (12 inch) but less than 900 mm (3 feet) is +20 mm (+3/4 inch) and -10 mm (-3/8 inch).

D. Slab Finishes: ACI 117, Section 4.5.6, F-number method in accordance with ASTM E1155, except as follows:

1. Test entire slab surface, including those areas within 600 mm (2 feet) of construction joints and vertical elements that project through slab surface.
2. Maximum elevation change which may occur within 600 mm (2 feet) of any column or wall element is 6 mm (0.25 inches).
3. Allow sample measurement lines that are perpendicular to construction joints to extend past joint into previous placement no further than 1500 mm (5 feet).

1.5 REGULATORY REQUIREMENTS:

A. ACI SP-66 – ACI Detailing Manual.
B. ACI 318 - Building Code Requirements for Reinforced Concrete.C. ACI 301 – Standard Specifications for Structural Concrete.
D. ASTM C 618, Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Uses as a Mineral Admixture in Portland Cement Concrete
E. ASTM C 311, Standard Methods of Sampling and Testing Fly Ash and Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete

1.6 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
B. Shop Drawings: Reinforcing steel: Complete shop drawings
C. Mill Test Reports:
   1. Reinforcing Steel.
   2. Cement.
D. Manufacturer's Certificates:
   1. Abrasive aggregate.
   2. Lightweight aggregate for structural concrete.
   3. Air-entraining admixture.
   4. Chemical admixtures, including chloride ion content.
   5. Waterproof paper for curing concrete.
   6. Liquid membrane-forming compounds for curing concrete.
   7. Non-shrinking grout.
   8. Liquid hardener.
   9. Waterstops.
   10. Expansion joint filler.
   11. Adhesive binder.

E. Testing Agency for Concrete Mix Design: Approval request including qualifications of principals and technicians and evidence of active participation in program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology and copy of report of latest CCRL, Inspection of Laboratory.

F. Test Report for Concrete Mix Designs: Trial mixes including water-cement fly ash ratio curves, concrete mix ingredients, and admixtures.

G. Shoring and Reshoring Sequence: Submit for approval a shoring and reshoring sequence for flat slab/flat plate portions, prepared by a registered Professional Engineer. As a minimum, include timing of form stripping, reshoring, number of floors to be re-shored and timing of re-shore removal to serve as an initial outline of procedures subject to modification as construction progresses. Submit revisions to sequence, whether initiated by Resident Engineer (see FORMWORK) or Contractor.

H. LEED BUILDING Submittal Requirements: The contractor or subcontractor shall submit the following LEED BUILDING certification items:

A. A completed LEED Concrete Mix Form– Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. LEED concrete mix form is attached at the end of this section. Information to be supplied includes:

1. The weight (lbs/ cubic yard) of all ingredients of the concrete mix such as cement, flyash, blast furnace slag, aggregates and admixtures.
2. Provide material costs of all ingredients in the concrete mix. Material cost does not include costs associated with labor and equipment
3. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
4. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

B. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

C. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

D. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Conform to ACI 304. Store aggregate separately for each kind or grade, to prevent segregation of sizes and avoid inclusion of dirt and other materials.

B. Deliver cement in original sealed containers bearing name of brand and manufacturer, and marked with net weight of contents. Store in suitable watertight building in which floor is raised at least 300 mm (1 foot) above ground. Store bulk cement and fly ash in separate suitable bins.

C. Deliver other packaged materials for use in concrete in original sealed containers, plainly marked with manufacturer's name and brand, and protect from damage until used.

1.8 PRE-CONCRETE CONFERENCE:

A. General: At least 15 days prior to submittal of design mixes, conduct a meeting to review proposed methods of concrete construction to achieve the required results.

B. Agenda: Includes but is not limited to:

1. Submittals.
2. Coordination of work.
3. Availability of material.
4. Concrete mix design including admixtures.
5. Methods of placing, finishing, and curing.
6. Finish criteria required to obtain required flatness and levelness.
7. Timing of floor finish measurements.
8. Material inspection and testing.

C. Attendees: Include but not limited to representatives of Contractor; subcontractors involved in supplying, conveying, placing, finishing, and

curing concrete; lightweight aggregate manufacturer; admixture manufacturers; Resident Engineer; Consulting Engineer; Department of Veterans Affairs retained testing laboratories for concrete testing and finish (F-number) verification.

D. Minutes of the meeting: Contractor shall take minutes and type and distribute the minutes to attendees within five days of the meeting.

1.9 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Concrete Institute (ACI):

117-10.....Tolerances for Concrete Construction and Materials
211.1-91(R2009).....Selecting Proportions for Normal, Heavyweight, and Mass Concrete
211.2-98(R2004).....Selecting Proportions for Structural Lightweight Concrete
214R-02.....Evaluation of Strength Test Results of Concrete
301-10.....Structural Concrete
304R-00(R2009).....Guide for Measuring, Mixing, Transporting, and Placing Concrete
305R-10.....Hot Weather Concreting
306R-10.....Cold Weather Concreting
308R-01(R2008).....Standard Practice for Curing Concrete
309R-05.....Guide for Consolidation of Concrete
318-08.....Building Code Requirements for Reinforced Concrete and Commentary
347-04.....Guide to Formwork for Concrete
SP-66-04.....ACI Detailing Manual

C. American National Standards Institute and American Hardboard Association (ANSI/AHA):

A135.4-2004.....Basic Hardboard

D. American Society for Testing and Materials (ASTM):

A82/A82M-07.....Steel Wire, Plain, for Concrete Reinforcement
A185/185M-07.....Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
A615/A615M-09.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

A653/A653M-09.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
A706/A706M-09.....Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
A767/A767M-09.....Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
A775/A775M-07.....Epoxy-Coated Reinforcing Steel Bars
A820-06.....Steel Fibers for Fiber-Reinforced Concrete
A996/A996M-09.....Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
C31/C31M-09.....Making and Curing Concrete Test Specimens in the field
C33-08.....Concrete Aggregates
C39/C39M-09.....Compressive Strength of Cylindrical Concrete Specimens
C94/C94M-09.....Ready-Mixed Concrete
C143/C143M-10.....Slump of Hydraulic Cement Concrete
C150-09.....Portland Cement
C171-07.....Sheet Materials for Curing Concrete
C172-08.....Sampling Freshly Mixed Concrete
C173-10.....Air Content of Freshly Mixed Concrete by the Volumetric Method
C192/C192M-07.....Making and Curing Concrete Test Specimens in the Laboratory
C231-09.....Air Content of Freshly Mixed Concrete by the Pressure Method
C260-06.....Air-Entraining Admixtures for Concrete
C309-07.....Liquid Membrane-Forming Compounds for Curing Concrete
C330-09.....Lightweight Aggregates for Structural Concrete
C494/C494M-10.....Chemical Admixtures for Concrete
C618-08.....Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
C666/C666M-03.....Resistance of Concrete to Rapid Freezing and Thawing
C881/C881M-02.....Epoxy-Resin-Base Bonding Systems for Concrete

C1107/1107M-08.....Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
C1315-08.....Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
D6-95(R2006).....Loss on Heating of Oil and Asphaltic Compounds
D297-93(R2006).....Rubber Products-Chemical Analysis
D1751-04(R2008).....Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
D4397-09.....Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
E1155-96(R2008).....Determining F_F Floor Flatness and F_L Floor Levelness Numbers

E. American Welding Society (AWS):
D1.4/D1.4M-11.....Structural Welding Code - Reinforcing Steel

F. Concrete Reinforcing Steel Institute (CRSI):
Handbook 2008

G. U. S. Department of Commerce Product Standard (PS):
PS 1.....Construction and Industrial Plywood
PS 20.....American Softwood Lumber

PART 2 – PRODUCTS:

2.1 FORMS:

A. Wood: PS 20 free from loose knots and suitable to facilitate finishing concrete surface specified; tongue and grooved.

B. Plywood: PS-1 Exterior Grade B-B (concrete-form) 16 mm (5/8 inch), or 20 mm (3/4 inch) thick for unlined contact form. B-B High Density Concrete Form Overlay optional.

C. Corrugated Fiberboard Void Boxes: Double faced, completely impregnated with paraffin and laminated with moisture resistant adhesive, size as shown. Design forms to support not less than 48 KPa (1000 psf) and not lose more than 15 percent of their original strength after being completely submerged in water for 24 hours and then air dried.

D. Form Lining:
1. Hardboard: ANSI/AHA A135.4, Class 2 with one (S1S) smooth side)
2. Plywood: Grade B-B Exterior (concrete-form) not less than 6 mm (1/4 inch) thick.
3. Plastic, fiberglass, or elastomeric capable of reproducing the desired pattern or texture.

E. Form Ties: Develop a minimum working strength of 13.35 kN (3000 pounds) when fully assembled. Ties shall be adjustable in length to permit tightening of forms and not have any lugs, cones, washers to act as spreader within form, nor leave a hole larger than 20 mm (3/4 inch) diameter, or a depression in exposed concrete surface, or leave metal closer than 40 mm (1 1/2 inches) to concrete surface. Wire ties not permitted. Cutting ties back from concrete face not permitted.

2.2 MATERIALS:

A. Portland Cement: ASTM C150 Type I or II.

B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalies, and loss on ignition (LOI) not to exceed 5 percent.

C. Coarse Aggregate: ASTM C33.

1. Size 67 or Size 467 may be used for footings and walls over 300 mm (12 inches) thick.
2. Coarse aggregate for applied topping, encasement of steel columns, and metal pan stair fill shall be Size 7.
3. Maximum size of coarse aggregates not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourth of minimum clear spacing between reinforcing bars.

D. Lightweight Aggregates for Structural Concrete: ASTM C330, Table 1. Maximum size of aggregate not larger than one-fifth of narrowest dimension between forms, nor three-fourth of minimum clear distance between reinforcing bars. Contractor to furnish certified report to verify that aggregate is sound and durable, and has a durability factor of not less than 80 based on 300 cycles of freezing and thawing when tested in accordance with ASTM C666.

E. Fine Aggregate: ASTM C33. Fine aggregate for applied concrete floor topping shall pass a 4.75 mm (No. 4) sieve, 10 percent maximum shall pass a 150 µm (No. 100) sieve.

F. Mixing Water: Fresh, clean, and potable.

G. Admixtures:

1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.

3. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
5. Air Entraining Admixture: ASTM C260.
7. Calcium Nitrite corrosion inhibitor: ASTM C494 Type C.
8. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.
9. Certification: Written conformance to the requirements above and the chloride ion content of the admixture prior to mix design review.

H. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil).

I. Reinforcing Steel: ASTM A615, or ASTM A996, deformed, grade as shown.

J. Welded Wire Fabric: ASTM A185.

K. Reinforcing Bars to be Welded: ASTM A706.

L. Galvanized Reinforcing Bars: ASTM A767.

M. Epoxy Coated Reinforcing Bars: ASTM A775.

N. Reinforcement for Metal Pan Stair Fill: 50 mm (2 inch) wire mesh, either hexagonal mesh at .8Kg/m^2 (1.5 pounds per square yard), or square mesh at .6Kg/m^2 (1.17 pounds per square yard).

O. Supports, Spacers, and Chairs: Types which will hold reinforcement in position shown in accordance with requirements of ACI 318 except as specified.

P. Expansion Joint Filler: ASTM D1751.

Q. Sheet Materials for Curing Concrete: ASTM C171.

R. Liquid Membrane-forming Compounds for Curing Concrete: ASTM C309, Type I, with fugitive dye. Compound shall be compatible with scheduled surface treatment, such as paint and resilient tile, and shall not discolor concrete surface.

S. Abrasive Aggregate: Aluminum oxide grains or emery grits.

T. Moisture Vapor Emissions & Alkalinity Control Sealer: 100% active colorless aqueous siliconate solution concrete surface treatment applied the day of the concrete pour in lieu of other curing methods for all concrete slabs receiving resilient flooring, such as, sheet vinyl, vinyl

composition tile, rubber, wood flooring, carpet, epoxy coatings and overlays .

1. ASTM C1315 Type 1 Class A, and ASTM C309 Type 1 Class A, penetrating product to have no less than 34% solid content, leaving no sheen, volatile organic compound (VOC) content rating as required to suite regulatory requirements. The product shall have at least a five (5) year documented history in controlling moisture vapor emission from damaging floor covering, compatible with all finish materials.
2. MVE 15-Year Warranty:
   a. When a floor covering is installed on a below grade, on grade, or above grade concrete slab treated with Moisture Vapor Emissions & Alkalinity Control Sealer according to manufacturer's instruction, sealer manufacturer shall warrant the floor covering system against failure due to moisture vapor migration or moisture-born contaminates for a period of fifteen (15) years from the date of original installation. The warranty shall cover all labor and materials needed to replace all floor covering that fails due to moisture vapor emission & moisture born contaminates.

U. Non-Shrink Grout:
1. ASTM C1107, pre-mixed, produce a compressive strength of at least 18 MPa at three days and 35 MPa (5000 psi) at 28 days. Furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 1200 mm x 1200 mm (4 foot by 4 foot) base plate.
2. Where high fluidity or increased placing time is required, furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent under an 450 mm x 900 mm (18 inch by 36 inch) base plate.

V. Adhesive Binder: ASTM C881.
1. Polyvinyl Chloride Waterstop: CRD C572.
2. Rubber Waterstops: CRD C513.
3. Bentonite Water Stop: Flexible strip of bentonite 25 mm x 20 mm (1 inch by 3/4 inch), weighing 8.7 kg/m (5.85 lbs. per foot) composed of Butyl Rubber Hydrocarbon (ASTM D297), Bentonite (SS-S-210-A) and Volatile Matter (ASTM D6).
4. Porous Backfill: Crushed stone or gravel graded from 25 mm to 20 mm (1 inch to 3/4 inch).

5. Synthetic Fibers: Monofilament or fibrillated polypropylene fibers for secondary reinforcing of concrete members. Use appropriate length and 0.9 kg/m^3 (1.5 lb. per cubic yard). Product shall have a UL rating.
6. Steel Fibers: ASTM A820, Type I cold drawn, high tensile steel wire for use as primary reinforcing in slab-on-grade. Minimum dosage rate 18 kg/m^3 (30 lb. per cubic yard).
7. Epoxy Joint Filler: Two component, 100 percent solids compound, with a minimum shore D hardness of 50.
8. Bonding Admixture: Non-rewettable, polymer modified, bonding compound.
9. Architectural Concrete: For areas designated as architectural concrete on the Contract Documents, use colored cements and specially selected aggregates as necessary to produce a concrete of a color and finish which exactly matches the designated sample panel.

2.3 CONCRETE MIXES:

A. Mix Designs: Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.
   1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
   2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, fly ash, admixtures, weight of fine and coarse aggregate per m^3 (cubic yard) measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water-cement -fly ash ratio, and consistency of each cylinder in terms of slump.
   3. Prepare a curve showing relationship between water-cement-fly ashratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
   4. If the field experience method is used, submit complete standard deviation analysis.

B. Fly Ash Testing: Submit certificate verifying conformance with specifications initially with mix design and for each truck load of fly ash delivered from source. Notify Resident Engineer immediately when change in source is anticipated. Prior to beginning trial mixes submit to the Resident Engineer the following representative samples of material to be used, properly identified source and project description

and number, type of testing (complete chemical and physical), suitably packaged for shipment, and addressed as specified. Allow 60 calendar days for test results after submittal of sample.

1. Fly ash - 2.25 kg (five pounds).
2. Portland cement - 3.5 kg (8 pounds):
   a. Address -Waterways Experiment Station (WES)
   b. 3909 Halls Ferry Road
   c. Vicksburg, MS 39180-6199
   d. ATTN: Engineering Materials Group

C. After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of Resident Engineer or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement and fly ash, providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. Resident Engineer may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and fly ash and approval of design mix.D. Cement Factor: Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums. Use Fly Ash as an admixture with 20% replacement by weight in all structural work.

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete Strength		Non-Air-Entrained	Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m^3 (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m^3 (lbs/c. yd)	Max. Water Cement Ratio
35 (5000)[1,3]	375 (630)	0.45	385 (650)	0.40
30 (4000)[1,3]	325 (550)	0.55	340 (570)	0.50
25 (3000)[1,3]	280 (470)	0.65	290 (490)	0.55
25 (3000)[1,2]	300 (500)	*	310 (520)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f’c.

2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
4. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

E. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II - MAXIMUM SLUMP, MM (INCHES)*

Type of Construction	Normal Weight Concrete	Lightweight Structural Concrete
Reinforced Footings and Substructure Walls	75mm (3 inches)	75 mm (3 inches)
Slabs, Beams, Reinforced Walls, and Building Columns	100 mm (4 inches)	100 mm (4 inches)

F. Slump may be increased by the use of the approved high-range water-reducing admixture (superplasticizer). Tolerances as established by ASTM C94. Concrete containing the high-range-water-reducing admixture may have a maximum slump of 225 mm (9 inches). The concrete shall arrive at the job site at a slump of 50 mm to 75 mm (2 inches to 3 inches), and 75 mm to 100 mm (3 inches to 4 inches) for lightweight concrete. This should be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.

G. Air-Entrainment: Air-entrainment of normal weight concrete shall conform with Table III. Air-entrainment of lightweight structural concrete shall conform with Table IV. Determine air content by either ASTM C173 or ASTM C231.

**TABLE III - TOTAL AIR CONTENT
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)**

Nominal Maximum Size of Total Air Content	Coarse Aggregate, mm (Inches) Percentage by Volume
10 mm (3/8 in).6 to 10	13 mm (1/2 in).5 to 9
20 mm (3/4 in).4 to 8	25 mm (1 in).3-1/2 to 6-1/2
40 mm (1 1/2 in).3 to 6	

TABLE IV
AIR CONTENT OF LIGHTWEIGHT STRUCTURAL CONCRETE

Nominal Maximum size of Total Air Content	Coarse Aggregate, mm's (Inches) Percentage by Volume
Greater than 10 mm (3/8 in) 4 to 8	10 mm (3/8 in) or less 5 to 9

H. High early strength concrete, made with Type III cement or Type I cement plus non-corrosive accelerator, shall have a 7-day compressive strength equal to specified minimum 28-day compressive strength for concrete type specified made with standard Portland cement.

I. Lightweight structural concrete shall not weigh more than air-dry unit weight shown. Air-dry unit weight determined on 150 mm by 300 mm (6 inch by 12 inch) test cylinders after seven days standard moist curing followed by 21 days drying at 23 degrees C ± 1.7 degrees C (73.4 ± 3 degrees Fahrenheit), and 50 (plus or minus 7) percent relative humidity. Use wet unit weight of fresh concrete as basis of control in field.

J. Concrete slabs placed at air temperatures below 10 degrees C (50 degrees Fahrenheit) use non-corrosive, non-chloride accelerator. Concrete required to be air entrained use approved air entraining admixture. Pumped concrete, synthetic fiber concrete, architectural concrete, concrete required to be watertight, and concrete with a water/cement ratio below 0.50 use high-range water-reducing admixture (superplasticizer).

K. Durability: Use air entrainment for exterior exposed concrete subjected to freezing and thawing and other concrete shown or specified. Air content as shown in Table III or Table IV.

L. Enforcing Strength Requirements: Test as specified in Section 01 45 29, TESTING LABORATORY SERVICES, during the progress of the work. Seven-day tests may be used as indicators of 28-day strength. Average of any three 28-day consecutive strength tests of laboratory-cured specimens representing each type of concrete shall be equal to or greater than specified strength. No single test shall be more than 3.5 MPa (500 psi) below specified strength. Interpret field test results in accordance with ACI 214. Should strengths shown by test specimens fall below required values, Resident Engineer may require any one or any combination of the following corrective actions, at no additional cost to the Government:

1. Require changes in mix proportions by selecting one of the other appropriate trial mixes or changing proportions, including cement content, of approved trial mix.
2. Require additional curing and protection.
3. If five consecutive tests fall below 95 percent of minimum values given in Table I or if test results are so low as to raise a question as to the safety of the structure, Resident Engineer may direct Contractor to take cores from portions of the structure. Use results from cores tested by the Contractor retained testing agency to analyze structure.
4. If strength of core drilled specimens falls below 85 percent of minimum value given in Table I, Resident Engineer may order load tests, made by Contractor retained testing agency, on portions of building so affected. Load tests in accordance with ACI 318 and criteria of acceptability of concrete under test as given therein.
5. Concrete work, judged inadequate by structural analysis, by results of load test, or for any reason, shall be reinforced with additional construction or replaced, if directed by the Resident Engineer.

M. LEED Building Performance Criteria:

1. Cast-in-place Concrete shall contain pre-consumer and/or post-consumer recycled content as follows:

   a. Flyash: Concrete shall incorporate flyash as a replacement for at least 25% (by weight) of the portland cement. All design mixes are subject to review and approval by the Structural Engineer.

2. Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this section.

3. Concrete manufactured within 500 miles (by air) of the project site shall be documented in accordance with the LEED Building Submittal Requirements of this section.

4. Adhesives or sealants used for work in this section shall meet the requirements of Section 018113, “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable. Certification of these products shall be in accordance with the LEED Building Submittal Requirements of this section.

5. Recycled Steel: Reinforcing bar, steel wire, welded wire fabric, and miscellaneous steel accessories shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials.

2.4 BATCHING AND MIXING:

A. General: Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94, except as specified. Batch mixing at the site is permitted. Mixing process and equipment must be approved by Resident Engineer. With each batch of concrete, furnish certified delivery tickets listing information in Paragraph 16.1 and 16.2 of ASTM C94. Maximum delivery temperature of concrete is 38^{0}C (100 degrees Fahrenheit). Minimum delivery temperature as follows:

Atmospheric Temperature	Minimum Concrete Temperature
-1. degrees to 4.4 degrees C (30 degrees to 40 degrees F)	15.6 degrees C (60 degrees F.)
-17 degrees C to -1.1 degrees C (0 degrees to 30 degrees F.)	21 degrees C (70 degrees F.)

1. Services of aggregate manufacturer's representative shall be furnished during the design of trial mixes and as requested by the Resident Engineer for consultation during batching, mixing, and placing operations of lightweight structural concrete. Services will be required until field controls indicate that concrete of required quality is being furnished. Representative shall be thoroughly familiar with the structural lightweight aggregate, adjustment and control of mixes to produce concrete of required quality. Representative shall assist and advise Resident Engineer.

PART 3 – EXECUTION

3.1 FORMWORK:

A. General: Design in accordance with ACI 347 is the responsibility of the Contractor. The Contractor shall retain a registered Professional Engineer to design the formwork, shores, and reshores.

1. Form boards and plywood forms may be reused for contact surfaces of exposed concrete only if thoroughly cleaned, patched, and repaired and Resident Engineer approves their reuse.
2. Provide forms for concrete footings unless Resident Engineer determines forms are not necessary.
3. Corrugated fiberboard forms: Place forms on a smooth firm bed, set tight, with no buckled cartons to prevent horizontal displacement, and in a dry condition when concrete is placed.

B. Treating and Wetting: Treat or wet contact forms as follows:
1. Coat plywood and board forms with non-staining form sealer. In hot weather, cool forms by wetting with cool water just before concrete is placed.
2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
3. Use sealer on reused plywood forms as specified for new material.

C. Size and Spacing of Studs: Size and space studs, wales and other framing members for wall forms so as not to exceed safe working stress of kind of lumber used nor to develop deflection greater than 1/270 of free span of member.

D. Unlined Forms: Use plywood forms to obtain a smooth finish for concrete surfaces. Tightly butt edges of sheets to prevent leakage. Back up all vertical joints solidly and nail edges of adjacent sheets to same stud with 6d box nails spaced not over 150 mm (6 inches) apart.

E. Lined Forms: May be used in lieu of unlined plywood forms. Back up form lining solidly with square edge board lumber securely nailed to studs with all edges in close contact to prevent bulging of lining. No joints in lining and backing may coincide. Nail abutted edges of sheets to same backing board. Nail lining at not over 200 mm (8 inches) on center along edges and with at least one nail to each square foot of surface area; nails to be 3d blued shingle or similar nails with thin flatheads.

F. Architectural Liner: Attach liner as recommended by the manufacturer with tight joints to prevent leakage.

G. Wall Form Ties: Locate wall form ties in symmetrically level horizontal rows at each line of wales and in plumb vertical tiers. Space ties to maintain true, plumb surfaces. Provide one row of ties within 150 mm (6 inches) above each construction joint. Space through-ties adjacent to horizontal and vertical construction joints not over 450 mm (18 inches) on center.

1. Tighten row of ties at bottom of form just before placing concrete and, if necessary, during placing of concrete to prevent seepage of concrete and to obtain a clean line. Ties to be entirely removed shall be loosened 24 hours after concrete is placed and shall be pulled from least important face when removed.
2. Coat surfaces of all metal that is to be removed with paraffin, cup grease or a suitable compound to facilitate removal.

H. Inserts, Sleeves, and Similar Items: Flashing reglets, steel strips, masonry ties, anchors, wood blocks, nailing strips, grounds, inserts, wire hangers, sleeves, drains, guard angles, forms for floor hinge boxes, inserts or bond blocks for elevator guide rails and supports, and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned, and built into construction, and maintained securely in place.

1. Locate inserts or hanger wires for furred and suspended ceilings only in bottom of concrete joists, or similar concrete member of overhead concrete joist construction.
2. Install sleeves, inserts and similar items for mechanical services in accordance with drawings prepared specially for mechanical services. Contractor is responsible for accuracy and completeness of drawings and shall coordinate requirements for mechanical services and equipment.
3. Do not install sleeves in beams, joists or columns except where shown or permitted by Resident Engineer. Install sleeves in beams, joists, or columns that are not shown, but are permitted by the Resident Engineer, and require no structural changes, at no additional cost to the Government.
4. Minimum clear distance of embedded items such as conduit and pipe is at least three times diameter of conduit or pipe, except at stub-ups and other similar locations.
5. Provide recesses and blockouts in floor slabs for door closers and other hardware as necessary in accordance with manufacturer's instructions.

I. Construction Tolerances:

1. Set and maintain concrete formwork to assure erection of completed work within tolerances specified and to accommodate installation of other rough and finish materials. Accomplish remedial work necessary for correcting excessive tolerances. Erected work that exceeds

specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.

2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 PLACING REINFORCEMENT:

A. General: Details of concrete reinforcement in accordance with ACI 318 unless otherwise shown.

B. Placing: Place reinforcement conforming to CRSI DA4, unless otherwise shown.

1. Place reinforcing bars accurately and tie securely at intersections and splices with 1.6 mm (16 gauge) black annealed wire. Secure reinforcing bars against displacement during the placing of concrete by spacers, chairs, or other similar supports. Portions of supports, spacers, and chairs in contact with formwork shall be made of plastic in areas that will be exposed when building is occupied. Type, number, and spacing of supports conform to ACI 318. Where concrete slabs are placed on ground, use concrete blocks or other non-corrodible material of proper height, for support of reinforcement. Use of brick or stone supports will not be permitted.

2. Lap welded wire fabric at least 1 1/2 mesh panels plus end extension of wires not less than 300 mm (12 inches) in structural slabs. Lap welded wire fabric at least 1/2 mesh panels plus end extension of wires not less than 150 mm (6 inches) in slabs on grade.

3. Splice column steel at no points other than at footings and floor levels unless otherwise shown.

C. Spacing: Minimum clear distances between parallel bars, except in columns and multiple layers of bars in beams shall be equal to nominal diameter of bars. Minimum clear spacing is 25 mm (1 inch) or 1-1/3 times maximum size of coarse aggregate.

D. Splicing: Splices of reinforcement made only as required or shown or specified. Accomplish splicing as follows:

1. Lap splices: Do not use lap splices for bars larger than Number 36 (Number 11). Minimum lengths of lap as shown.

2. Welded splices: Splicing by butt-welding of reinforcement permitted providing the weld develops in tension at least 125 percent of the yield strength (fy) for the bars. Welding conform to the requirements

of AWS D1.4. Welded reinforcing steel conform to the chemical analysis requirements of AWS D1.4.

a. Submit test reports indicating the chemical analysis to establish weldability of reinforcing steel.
b. Submit a field quality control procedure to insure proper inspection, materials and welding procedure for welded splices.
c. Department of Veterans Affairs retained testing agency shall test a minimum of three splices, for compliance, locations selected by Resident Engineer.

3. Mechanical Splices: Develop in tension and compression at least 125 percent of the yield strength (fy) of the bars. Stresses of transition splices between two reinforcing bar sizes based on area of smaller bar. Provide mechanical splices at locations indicated. Use approved exothermic, tapered threaded coupling, or swaged and threaded sleeve. Exposed threads and swaging in the field not permitted.
   a. Initial qualification: In the presence of Resident Engineer, make three test mechanical splices of each bar size proposed to be spliced. Department of Veterans Affairs retained testing laboratory will perform load test.
   b. During installation: Furnish, at no additional cost to the Government, one companion (sister) splice for every 50 splices for load testing. Department of Veterans Affairs retained testing laboratory will perform the load test.

E. Bending: Bend bars cold, unless otherwise approved. Do not field bend bars partially embedded in concrete, except when approved by Resident Engineer.

F. Cleaning: Metal reinforcement, at time concrete is placed, shall be free from loose flaky rust, mud, oil, or similar coatings that will reduce bond.

G. Future Bonding: Protect exposed reinforcement bars intended for bonding with future work by wrapping with felt and coating felt with a bituminous compound unless otherwise shown.

3.3 VAPOR BARRIER:

A. Except where membrane waterproofing is required, interior concrete slab on grade shall be placed on a continuous vapor barrier.
   1. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.

2. Vapor barrier joints lapped 150 mm (6 inches) and sealed with compatible waterproof pressure-sensitive tape.
3. Patch punctures and tears.

3.4 MOISTURE VAPOR EMISSIONS & ALKALINITY CONTROL SEALER:

A. Sealer is applied on the day of the concrete pour or as as soon as harsh weather permits, prior to any other chemical treatments for concrete slabs either on grade, below grade or above grade receiving resilient flooring, such as, sheet vinyl, vinyl composition tile, rubber, wood flooring, carpet, epoxy coatings and overlays.

B. Manufacturer’s representative will be on the site the day of concrete pour to install or train its application and document. He shall return on every application thereafter to verify that proper procedures are followed.

1. Apply Sealer to concrete slabs as soon as final finishing operations are complete and the concrete has hardened sufficiently to sustain floor traffic without damage.
2. Spray apply Sealer at the rate of 20 m^2 (200 square feet) per gallon. Lightly broom product evenly over the substrate and product has completely penetrated the surface.
3. If within two (2) hours after initial application areas are subjected to heavy rainfall and puddling occurs, reapply Sealer product to these areas as soon as weather condition permits.

3.5 CONSTRUCTION JOINTS:

A. Unless otherwise shown, location of construction joints to limit individual placement shall not exceed 24,000 mm (80 feet) in any horizontal direction, except slabs on grade which shall have construction joints shown. Allow 48 hours to elapse between pouring adjacent sections unless this requirement is waived by Resident Engineer.

B. Locate construction joints in suspended floors near the quarter-point of spans for slabs, beams or girders, unless a beam intersects a girder at center, in which case joint in girder shall be offset a distance equal to twice width of beam. Provide keys and inclined dowels as shown. Provide longitudinal keys as shown.

C. Place concrete for columns slowly and in one operation between joints. Install joints in concrete columns at underside of deepest beam or girder framing into column.

D. Allow 2 hours to elapse after column is cast before concrete of supported beam, girder or slab is placed. Place girders, beams, grade beams, column capitals, brackets, and haunches at the same time as slab unless otherwise shown.

E. Install polyvinyl chloride or rubber water seals, as shown in accordance with manufacturer's instructions, to form continuous watertight seal.

3.6 EXPANSION JOINTS:

A. Clean expansion joint surfaces before installing premolded filler and placing adjacent concrete.

B. Install polyvinyl chloride or rubber water seals, as shown in accordance with manufacturer's instructions, to form continuous watertight seal.

3.7 PLACING CONCRETE:

A. Preparation:

1. Remove hardened concrete, wood chips, shavings and other debris from forms.
2. Remove hardened concrete and foreign materials from interior surfaces of mixing and conveying equipment.
3. Have forms and reinforcement inspected and approved by Resident Engineer before depositing concrete.
4. Provide runways for wheeling equipment to convey concrete to point of deposit. Keep equipment on runways which are not supported by or bear on reinforcement. Provide similar runways for protection of vapor barrier on coarse fill.

B. Bonding: Before depositing new concrete on or against concrete which has been set, thoroughly roughen and clean existing surfaces of laitance, foreign matter, and loose particles.

1. Preparing surface for applied topping:
   a. Remove laitance, mortar, oil, grease, paint, or other foreign material by sand blasting. Clean with vacuum type equipment to remove sand and other loose material.
   b. Broom clean and keep base slab wet for at least four hours before topping is applied.
   c. Use a thin coat of one part Portland cement, 1.5 parts fine sand, bonding admixture; and water at a 50: 50 ratio and mix to achieve the consistency of thick paint. Apply to a damp base slab by scrubbing with a stiff fiber brush. New concrete shall be placed while the bonding grout is still tacky.

C. Conveying Concrete: Convey concrete from mixer to final place of deposit by a method which will prevent segregation. Method of conveying concrete subject to approval of Resident Engineer.

D. Placing: For special requirements see Paragraphs, HOT WEATHER and COLD WEATHER.

1. Do not place concrete when weather conditions prevent proper placement and consolidation, or when concrete has attained its initial set, or has contained its water or cement content more than 1 1/2 hours.
2. Deposit concrete in forms as near as practicable in its final position. Prevent splashing of forms or reinforcement with concrete in advance of placing concrete.
3. Do not drop concrete freely more than 3000 mm (10 feet) for concrete containing the high-range water-reducing admixture (superplasticizer) or 1500 mm (5 feet) for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk), attached to a suitable hopper.
4. Discharge contents of tremies or flexible spouts in horizontal layers not exceeding 500 mm (20 inches) in thickness, and space tremies such as to provide a minimum of lateral movement of concrete.
5. Continuously place concrete until an entire unit between construction joints is placed. Rate and method of placing concrete shall be such that no concrete between construction joints will be deposited upon or against partly set concrete, after it's initial set has taken place, or after 45 minutes of elapsed time during concrete placement.
6. On bottom of members with severe congestion of reinforcement, deposit 25 mm (1 inch) layer of flowing concrete containing the specified high-range water-reducing admixture (superplasticizer). Successive concrete lifts may be a continuation of this concrete or concrete with a conventional slump.
7. Concrete on metal deck:
   a. Concrete on metal deck shall be minimum thickness shown. Allow for deflection of steel beams and metal deck under the weight of wet concrete in calculating concrete quantities for slab.
      1) The Contractor shall become familiar with deflection characteristics of structural frame to include proper amount of additional concrete due to beam/deck deflection.

E. Consolidation: Conform to ACI 309. Immediately after depositing, spade concrete next to forms, work around reinforcement and into angles of

forms, tamp lightly by hand, and compact with mechanical vibrator applied directly into concrete at approximately 450 mm (18 inch) intervals. Mechanical vibrator shall be power driven, hand operated type with minimum frequency of 5000 cycles per minute having an intensity sufficient to cause flow or settlement of concrete into place. Vibrate concrete to produce thorough compaction, complete embedment of reinforcement and concrete of uniform and maximum density without segregation of mix. Do not transport concrete in forms by vibration.

1. Use of form vibration shall be approved only when concrete sections are too thin or too inaccessible for use of internal vibration.
2. Carry on vibration continuously with placing of concrete. Do not insert vibrator into concrete that has begun to set.

3.8 HOT WEATHER:

Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.

3.9 COLD WEATHER:

Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyantes or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.

3.10 PROTECTION AND CURING:

A. Conform to ACI 308: Initial curing shall immediately follow the finishing operation. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, wind, mechanical injury, and excessively hot or cold temperatures. Keep concrete not covered with membrane or other curing material continuously wet for at least 7 days after placing, except wet curing period for high-early-strength concrete shall be not less than 3 days. Keep wood forms continuously wet to prevent moisture loss until forms are removed. Cure exposed concrete surfaces as described below. Other curing methods may be used if approved by Resident Engineer.

1. Liquid curing and sealing compounds: Apply by power-driven spray or roller in accordance with the manufacturer's instructions. Apply immediately after finishing. Maximum coverage $10m^2/L$ (400 square feet per gallon) on steel troweled surfaces and $7.5m^2/L$ (300 square feet per gallon) on floated or broomed surfaces for the curing/sealing compound.
2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with tape.
3. Paper: Utilize widest practical width paper and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.

3.11 REMOVAL OF FORMS:

A. Remove in a manner to assure complete safety of structure after the following conditions have been met.
   1. Where structure as a whole is supported on shores, forms for beams and girder sides, columns, and similar vertical structural members may be removed after 24 hours, provided concrete has hardened sufficiently to prevent surface damage and curing is continued without any lapse in time as specified for exposed surfaces.
   2. Take particular care in removing forms of architectural exposed concrete to insure surfaces are not marred or gouged, and that corners and arises are true, sharp and unbroken.

B. Control Test: Use to determine if the concrete has attained sufficient strength and curing to permit removal of supporting forms. Cylinders required for control tests taken in accordance with ASTM C172, molded in accordance with ASTM C31, and tested in accordance with ASTM C39. Control cylinders cured and protected in the same manner as the structure they represent. Supporting forms or shoring not removed until strength of control test cylinders have attained at least 70 percent of minimum 28-day compressive strength specified. Exercise care to assure that newly unsupported portions of structure are not subjected to heavy construction or material loading.

C. Reshoring: Reshoring is required if superimposed load plus dead load of the floor exceeds the capacity of the floor at the time of loading. Reshoring accomplished in accordance with ACI 347 at no additional cost to the Government.

3.12 CONCRETE SURFACE PREPARATION:

A. Metal Removal: Unnecessary metal items cut back flush with face of concrete members.

B. Patching: Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 25 mm (1 inch). Cut edge perpendicular to surface of concrete. Saturate with water area to be patched, and at least 150 mm (6 inches) surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force mortar through wall. Wipe excess mortar off exposed face with a cloth.

C. Upon removal of forms, clean vertical concrete surface that is to receive bonded applied cementitious application with wire brushes or by sand blasting to remove unset material, laitance, and loose particles to expose aggregates to provide a clean, firm, granular surface for bond of applied finish.

3.13 CONCRETE FINISHES:

A. Vertical and Overhead Surface Finishes:

1. Unfinished areas: Vertical and overhead concrete surfaces exposed in pipe basements, elevator and dumbwaiter shafts, pipe spaces, pipe trenches, above suspended ceilings, manholes, and other unfinished areas will not require additional finishing.
2. Interior and exterior exposed areas to be painted: Remove fins, burrs and similar projections on surfaces flush, and smooth by mechanical

means approved by Resident Engineer, and by rubbing lightly with a fine abrasive stone or hone. Use ample water during rubbing without working up a lather of mortar or changing texture of concrete.

3. Interior and exterior exposed areas finished: Give a grout finish of uniform color and smooth finish treated as follows:
   a. After concrete has hardened and laitance, fins and burrs removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone stone.
   b. Apply grout composed of one part of Portland cement, one part fine sand, smaller than a 600 µm (No. 30) sieve. Work grout into surface of concrete with cork floats or fiber brushes until all pits, and honeycombs are filled.
   c. After grout has hardened slightly, but while still plastic, scrape grout off with a sponge rubber float and, about 1 hour later, rub concrete vigorously with burlap to remove any excess grout remaining on surfaces.
   d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish of area in same day. Make limits of finished areas at natural breaks in wall surface. Leave no grout on concrete surface overnight.
4. Textured: Finish as specified. Maximum quantity of patched area 0.2 m^2 (2 square feet) in each 93 m^2 (1000 square feet) of textured surface.

B. Slab Finishes:
1. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances. Monitor elevations of structural steel in key locations before and after concrete placement to establish typical deflection patterns for the structural steel. Determine elevations of cast-in-place slab soffits prior to removal of shores. Provide information to Resident Engineer and floor consultant for evaluation and recommendations for subsequent placements.
2. Set perimeter forms to serve as screed using either optical or laser instruments. For slabs on grade, wet screeds may be used to establish initial grade during strike-off, unless Resident Engineer determines that the method is proving insufficient to meet required finish tolerances and directs use of rigid screed guides. Where wet screeds are allowed, they shall be placed using grade stakes set by optical

or laser instruments. Use rigid screed guides, as opposed to wet screeds, to control strike-off elevation for all types of elevated (non slab-on-grade) slabs. Divide bays into halves or thirds by hard screeds. Adjust as necessary where monitoring of previous placements indicates unshored structural steel deflections to other than a level profile.

3. Place slabs monolithically. Once slab placement commences, complete finishing operations within same day. Slope finished slab to floor drains where they occur, whether shown or not.
4. Use straightedges specifically made for screeding, such as hollow magnesium straightedges or power strike-offs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strike-off. Repeat strike-off as necessary. Complete screeding before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.
5. Immediately following screeding, and before any bleed water appears, use a 3000 mm (10 foot) wide highway straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or darbys, except that darbying may be allowed for narrow slabs and restricted spaces.
6. Wait until water sheen disappears and surface stiffens before proceeding further. Do not perform subsequent operations until concrete will sustain foot pressure with maximum of 6 mm (1/4 inch) indentation.
7. Scratch Finish: Finish base slab to receive a bonded applied cementitious application as indicated above, except that bull floats and darbys may be used. Thoroughly coarse wire broom within two hours after placing to roughen slab surface to insure a permanent bond between base slab and applied materials.
8. Float Finish: Slabs to receive unbonded toppings, steel trowel finish, fill, mortar setting beds, or a built-up roof, and ramps, stair treads, platforms (interior and exterior), and equipment pads shall be floated to a smooth, dense uniform, sandy textured finish. During floating, while surface is still soft, check surface for flatness using a 3000 mm (10 foot) highway straightedge. Correct high spots by cutting down and correct low spots by filling in with

material of same composition as floor finish. Remove any surface projections and re-float to a uniform texture.

9. Steel Trowel Finish: Concrete surfaces to receive resilient floor covering or carpet, monolithic floor slabs to be exposed to view in finished work, future floor roof slabs, applied toppings, and other interior surfaces for which no other finish is indicated. Steel trowel immediately following floating. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure to compact cement paste and form a dense, smooth surface. Finished surface shall be smooth, free of trowel marks, and uniform in texture and appearance.
10. Broom Finish: Finish exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after surfaces have been floated. Brush in a direction transverse to main traffic. Match texture approved by Resident Engineer from sample panel.
11. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:
    a. Areas covered with carpeting, or not specified otherwise in b. below:
       1) Slab on Grade:
          a) Specified overall value F_F 25/F_L 20
          b) Minimum local value F_F 17/F_L 15
       2) Level suspended slabs (shored until after testing) and topping slabs:
          a) Specified overall value FF 25/FL 20
          b) Minimum local value FF 17/FL 15
       3) Unshored suspended slabs:
          a) Specified overall value FF 25
          b) Minimum local value FF 17
       4) Level tolerance such that 80 percent of all points fall within a 20 mm (3/4 inch) envelope +10 mm, -10 mm (+3/8 inch, -3/8 inch) from the design elevation.
    b. Areas that will be exposed, receive thin-set tile or resilient flooring, or roof areas designed as future floors:
       1) Slab on grade:
          a) Specified overall value FF 36/FL 20
          b) Minimum local value FF 24/FL 15
       2) Level suspended slabs (shored until after testing) and topping slabs

a) Specified overall value FF 30/FL 20
b) Minimum local value FF 24/FL 15

3) Unshored suspended slabs:
a) Specified overall value FF 30
b) Minimum local value FF 24

4) Level tolerance such that 80 percent of all points fall within a 20 mm (3/4 inch) envelope +10 mm, -10 mm (+3/8 inch, -3/8 inch) from the design elevation.

c. "Specified overall value" is based on the composite of all measured values in a placement derived in accordance with ASTM E1155.

d. "Minimum local value" (MLV) describes the flatness or levelness below which repair or replacement is required. MLV is based on the results of an individual placement and applies to a minimum local area. Minimum local area boundaries may not cross a construction joint or expansion joint. A minimum local area will be bounded by construction and/or control joints, or by column lines and/or half-column lines, whichever is smaller.

12. Measurements

a. Department of Veterans Affairs retained testing laboratory will take measurements as directed by Resident Engineer, to verify compliance with FF, FL, and other finish requirements. Measurements will occur within 72 hours after completion of concrete placement (weekends and holidays excluded). Make measurements before shores or forms are removed to insure the "as-built" levelness is accurately assessed. Profile data for above characteristics may be collected using a laser level or any Type II apparatus (ASTM E1155, "profileograph" or "dipstick"). Contractor's surveyor shall establish reference elevations to be used by Department of Veterans Affairs retained testing laboratory.

b. Contractor not experienced in using FF and FL criteria is encouraged to retain the services of a floor consultant to assist with recommendations concerning adjustments to slab thicknesses, finishing techniques, and procedures on measurements of the finish as it progresses in order to achieve the specific flatness and levelness numbers.

13. Acceptance/ Rejection:

a. If individual slab section measures less than either of specified minimum local F_F/F_L numbers, that section shall be rejected and remedial measures shall be required. Sectional boundaries may be set at construction and contraction (control) joints, and not smaller than one-half bay.

b. If composite value of entire slab installation, combination of all local results, measures less than either of specified overall F_F/F_L numbers, then whole slab shall be rejected and remedial measures shall be required.

14. Remedial Measures for Rejected Slabs: Correct rejected slab areas by grinding, planing, surface repair with underlayment compound or repair topping, retopping, or removal and replacement of entire rejected slab areas, as directed by Resident Engineer, until a slab finish constructed within specified tolerances is accepted.

3.14 SURFACE TREATMENTS:

A. Use on exposed concrete floors and concrete floors to receive carpeting except those specified to receive non-slip finish.

B. Liquid Densifier/Sealer: Apply in accordance with manufacturer's directions just prior to completion of construction.

C. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Broadcast aggregate uniformly over concrete surface at rate of application of 8% per 1/10th m^2 (7.5 percent per square foot) of area. Trowel concrete surface to smooth dense finish. After curing, rub treated surface with abrasive brick and water to slightly expose abrasive aggregate.

3.15 APPLIED TOPPING:

A. Separate concrete topping on floor base slab of thickness and strength shown. Topping mix shall have a maximum slump of 200 mm (8 inches) for concrete containing a high-range water-reducing admixture (superplasticizer) and 100 mm (4 inches) for conventional mix. Neatly bevel or slope at door openings and at slabs adjoining spaces not receiving an applied finish.

B. Placing: Place continuously until entire section is complete, struck off with straightedge, leveled with a highway straightedge or highway bull float, floated and troweled by machine to a hard dense finish. Slope to floor drains as required. Do not start floating until free water has

disappeared and no water sheen is visible. Allow drying of surface moisture naturally. Do not hasten by "dusting" with cement or sand.

3.16 RESURFACING FLOORS:

Remove existing flooring areas to receive resurfacing to expose existing structural slab and extend not less than 25 mm (1 inch) below new finished floor level. Prepare exposed structural slab surface by roughening, broom cleaning, and dampening. Apply specified bonding grout. Place topping while the bonding grout is still tacky.

3.17 RETAINING WALLS:

A. Use air-entrained concrete.
B. Expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves installed and constructed as shown.
C. Exposed surfaces finished to match adjacent concrete surfaces, new or existing.
D. Place porous backfill as shown.

3.18 PRECAST CONCRETE ITEMS:

Precast concrete items, not specified elsewhere. Cast using 25 MPa (3000 psi) air-entrained concrete to shapes and dimensions shown. Finish to match corresponding adjacent concrete surfaces. Reinforce with steel for safe handling and erection.

- - - E N D - - -

LEED Concrete Mix Form

Project Name: _____ Contractor Name: _____ VA Submittal Number: _____

VA Project Number: _____ Telephone Number: _____ VA Submittal Date: _____

(Fill out one form per mix design)

MIX NUMBER:				**RECYCLED CONTENT**		**REGIONAL MATERIALS**	
Total Cubic Yards Used on Site:		**INGREDIENT WEIGHT**	**INGREDIENT COST**[1]	**POST-CONSUMER**[2]	**PRE-CONSUMER**[3]	**RAW RESOURCES LOCATION**[5]	**SUPPORTING DOCUMENTS**[6]
Total Concrete Cost Used on Site:							
INGREDIENTS (per Cubic Yard)		(lbs / cubic yard)	($ / lbs)	(%)	(%)	(City, State)	
EXAMPLE: Cast In Place		*752*	*$0.11*	*0%*	*0%*	*Lebanon, PA*	☑ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other
Cement							☐ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other
Fly Ash							☐ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other
Blast Furnace Slag							☐ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other
Fine Aggregate							☐ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other
Coarse Aggregate							☐ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other
Admixture 1							☐ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other
Admixture 2							☐ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other
(other)							☐ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other
(other)							☐ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other
(other)							☐ MSDS/ Cut Sheet/ Manufacturer Letter ☐ Other

[1]***Material Cost ($)***: The cost of the materials as it would appear on the manufacturer's or distributor's invoice to the contractor or subcontractor. Note: This does not include labor or equipment costs associated with the installation of the material or product.

[2]***Post-Consumer Recycled Content (%)***: Portion (by weight) of material or product which derives from discarded consumer waste that has served its intended purpose and has been recovered for use as a raw material (e.g. glass from a bottle).

[3]***Pre-Consumer Recycled Content (%)***: (also called Post-Industrial) Portion (by weight) of material or product which derives from recovered industrial and manufacturing waste materials that are diverted for use in a different manufacturing process prior to use by a consumer (e.g. fly-ash in concrete is a recovered waste product from coal burning electricity plants). Note: Pre-Consumer Recycled Content does not include scrap raw materials that can be reused in the same manufacturing process from which they are recovered.

[5]***Raw Resources Location (City, State)***: The location from which the building product components were extracted, harvested, or recovered (e.g. in the example above, the Raw Resources Location of the cement is Lebanon, PA).

[6]***Supporting Documents***: Required to verify the accuracy of the information supplied on this form; may include, but are not limited to: Material Safety Data Sheets (MSDS), Product Data Sheets (cut sheets), Manufacturer Letters of Certification provided on the manufacturer's letterhead.

I, _____ a duly authorized representative of _____ hereby certify that the material information contained herein is an accurate representation of the material qualifications to be provided by us, as components of the final building construction. Furthermore, I understand that any change in such qualifications during the purchasing period will require prior written approval from the Contractor and Contracting Officer Technical Representative.

_____ _____

Signature of Authorized Representative Date

SECTION **03** 36 00

CONCRETE FINISHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pigmented interior and exterior floor coatings.

B. Decorative floor and wall overlay techniques to mimic pattern, texture and color of natural occurring materials and artistic designs.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast In-Place Concrete: Concrete mix designs and additives.

1.3 REFERENCES

A. Sampling and Testing for Chloride Ion In Concrete and Concrete Raw Materials.

B. AASHTO T259 - Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration.

C. ANSI A 118.4 - Specifications for Latex Portland Cement Mortar.

D. ASTM C23 - Determination of Particle Size Distribution of Soils in Forensic Science Using Classical and Modern Instrumental Methods.

E. ASTM C78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

F. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).

G. ASTM C190 - Method of Test for Tensile Strength of Hydraulic Cement Mortars.

H. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

I. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.

J. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

K. ASTM C666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.

L. ASTM C882 Modified - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear.

M. ASTM C944 - Standard Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating-Cutter Method.

N. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.

O. ASTM D1849 - Standard Test Method for Package Stability of Paint.

P. ASTM D3359 - Standard Test Methods for Measuring Adhesion by Tape Test.

Q. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test.

R. ASTM D4946 - Standard Test Method for Blocking Resistance of Architectural Paints.

S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

T. ASTM G53 - Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

C. Shop Drawings: Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

B. Installer Qualifications:

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish areas designated by Architect.

2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

3. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated in SCHEDULE FOR FINISHES 09 06 00or a comparable product by one of the following:

1. SureCrete Design Products
2. Bulach Custom Rokc
3. AVM Industries
4. Concrete Solutions

B. Stamp Topping/Overlay: SureStamp by SureCrete Design Products.

1. Performance:

a. Thickness: 1/4 inch to 3/8 inch (6.35 mm to 9.5 mm).

b. Compressive Strength (ASTM C109): 7 day 3580 psi (24,683. kPa), 28 day 4350 psi (29,972 kPa).

c. Flexural Strength (ÅSTM C78): 9 day 880.7 psi (6063 kPa), 28 day 1494.3 psi (10,296 kPa).

2. Pigment Color: Product as indicated in Section 09 06 00 SCHEDULE FOR FINISHES

C. Tool Release Agent: Liquid Release Stamping Tool: Standard and custom fabricated concrete stamping tools to achieve required surface profile, texture and design required. Urethane materials compatible with manufacturer's standard products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Prepare exterior surfaces with chemical cleaner/profiler followed by rinsing with 3000-psi (20670 kPa) (minimum) pressure washer equipped with a turbo-tip to remove loose surface matrix and loose aggregate.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 STAMP OVERLAY / CEMENTITIOUS TOPPING

A. Bond Coat: Begin by saturating area to be covered with water. Before application of bond coat, remove any excess water leaving no puddles. The

surface should be saturated, surface dry (SSD). Place the bond coat with a squeegee and force into surface completely covering existing concrete with this slurry. Apply only in sections that may be covered with stamp mix while maintaining a wet edge.

B. Stamp Coat: While the bond coat is still wet apply stamp coat. Mix water and integrally tint if required. Mechanically mix to a lump-free consistency. Use a gauge rake to apply stamp coat at 1/4 to 3/8 inch (6 mm to 9.5 mm), then steel trowel, fresno, or steel squeegee to a smooth and slick surface. Use surface retarder in hot and/or windy conditions to slow initial evaporation of surface. Allow stamp coat to set until material does not stick easily to the finger when touched, but yields to pressure.

C. Apply stamps, texture to affect pattern desired. Use clear liquid release agent.

D. Clean-up and detail double lines from stamping tools.

E. Apply secondary coloring and 2 coats of selected sealer.

3.4SURFACE TREATMENTS

A. Dry Shake Surface Hardeners:

1. Hand broadcast evenly to the surface of freshly placed concrete when the concrete reaches the point where no bleed water remains on the surface.

2. Do not spray water on the treated substrate.

3. Apply in two shakes, with two-thirds being applied in the first shake and one-third in the second shake (holding back a small amount for touch up work).

4. After the first shake, the surface is floated. Do not trowel between applications.

5. Apply the second shake perpendicular to the first application in a uniform manner. Float in and trowel to the final finish desired.

6. Install construction or control joints as soon as possible. Prevent trowel burns, especially at tooled joints and edges, when hard steel troweling.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

- - - END - - -

SECTION 03 54 16

HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes hydraulic-cement-based underlayment for use below interior floor coverings.

B. Related Sections include the following:

1. Division 09 Sections for patching and leveling compounds applied with floor coverings.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements:

1. A completed LEED Concrete Mix Form– Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. LEED concrete mix form is attached at the end of this section. Information to be supplied includes:

a. The weight (lbs/ cubic yard) of all ingredients of the concrete mix such as cement, flyash, blast furnace slag, aggregates and admixtures.

b. Provide material costs of all ingredients in the concrete mix. Material cost does not include costs associated with labor and equipment.

c. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

d. The manufacturing location for the product(s); and the location(source) of the raw materials used to manufacture the product(s).

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

4. Product Data for Credit IEQ 4.2: For priming and sealing coatings, documentation including printed statement of VOC

content.

5. Laboratory Test Reports for Credit IEQ 4: For priming and sealing coatings documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for theTesting of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers”

B. Product Data: For each type of product indicated.

C. Shop Drawings: Plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

D. Manufacturer Certificates: Signed by manufacturers of both underlayment and floor covering system certifying that products are compatible.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

B. Product Compatibility: Manufacturers of both underlayment and floor covering system certify in writing that products are compatible.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature and humidity, ventilation, and other conditions affecting underlayment performance.

1. Place hydraulic-cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 degrees F.

1.7 COORDINATION

A. Coordinate application of underlayment with requirements of floor covering products, including adhesives, specified in Division 09 Sections, to ensure compatibility of products.

PART 2 - PRODUCTS

2.1 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

A. Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thicknesses of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Ardex; K-15 Self-Leveling Underlayment Concrete

b. Bonsal, W. R. Company; Self-Leveling Underlayment

c. ChemRex; MBT Mastertop 110 Plus Underlayment.

2. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.

3. Compressive Strength: Not less than [4100 psi] at 28 days when tested according to ASTM C 109/C 109M.

B. Water: Potable and at a temperature of not more than 70 deg F

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance.

1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.

2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.

2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.

3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended

spreading rate.

C. Apply underlayment to produce uniform, level surface.

1. Apply a final layer without aggregate to produce surface.

2. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

A. Protect underlayment from concentrated and rolling loadsfor remainder of construction period.

- - - E N D - - -

SECTION 04 05 13

MASONRY MORTARING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Section specifies mortar materials and mixes.

1.2 RELATED WORK:

A. Mortar used in Section:

1. Section 04 05 16, MASONRY GROUTING.
2. Section 04 20 00, UNIT MASONRY.
3. Section 04 72 00, CAST STONE MASONRY.

B. Mortar Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 TESTING LABORATORY-CONTRACTOR RETAINED

A. Engage a commercial testing laboratory approved by Resident Engineer to perform tests specified below.

B. Submit information regarding testing laboratory's facilities and qualifications of technical personnel to Resident Engineer.

1.4 TESTS

A. Test mortar and materials specified.

B. Certified test reports.

C. Identify materials by type, brand name and manufacturer or by origin.

D. Do not use materials until laboratory test reports are approved by Resident Engineer.

E. After tests have been made and materials approved, do not change without additional test and approval of Resident Engineer.

F. Testing:

1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
2. Mortar:
   a. Test for compressive strength and water retention; ASTM C270.
   b. Mortar compressive strengths 28 days as follows:
      1) Type M: Minimum 17230 kPa (2500 psi) at 28 days.
      2) Type S: Minimum 12400 kPa (1800 psi) at 28 days.
      3) Type N: Minimum 5170 kPa (750 psi) at 28 days.
3. Cement:
   a. Test for water soluble alkali (nonstaining) when nonstaining cement

is specified.

b. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.

4. Sand: Test for deleterious substances, organic impurities, soundness and grading.

5. High Bond Mortar: Test for compressive strength, tensile strength, flexural strength, and brick bond strength.

G. During progress of work, testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES, takes and tests samples as specified in that section. Testing procedures and test methods in ASTM C780.

1.5 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013300 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Certificates:

1. Testing laboratory's facilities and qualifications of its technical

personnel.

2. Indicating that following items meet specifications:

a. Portland cement.

b. Masonry cement.

c. Mortar cement.

d. Hydrated lime.

e. Fine aggregate (sand).

f. Color admixture.

D. Laboratory Test Reports:

1. Mortar, each type.

2. Admixtures.

E. Manufacturer's Literature and Data:

1. Cement, each kind.

2. Hydrated lime.

3. Admixtures.

4. Liquid acrylic resin.

1.6 QUALITY ASSURANCE:

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable and on all interior mortar.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.

B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.8 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Society for Testing and Materials (ASTM):

1. C40-04 Organic Impurities in Fine Aggregates for Concrete
2. C91-05 Masonry Cement
3. C109-07 Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-MM Cube Specimens)
4. C144-04 Aggregate for Masonry Mortar
5. C150-05 Portland Cement
6. C207-06 Hydrated Lime for Masonry Purposes
7. C270-07 Mortar for Unit Masonry
8. C307-03 Tensile Strength of Chemical - Resistant Mortar, Grouts, and Monolithic Surfacing
9. C321-00/R05 Bond Strength of Chemical-Resistant Mortars
10. C348-02 Flexural Strength of Hydraulic Cement Mortars
11. C595-08 Blended Hydraulic Cement
12. C780-07 Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
13. C979-05 Pigments for Integrally Colored Concrete
14. C1329-05 Mortar Cement

PART 2 - PRODUCTS

2.1 HYDRATED LIME

A. ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY MORTAR

A. ASTM C144 and as follows:

1. White plastering sand meeting sieve analysis for mortar joints for pointing.

B. Test sand for color value in accordance with ASTM C40. Sand producing color darker than specified standard is unacceptable.

2.3 MASONRY CEMENT

A. ASTM C91. Type N, S, or M.

B. Use white masonry cement whenever white mortar is specified.

2.4 MORTAR CEMEMT

A. ASTM C1329, Type N, S or M.

2.5 PORTLAND CEMENT

A. ASTM C150, Type I.

B. Use white Portland cement wherever white mortar is specified.

2.6 WATER

A. Potable, free of substances that are detrimental to mortar, masonry, and

metal.

2.7 MASONRY MORTAR

A. Conform to ASTM C270.

B. Admixtures:

1. Do not use mortar admixtures, unless approved by Resident Engineer.

C. Colored Mortar:

1. Maintain uniform mortar color for exposed work throughout.

2. Match mortar color in approved sample.

PART 3 - EXECUTION

3.1 MIXING

A. Mix in a mechanically operated mortar mixer.

1. Mix mortar for at least three minutes but not more than five minutes.

B. Measure ingredients by volume. Measure by the use of a container of known capacity.

C. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces of masonry units.

D. Mortar that has stiffened because of loss of water through evaporations:

1. Re-tempered by adding water to restore to proper consistency and workability.

2. Discard mortar that has reached its initial set or has not been used within two hours.

E. Pointing Mortar:

1. Mix dry ingredients with enough water to produce a damp mixture of workable consistency which will retain its shape when formed into a ball.

2. Allow mortar to stand in dampened condition for 1 to 1-1/2 hours.

3. Add water to bring mortar to a workable consistency prior to application.

3.2 MORTAR USE LOCATION

A. Use Type M mortar for waterproof parging below grade.

B. Use Type S mortar for masonry containing vertical reinforcing bars (non-engineered) setting cast stone.

C. Use Type N mortar for other masonry work, except as otherwise specified.

D. Use Type N mortar for tuck pointing work.

E. Use pointing mortar for items specified.

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SECTION 04 05 16

MASONRY GROUTING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Section specifies grout materials and mixes.

1.2 RELATED WORK:

A. Grout used in Section:

1. Section 04 20 00, UNIT MASONRY.
2. Section 04 72 00, CAST STONE MASONRY.

B. Grout Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 TESTS:

A. Test grout and materials specified.

B. Certified test reports.

C. Identify materials by type, brand name and manufacturer or by origin.

D. Do not use materials until laboratory test reports are approved by Resident Engineer.

E. After tests have been made and materials approved, do not change without additional test and approval of Resident Engineer.

F. Testing:

1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
2. Grout:
   a. Test for compressive strength; ASTM C1019.
   b. Grout compressive strength of 13790 kPa (2000 psi) at 28 days.
3. Cement:
   a. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
   b. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.
4. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Certificates:

1. Indicating that following items meet specifications:
   a. Portland cement.
   b. Masonry cement.
   c. Grout.
   d. Hydrated lime.
   e. Fine aggregate (sand).
   f. Coarse aggregate for grout.
   g. Color admixture.

C. Laboratory Test Reports:
   1. Grout, each type.
   2. Admixtures.

D. Manufacturer's Literature and Data:
   1. Cement, each kind.
   2. Hydrated lime.
   3. Admixtures.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.

B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.6 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Society for Testing and Materials (ASTM):
   1. C40-04 Organic Impurities in Fine Aggregates for Concrete
   2. C91-05 Masonry Cement
   3. C150-05 Portland Cement
   4. C207-06 Hydrated Lime for Masonry Purposes
   5. C404-07 Aggregate for Masonry Grout
   6. C476-07 Grout for Masonry
   7. C595-08 Blended Hydraulic Cement
   8. C979-05 Pigments for Integrally Colored Concrete
   9. C1019-05 Sampling and Testing Grout

PART 2 - PRODUCTS

2.1 HYDRATED LIME:

A. ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY GROUT:

A. ASTM C404, Size 8.

2.3 BLENDED HYDRAULIC CEMENT:

A. ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT:

A. ASTM C91. Type N, S, or M.

B. Use white masonry cement whenever white mortar is specified.

2.5 PORTLAND CEMENT:

A. ASTM C150, Type I.

B. Use white Portland cement wherever white mortar is specified.

2.6 WATER:

A. Potable, free of substances that are detrimental to grout, masonry, and metal.

2.7 GROUT:

A. Conform to ASTM C476 except as specified.

B. Grout type proportioned by volume as follows:

1. Fine Grout:

a. Portland cement or blended hydraulic cement: one part.

b. Hydrated lime: 0 to 1/10 part.

c. Fine aggregate: 2-1/4 to 3 times sum of volumes of cement and lime used.

2. Coarse Grout:

a. Portland cement or blended hydraulic cement: one part.

b. Hydrated lime: 0 to 1/10 part.

c. Fine aggregate: 2-1/4 to 3 times sum of volumes of cement and lime used.

d. Coarse aggregate: 1 to 2 times sum of volumes of cement and lime used.

3. Sum of volumes of fine and coarse aggregates: Do not exceed 4 times sum of volumes of cement and lime used.

2.8 COLOR ADMIXTURE:

A. Pigments: ASTM C979.

B. Use mineral pigments only. Organic pigments are not acceptable.

C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

2.9 Water-Repellent Admixture:

A. Liquid water-repellent mortar admixture intended for use with CMUs

containing integral water repellent by same manufacturer.

2.10 Cold-Weather Admixture:

A. Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

PART 3 - EXECUTION

3.1 MIXING:

A. Mix in a mechanically operated grout mixer.

1. Mix grout for at least five minutes.

B. Measure ingredients by volume. Measure by the use of a container of known capacity.

C. Mix water with grout dry ingredients in sufficient amount to bring grout mixture to a pouring consistency.

3.2 GROUT USE LOCATIONS:

A. Use fine grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is 50 mm (2 inches) or less.

B. Use either fine grout or coarse grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is greater than 50 mm (2 inches).

C. Do not use grout for filling bond beam or lintel units.

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SECTION 04 20 00

UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies requirements for construction of masonry unit walls.

1.2 RELATED WORK

A. Mortars and grouts: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.

B. Steel lintels and shelf angles: Section 05 50 00, METAL FABRICATIONS.

C. Cavity insulation: Section 07 21 13, THERMAL INSULATION.

D. Flashing: Section 07 60 00, FLASHING AND SHEET METAL.

E. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.

F. Color and texture of masonry units: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

C. Samples:

1. Concrete masonry units for chamfered units, when exposed in finish work.
2. Anchors, and ties, one each and joint reinforcing 1200 mm (48 inches) long.

D. Shop Drawings:

1. Special masonry shapes.
2. Drawings, showing reinforcement, applicable dimensions and methods of hanging soffit or lintel masonry and reinforcing masonry for embedment of anchors for hung fixtures.
3. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcing bars. Comply with ACI 315. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.

E. Certificates:

1. Certificates signed by manufacturer, including name and address of Contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
2. Indicating that the following items meet specification requirements:

   a. Solid and load-bearing concrete masonry units.

3. Testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.

F. Manufacturer's Literature and Data:

1. Anchors, ties, and reinforcement.
2. Reinforcing bars.

1.4 WARRANTY

A. Warrant exterior masonry walls against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be five years.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

1. A951-06 Steel Wire for Masonry Joint Reinforcement.
2. A615/A615M-07 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. A675/A675M-03 Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical PropertiesC34-03 Structural Clay Load-Bearing Wall Tile
4. C90-06 Load-Bearing Concrete Masonry Units

5. C476-02 Standard Specification for Grout for Masonry
6. C612-04 Mineral Fiber Block and Board Thermal Insulation
7. C744-05 Prefaced Concrete and Calcium Silicate Masonry Units.
8. D1056-07 Flexible Cellular Materials - Sponge or Expanded Rubber
9. D2240-05 Rubber Property - Durometer Hardness
10. D3574-05 Flexible Cellular Materials-Slab, Bonded, and Molded Urethane Foams
11. F1667-05 Fasteners: Nails, Spikes and Staples

C. Masonry Industry Council:

1. All Weather Masonry Construction Manual, 2000.

D. American Welding Society (AWS):

1. D1.4-05 Structural Welding Code – Reinforcing Steel.

E. Federal Specifications (FS):

1. FF-S-107C-00 Screws, Tapping and Drive

F. Masonry Standards Joint Committee; Specifications for Masonry Structures (ACI 530.1-05/ASCE 6-05/TMS 602-99) (MSJC).

1.6 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.

1. Unit Weight: Normal weight.
2. Sizes: Modular.
3. For molded faces used as a finished surface, use concrete masonry units with uniform fine to medium surface texture unless specified otherwise.
4. Use manufactured mitered and special shape concrete masonry units at corners exposed in finished work to match with planes of sides of connecting chamfers. Provide uncut sides at corners.
5. Customized units:

a. Split-face Units (CHAMFERED BLOCK):

1) Ground Face Units:7 5/8" x 16 5/8" x 3 5/8" veneer; 7 5/8" x 16 5/8" x 3 5/8" with 45 degree diagonal chamfer that begins 1" below the top horizontal surface in section, as depicted on drawings, to match the existing chamfered block.

2.2 SHEAR KEYS

A. ASTM D2000, solid extruded cross-shaped section of rubber, neoprene, or polyvinyl chloride, with a durometer hardness of approximately 80 when tested in accordance with ASTM D2240, and a minimum shear strength of 3.5 MPa (500 psi).

B. Shear key dimensions: Approximately 70 mm by 8 mm for long flange and 38 mm by 16 mm for short flange (2-3/4 inches by 5/16 inch for long flange, and 1-1/2 inches by 5/8 inch for short flange).

2.3 REINFORCEMENT:

A. Steel Reinforcing Bars: ASTM A615, deformed bars, 420 MPa (Grade 60) for bars No. 10 to No. 57 (No. 3 to No. 18), except as otherwise indicated.

B. Shop-fabricate reinforcement bars which are shown to be bent or hooked.

C. Joint Reinforcement:

1. Form from wire complying with ASTM A951.
2. Galvanized after fabrication.
3. Width of joint reinforcement 40 mm (1-5/8 inches) less than nominal width of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcing at least 3000 mm (10 feet) in length.
6. Joint reinforcing in rolls is not acceptable.
7. Joint reinforcing that is crimped to form drip is not acceptable.
8. Maximum spacing of cross wires 400 mm (16 inches) to longitudinal wires.
9. Ladder Design:

a. Longitudinal wires deformed 4 mm (0.16 inch) diameter wire.

b. Cross wires 2.6 mm (0.10 inch)diameter.

10. Trussed Design:

a. Longitudinal and cross wires not less than 4 mm (0.16 inch nominal) diameter.

b. Longitudinal wires deformed.

2.4 **ANCHORS, AND** TIES

A. Adjustable Veneer Anchor for Frame Walls:

1. Two piece, adjustable anchor and tie.
2. Anchor and tie may be either type; use only one type throughout.
3. Loop Type:

a. Anchor: Screw-on galvanized steel anchor strap 2.75 mm (0.11 inch) by 19 mm (3/4 inch) wide by 225 mm (9 inches) long, with 9 mm (0.35 inch) offset and 100 mm (4 inch) adjustment. Provide 5 mm (0.20 inch) hole at each end for fasteners.

b. Ties: Triangular tie, fabricated of 5 mm (0.20 inch) diameter galvanized cold drawn steel wire. Ties long enough to engage the anchor and be embedded not less than 50 mm (2 inches) into the bed joint of the masonry veneer.

4. Angle Type:

a. Anchor: Minimum 2 mm (16 gage) thick galvanized steel angle shaped anchor strap. Provide hole in vertical leg for fastener. Provide hole near end of outstanding leg to suit upstanding portion of tie.

b. Tie: Fabricate from 5 mm (0.20 inch) diameter galvanized cold drawn steel wire. Form "L" shape to be embedded not less than 50 mm (2 inches) into the bed joint of the masonry veneer and provide upstanding leg to fit through hole in anchor and be long enough to allow 50 mm (2 inches) of vertical adjustment.

B. Dovetail Anchors:

1. Form dovetail anchor slots from 0.6 mm (0.0239 inch) thick galvanized steel (with felt or fiber filler).

C. Individual ties:

1. Rectangular ties: Form from 5 mm (3/16 inch) diameter galvanized steel rod to a rectangular shape not less than 50 mm (2 inches) wide by sufficient length for ends of ties to extend within 25 mm (1 inch) of each face of wall. Ties that are crimped to form drip are not permitted.

D. Wall Ties, (Mesh or Wire):

1. Mesh wall ties formed of ASTM A82, W0.5, 2 mm, (16 gage) galvanized steel wire 13 mm by 13 mm (1/2 inch by 1/2 inch) mesh, 75 mm (3 inches) wide by 200 mm (8 inches) long.

2. Rectangular wire wall ties formed of W1.4, 3 mm, (9 gage) galvanized steel wire 50 mm (2 inches) wide by 200 mm (8 inches) long.

2.5 PREFORMED COMPRESSIBLE JOINT FILLER

A. Thickness and depth to fill the joint as specified.

B. Closed Cell Neoprene: ASTM D1056, Type 2, Class A, Grade 1, B2F1.

C. Non-Combustible Type: ASTM C612, Class 5, 1800 degrees F.

2.6 ACCESSORIES

A. Weep Hole Wicks: Glass fiber ropes, 10 mm (3/8 inch) minimum diameter, 300 mm (12 inches) long.

B. Masonry Cleaner:

1. Detergent type cleaner selected for each type masonry used.

2. Acid cleaners are not acceptable.

3. Use soapless type specially prepared for cleaning brick or concrete masonry as appropriate.

C. Fasteners:

1. Concrete Nails: ASTM F1667, Type I, Style 11, 19 mm (3/4 inch) minimum length.
2. Masonry Nails: ASTM F1667, Type I, Style 17, 19 mm (3/4 inch) minimum length.
3. Screws: FS-FF-S-107, Type A, AB, SF thread forming or cutting.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. Protection:

1. Cover tops of walls with nonstaining waterproof covering, when work is not in progress. Secure to prevent wind blow off.
2. On new work protect base of wall from mud, dirt, mortar droppings, and other materials that will stain face, until final landscaping or other site work is completed.

B. Cold Weather Protection:

1. Masonry may be laid in freezing weather when methods of protection are utilized.
2. Comply with MSJC and "Hot and Cold Weather Masonry Construction Manual".

3.2 CONSTRUCTION TOLERANCES

A. Lay masonry units plumb, level and true to line within the tolerances as per MSJC requirements and as follows:

B. Maximum variation from plumb:

1. In 3000 mm (10 feet) - 6 mm (1/4 inch).
2. In 6000 mm (20 feet) - 10 mm (3/8 inch).
3. In 12 000 mm (40 feet) or more - 13 mm (1/2 inch).

C. Maximum variation from level:

1. In any bay or up to 6000 mm (20 feet) - 6 mm (1/4 inch).
2. In 12 000 mm (40 feet) or more - 13 mm (1/2 inch).

D. Maximum variation from linear building lines:

1. In any bay or up to 6000 mm (20 feet) - 13 mm (1/2 inch).
2. In 12 000 mm (40 feet) or more - 19 mm (3/4 inch).

E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:

1. Minus 6 mm (1/4 inch).
2. Plus 13 mm (1/2 inch).

F. Maximum variation in prepared opening dimensions:

1. Accurate to minus 0 mm (0 inch).
2. Plus 6 mm (1/4 inch).

3.3 INSTALLATION GENERAL

A. Keep finish work free from mortar smears or spatters, and leave neat and clean.

B. Anchor masonry as specified in Paragraph, ANCHORAGE.

C. Wall Openings:

1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.

2. If items are not available when walls are built, prepare openings for subsequent installation.

D. Tooling Joints:

1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.

2. Tool while mortar is soft enough to be compressed into joints and not raked out.

3. Finish joints in exterior face masonry work with a jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.

4. Tool Exposed interior joints in finish work concave unless specified otherwise.

E. Lintels:

1. Lintels are not required for openings less than 1000 mm (3 feet 4 inches) wide that have hollow metal frames.

2. Openings 1025 mm (3 feet 5 inches) wide to 1600 mm (5 feet 4 inches) wide with no structural steel lintel or frames, require a lintel formed of concrete masonry lintel or bond beam units or structural facing tile lintel units filled with grout per ASTM C476 and reinforced with 1- #15m (1-#5) rod top and bottom for each 100 mm (4 inches) of nominal thickness unless shown otherwise.

3. Use steel lintels, for openings over 1600 mm (5 feet 4 inches) wide, brick masonry, and elevator openings unless shown otherwise.

4. Doors having overhead concealed door closers require a steel lintel, and a pocket for closer box.

5. Length for minimum bearing of 100 mm (4 inches) at ends.

F. Wall, Furring, and Partition Units:

1. Lay out field units to provide for running bond of walls and partitions, with vertical joints in second course centering on first course units unless specified otherwise.

2. Align head joints of alternate vertical courses.

3. At sides of openings, balance head joints in each course on vertical center lines of openings.

4. Use no piece shorter than 100 mm (4 inches) long.

5. Use not less than 100 mm (4 inches) nominal thick masonry for free standing furring unless shown otherwise.

G. Use not less than 100 mm (4 inches) nominal thick masonry for fireproofing

steel columns unless shown otherwise.

H. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.

I. Structural Steel Encased in Masonry:

1. Where structural steel is encased in masonry and the voids between the steel and masonry are filled with mortar, provide a minimum 25 mm (1 inch) mortar free expansion space between the masonry and the steel by applying a box board material to the steel before the masonry is laid.

2. Do not place spacing material where steel is bearing on masonry or masonry is bearing on steel.

J. Wetting and Wetting Test:

1. Test and wet brick or clay tile in accordance with BIA 11B.

2. Do not wet concrete masonry units or glazed structural facing tile before laying.

K. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.

L. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, tie and support as required to maintain position and shape during construction and curing of reinforced masonry.

M. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and all other reasonable temporary loads that may be placed on them during construction.

N. Allow not less than the following minimum time to elapse after completion of members before removing shores or forms, provided suitable curing conditions have been obtained during the curing period.

1. 7 days for slabs.

3.4 ANCHORAGE

A. Veneer to Concrete Walls:

1. Install dovetail slots in concrete vertically at 600 mm (2 feet) on centers.

2. Locate dovetail anchors at 400 mm (16 inch) maximum vertical intervals.

3. Anchor new masonry facing to existing concrete with corrugated wall ties spaced at 400 mm (16 inch), maximum vertical intervals, and at 600 mm (2 feet) maximum horizontal intervals. Fasten ties to concrete with power actuated fasteners or concrete nails.

B. Masonry Furring:

1. Anchor masonry furring less than 100 mm (4 inches) nominal thick to masonry walls or to concrete with corrugated wall ties or dovetail anchors.

2. Space not over 600 mm (2 feet) on centers in both directions.

C. Anchorage to Steel Beams or Columns:

1. Use adjustable beam anchors on each flange.

2. At columns weld the 6 mm (1/4 inch) steel rod to steel columns at 300 mm (12 inch) intervals, and place wire ties in masonry courses at 400 mm (16 inches) maximum vertically.

3.5 REINFORCEMENT

A. Joint Reinforcement:

1. Use as joint reinforcement in single wythe concrete masonry unit walls or partitions.
2. Locate joint reinforcement in mortar joints at 400 mm (16 inch) maximum vertical intervals.
3. Additional joint reinforcement is required in mortar joints at both 200 mm (8 inches) and 400 (16 inches) above and below windows, doors, louvers and similar openings in masonry, except where other type anchors are required for anchorage of masonry to concrete structure.
4. Joint reinforcement is required in every other course of stack bond CMU masonry.

B. Steel Reinforcing Bars:

1. Install in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for lintels and bond beam horizontal reinforcement. Install in wall cavities of reinforced masonry walls where shown.
2. Use grade 60 bars if not specified otherwise.
3. Bond Beams:
   a. Form Bond beams of load-bearing concrete masonry units filled with ASTM C476 grout and reinforced with 2-#15m (#5) reinforcing steel unless shown otherwise. Do not cut reinforcement.
   b. Brake bond beams only at expansion joints and at control joints, if shown.
4. Stack Bond:
   a. Locate additional joint reinforcement in vertical and horizontal joints as shown.
   b. Anchor vertical reinforcement into the foundation or wall or bond beam below and hold in place.
   c. Provide temporary bracing for walls over 8 ft. tall until permanent horizontal bracing is completed.

3.6 CMU CONTROL JOINTS.

A. Provide CMU control (CJ) joints where shown on drawings.

B. Keep joint free of mortar and other debris.

C. Where joints occur in masonry walls.

1. Install preformed compressible joint filler in brick wythe.
2. Install cross shaped shear keys in concrete masonry unit wythe with preformed compressible joint filler on each side of shear key unless otherwise specified.

3. Install filler, backer rod, and sealant on exposed faces.

D. Use standard notched concrete masonry units (sash blocks) made in full and half- length units where shear keys are used to create a continuous vertical joint.

E. Interrupt steel joint reinforcement at expansion and control joints unless otherwise shown.

F. Fill opening in exposed face of expansion and control joints with sealant as specified in Section 07 92 00, JOINT SEALANTS.

3.7 BUILDING EXPANSION AND SEISMIC JOINTS

A. Keep joint free of mortar. Remove mortar and other debris.

B. Install non-combustible, compressible type joint filler to fill space completely except where sealant is shown on joints in exposed finish work.

C. Where joints are on exposed faces, provide depth for backer rod and sealant as specified in Section 07 92 00, JOINT SEALANTS, unless shown otherwise.

3.8 ISOLATION SEAL

A. Where full height walls or partitions lie parallel or perpendicular to and under structural beams or shelf angles, provide a separation between walls or partitions and bottom of beams or shelf angles not less than the masonry joint thickness unless shown otherwise.

B. Insert in the separation, a continuous full width strip of non-combustible type compressible joint filler.

C. Where exposed in finish work, cut back filler material in the joint enough to allow for the joint to be filled with sealant material specified in Section 07 92 00, JOINT SEALANTS.

3.9 **CONCRETE MASONRY** UNITS

A. Kind and Users:

1. Provide special concrete masonry shapes as required, including lintel and bond beam units, sash units, and corner units . Use solid concrete masonry units, where full units cannot be used, or where needed for anchorage of accessories.

2. Provide solid load-bearing concrete masonry units or grout the cell of hollow units at jambs of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.

3. Provide rounded corner (bullnose) shapes at opening jambs in exposed work and at exterior corners.

4. Masonry assemblies shall meet the required fire resistance in fire rated partitions of type and construction that will provide fire rating as shown.

B. Laying:

1. Lay concrete masonry units with 10 mm (3/8 inch) joints, with a bond overlap of not less than 1/4 of the unit length, except where stack bond is required.

2. Do not wet concrete masonry units before laying.

3. Bond external corners of partitions by overlapping alternate courses.
4. Lay first course in a full mortar bed.
5. Set anchorage items as work progress.
6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill such voids with mortar or grout.
7. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
8. Lay concrete masonry units so that cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar. Unobstructed core openings not less than 50 mm (2 inches) by 75 mm (3 inches).
9. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
10. Install deformed reinforcing bars of sizes shown.
11. Steel reinforcement, at time of placement, free of loose flaky rust, mud, oil, or other coatings that will destroy or reduce bond.
12. Steel reinforcement in place before grouting.
13. Minimum clear distance between parallel bars: One bar diameter.
14. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacings noted.
15. Support vertical bars near each end and at intermediate intervals not exceeding 192 bar diameters.
16. Reinforcement shall be fully encased by grout or concrete.
17. Splice reinforcement or attach reinforcement to dowels by placing in contact and secured or by placing the reinforcement within 1/5 of the required bar splice length.
18. Stagger splices in adjacent horizontal reinforcing bars. Lap reinforcing bars at splices a minimum of 40 bar diameters.
19. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.
20. Cavity and joint horizontal reinforcement may be placed as the masonry work progresses.

C. Waterproofing Parging:

1. Parge earth side of concrete masonry unit basement walls with mortar applied in two coats, each coat 6 mm (1/4 inch) thick.
2. Clean wall surfaces to receive parging of dirt, oil, or grease, and moisten before application of first coat.
3. Roughen first coat when partially set, permit to hardened for 24 hours, and moisten before application of second coat.
4. Keep second coat damp for at least 48 hours.
5. Thicken parging and round to form a cove at the junction of outside wall face and footing.

3.10 POINTING

A. Fill joints with pointing mortar using rubber float trowel to rub mortar solidly into raked joints.

B. Finish exposed joints in finish work with a jointing tool to provide a smooth concave joint unless specified otherwise.

3.11 GROUTING

A. Preparation:

1. Clean grout space of mortar droppings before placing grout.
2. Close cleanouts.
3. Install vertical solid masonry dams across grout space for full height of wall at intervals of not more than 9000 mm (30 feet). Do not bond dam units into wythes as masonry headers.
4. Verify reinforcing bars are in cells of units or between wythes as shown.

B. Placing:

1. Place grout by hand bucket, concrete hopper, or grout pump.
2. Consolidate each lift of grout after free water has disappeared but before plasticity is lost.
3. Do not slush with mortar or use mortar with grout.
4. Interruptions:
   a. When grouting must be stopped for more than an hour, top off grout 40 mm (1-1/2 inch) below top of last masonry course.
   b. Grout from dam to dam on high lift method.
   c. A longitudinal run of masonry may be stopped off only by raking back one-half a masonry unit length in each course and stopping grout 100 mm (4 inches) back of rake on low lift method.

C. Puddling Method:

1. Consolidate by puddling with a grout stick during and immediately after placing.
2. Grout the cores of concrete masonry units containing the reinforcing bars solid as the masonry work progresses.

D. Low Lift Method:

1. Construct masonry to a height of 1.5 m (5 ft) maximum before grouting.
2. Grout in one continuous operation and consolidate grout by mechanical vibration and reconsolidate after initial water loss and settlement has occurred.

3.12 PLACING REINFORCEMENT

A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Contract Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 25 mm (1 inch), whichever is greater.

C. For columns, piers and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 38 mm (1-1/2 inches), whichever is greater. Provide lateral ties as indicated.

D. Splice reinforcement bars where shown; do not splice at other places unless accepted by the Resident Engineer. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.

E. Provide not less than minimum lap as indicated on shop drawings, or if not indicated, as required by governing code.

F. Weld splices where indicated. Comply with the requirements of AWS D1.4 for welding materials and procedures.

G. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations.

H. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations. Lap joint reinforcement not less than 150 mm (6 inches) at ends. Use prefabricated "L" and "T" sections to provide continuity at corners and intersections. Cut and bend joint reinforcement as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

I. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.

J. Anchor reinforced masonry walls to non-reinforced masonry where they intersect.

3.13 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

A. Do not wet concrete masonry units (CMU).

B. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 10 mm (3/8 inch) joints.

C. Where solid CMU units are shown, lay with full mortar head and bed joints.

D. Walls:

1. Pattern Bond: Lay CMU wall units in 1/2-running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.

2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
3. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.

E. Grouting:

1. Use "Fine Grout" per ASTM C476 for filling spaces less than 100 mm (4 inches) in one or both horizontal directions.
2. Use "Coarse Grout" per ASTM C476 for filling 100 mm (4 inch) spaces or larger in both horizontal directions.

F. Low-Lift Grouting:

1. Provide minimum clear dimension of 50 mm (2 inches) and clear area of 5160 mm2 (8 square inches) in vertical cores to be grouted.
2. Place vertical reinforcement prior to grouting of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 3 m (10 feet).
3. Lay CMU to maximum pour height. Do not exceed 1.5 m (5 foot) height, or if bond beam occurs below 1.5 m (5 foot) height, stop pour 38 mm (1-1/2 in) below top of bond beam.
4. Pour grout using chute container with spout or pump hose. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one Terminate grout pours 38 mm (1-1/2 inches) below top course of pour.
5. Bond Beams: Stop grout in vertical cells 38 mm (1-1/2 inches) below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

3.14 CLEANING AND REPAIR

A. General:

1. Clean exposed masonry surfaces on completion.
2. Protect adjoining construction materials and landscaping during cleaning operations.
3. Cut out defective exposed new joints to depth of approximately 19 mm (3/4 inch) and repoint.
4. Remove mortar droppings and other foreign substances from wall surfaces.

B. Concrete Masonry Units:

1. Immediately following setting, brush exposed surfaces free of mortar or other foreign matter.

2. Allow mud to dry before brushing.

3.15 WATER PENETRATION TESTING

A. Seven days before plastering or painting, in the presence of Resident Engineer, test solid exterior masonry walls for water penetration.

B. Direct water on masonry for a period of one hour at a time when wind velocity is less than five miles per hour.

C. Should moisture appear on inside of walls tested, make additional tests at other areas as directed by Resident Engineer.

D. Correct the areas showing moisture on inside of walls, and repeat test at repaired areas, to insure that moisture penetration has been stopped.

E. Make water test at following locations:

1. Sixteen places on Building Number 105.

- - - E N D - - -

SECTION 04 40 00

NATURAL THIN VENEER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes the application of natural thin veneer stone system for exterior and interior vertical surfaces.

1. Exterior Application: Natural thin veneer stone system adhered to exterior gypsum sheathing, cold formed metal framing, air barrier, vent system and exterior metal lath.

2. Interior Application: Natural thin veneer stone system adhered to gypsum sheathing, cold formed metal framing, and metal lath.

B. Special decorative sawn thin veneer stone shapes.

1.2 RELATED SECTIONS:

A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for additional LEED requirements.

B. Section 01 81 19, INDOOR AIR QUALITY REQUIREMENTS for VOC limit.

C. Section 05 40 00, COLD-FORMED METAL FRAMING.

D. Section 07 19 00, WATER REPELLANTS.

E. Section 07 60 00, FLASHING AND SHEET METAL.

F. Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

A. LEED BUILDING Submittal Requirements: The contractor or subcontractor shall submit the following LEED BUILDING certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content

B. Product Data: For each type of product indicated.

1. For stone varieties proposed for use on Project, include test data indicating compliance with physical properties specified and required by referenced ASTM standards.
2. Surface preparation and installation instructions.

C. Samples:

1. For each stone type indicated. Include at least three samples in each set for each type of stone, exhibiting extremes of the full range of color and other visual characteristics expected in completed Work. Samples will establish the standard by which stone provided will be judged.
2. For each color of mortar required. Label Samples to indicate types and amounts of pigments used.

D. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, sources of supply, and other information as required to identify materials used. Include mix proportions for mortar and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockups constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

E. Qualification Data: For qualified Installer.

1.4 QUALITY ASSURANCE

A. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable, including interior veneer stone.

a. Ceramic Tile Adhesives- 65g/l.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.

C. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from one quarry with resources to provide materials of consistent quality in appearance and physical properties.

D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

E. Mockups: Build mockups to demonstrate aesthetic effects and set quality

standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
   a. Include stone coping at top of mockup.
   b. Include a sealant-filled joint at least 16 inches (400 mm) long in mockup.
   c. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit stone masonry above half of flashing).
   d. Include all stone unit types and sizes to be used including a typical corner condition, special shapes and mortar joint treatment, wall framing, veneer anchors, flashing, rain screen and weep holes in exterior wall.
2. Protect accepted mockups from the elements with weather-resistant membrane.
3. Approval of mockups is for color, texture, and blending of stone; relationship of mortar and sealant colors to stone colors; tooling of joints; and aesthetic qualities of workmanship.
   a. Approval of mockups is also for other material and construction qualities Resident Engineer specifically approves in writing.
   b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Resident Engineer specifically approves such deviations in writing.

F. Pre-installation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

A. Protection of Stone: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.

   1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.

B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the face of stone masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over the wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and dirt on completed stone masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace stone damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until stone has dried, but not less than 7 days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.7 COORDINATION

A. Advise installers of other work about specific requirements for placement of reinforcement, veneer anchors, flashing, and similar items to be built into stone masonry.

PART 2 - PRODUCTS

2.1 STONE

A. Exterior Application:

1. Basis of Design Product: Subject to compliance with requirements, provide the following or comparable approved equal: Rolling Rock Building Stone, Inc.; Real Stone Veneer, Core Series; Appalachian Blue Thin Veneer.

2. Properties:

a. Material: Quartzite.

b. Pattern: “Irregular”.

c. Thickness: 0.50” to 1.50”.

d. Size: 4” – 15” Diameter.

e. Weight: 13 – 14 lbs./sq.ft.

B. Interior Application:

1. Basis of Design Product: Subject to compliance with requirements, provide the following or comparable approved equal: Natural Stone Veneers International, Inc.; Ledgestone Collection.

2. Properties:

a. Material: Quartzitic sandstone, rated as Type-III when test in accordance with ASTM C 616.

b. Pattern: “Silver Ledgestone”.

c. Height: 1 inch to 2 inches (25 mm to 51 mm).

d. Length: 4 inches to 14 inches (102 mm to 356 mm).

e. Nominal Thickness: 3/4 inch to 1-1/2 inches (19 mm to 38 mm).

f. Weight: 12.2 lbs./sq.ft.

g. Color: Silver and gray.

2.2 SPECIAL SHAPES

A. Interior Application:

1. Cornerstones

a. Material shall conform to the properties specified for the materials specified.

b. Color and finish to match veneer stone.

2.3 MORTAR MATERIALS

A. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or III, and hydrated lime complying with ASTM C 207.

B. Colored Cement Product: Packaged blend made from portland cement and lime and mortar pigments, shall complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.

2. Pigments shall not exceed 10 percent of portland cement by weight.

C. Aggregate: ASTM C 144 and as follows:

1. For pointing mortar, use aggregate graded with 100 percent passing No.16 (1.18-mm) sieve.

2. White Aggregates: Natural white sand or ground white stone.

3. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.

D. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ACM Chemistries; RainBloc for Mortar.

b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.

c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating

admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

F. Water: Potable.

2.4 MISCELLANEOUS ACCESSORIES

A. Expanded Metal Lath: 3.4 lb/sq. yd. (1.8 kg/sq. m), self-furring, diamond-mesh lath complying with ASTM C 847. Fabricate from structural-quality, zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G60 (Z180).

B. Lath Attachment Devices: Material and type required by ASTM C 1063 for installation indicated.

C. Water resistant and vapor permeable self-adhering air barrier membrane: See specification section 07 13 26.

D. Rainscreen drainage plane: 0.024" (0.6 mm) thick high impact polystyrene sheets. Formed with corrugations and a spunbond polypropylene fabric on one side with a 4" (102 mm) skirt on one edge.

E. Window sub-sill drainage planes: 0.024" (0.6 mm) thick high-impact polystyrene strip formed with .120" (3 mm) deep corrugations, bent into L-shape, 5" (127 mm) wide by 9" (229 mm) high, to fit on top of sub-sill region of a window rough opening prior to window installation to facilitate drainage.

F. Vent Strip: 0.024" (0.6 mm) thick high impact polystyrene strip formed with 3/16" (4.8 mm) deep corrugations; 4.6" (116.84 mm) wide, 50'-0" (15 m) long continuous belt.

G. Moisture Diverter, floor edging: 26 gauge galvanized steel bent into 70° V shape. Vertical attachment flange - 3.5" (89 mm), ground - 0.5" (13 mm), bonding slots 1" (25 mm) punched 1.75" (44 mm) apart, 8 ft long.

2.5 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar and grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

2.6 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride.

2. Limit cementitious materials in mortar to portland cement and lime.

3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

4. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate

materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within 30 minutes of final mixing; do not re-temper or use partially hardened material.

B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Stone Masonry: Comply with ASTM C 270, Proportion or Property Specification.

1. Mortar for Setting Stone: Type S.

D. Mortar for Scratch Coat over Metal Lath: 1 part portland cement, 1/2 part lime, 5 parts loose damp sand, and enough water to produce a workable consistency.

E. Pigmented Mortar: Use colored cement product.

1. Pigments shall not exceed 10 percent of portland cement by weight.

F. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

2.7 FABRICATION

A. Fabricate stone to comply with sizes, shapes, and tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.

B. Cut and select stone to produce pieces of thickness, size, and shape indicated, including details on Drawings. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated.

C. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.
1. Clean sawed backs of stone to remove rust stains and iron particles.

D. Gage backs of stones for adhered veneer if more than 81 sq. in. (522 sq. cm) in area.

E. Thickness of Stone: Provide thickness indicated, but not less than the following:

1. Thickness: 1 inch (25 mm) plus or minus 1/8 inch (3 mm).

F. Shape stone for type of masonry (pattern) as follows:

1. Sawed-bed, with uniform course heights as indicated on Drawings and with random lengths.

G. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups.

1. Finish: As indicated and as selected by Resident Engineer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in substrates and required for or extending into stone masonry are correctly installed.

C. Examine cold-formed wall framing and water resistant and vapor permeable self-adhering air barrier membrane to verify that installation will result in a weatherproof covering.

D. Notify Architect of conditions that would adversely affect installation.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. Coordinate placement of flashings and other moisture control products supplied by other sections.

3.3 SETTING OF STONE MASONRY, GENERAL

A. Perform necessary field cutting and trimming as stone is set.

1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping.

2. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true, matching similar surfaces that were shop or quarry fabricated.

3. Pitch face at field-split edges as needed to match stones that are not field split.

B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.

C. Arrange stones in pattern with course heights as indicated, random lengths, and uniform joint widths, with offset between vertical joints as indicated.

D. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.

E. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than 3/8 inch (10 mm) at narrowest points or more than 1/2 inch (13 mm) at widest points.

F. Provide sealant joints of widths and at locations indicated.

1. Keep sealant joints free of mortar and other rigid materials.

G. Install metal expansion strips in sealant joints at locations indicated. Build flanges of expansion strips into masonry by embedding in mortar between stone masonry and backup wythe. Lap each joint 4 inches (100 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.

H. Install embedded flashing at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

1. At cold-formed exterior wall, extend flashing through stone masonry, up the face of sheathing at least 8 inches (200 mm), and behind Water resistant and vapor permeable self-adhering air barrier membrane.

2. At lintels and shelf angles, extend flashing full length of angles but not less than 6 inches (150 mm) into masonry at each end.

3. At sills, extend flashing not less than 4 inches (100 mm) at ends.

4. At ends of head and sill flashing turn up not less than 2 inches (50 mm) to form end dams.

5. Extend sheet metal flashing 1/2 inch (13 mm) beyond face of masonry at exterior and turn flashing down to form a drip.

6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.

3.4 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed

1. 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (13 mm in 12 m) or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.

C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet (13 mm in 6 m) or 3/4 inch in 40 feet (19 mm in 12 m) or more.

D. Measure variation from level, plumb, and position shown in plan as variation of the average plane of the face of each stone from level, plumb, or dimensioned plane.

E. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.

F. Variation in Plane between Adjacent Stones: Do not exceed one-half of tolerance specified for thickness of stone.

3.5 INSTALLATION OF ADHERED STONE MASONRY VENEER

A. Install flashing over sheathing and behind weather Water resistant and vapor permeable self-adhering air barrier membrane by fastening through sheathing into framing.

B. Install lath over water resistant and vapor permeable self-adhering air barrier membrane by fastening through sheathing into framing to comply with ASTM C 1063.

C. Install scratch coat over metal lath 3/8 inch (10 mm) thick to comply with ASTM C 926.

D. Coat backs of stone units and face of scratch coat with cement-paste bond coat, then butter both surfaces with setting mortar. Use sufficient setting mortar so a slight excess will be forced out the edges of stone units as they are set. Tap units into place, completely filling space between units and scratch coat.

E. Rake out joints for pointing with mortar to depth of not less than 3/4 inch (19 mm) before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.6 POINTING

A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch (10 mm) deep until a uniform depth is formed.

B. Point stone joints by placing and compacting pointing mortar in layers not more than 3/8 inch (10 mm) deep. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:

1. Joint Profile: As indicated.

3.7 ADJUSTING AND CLEANING

A. Remove and replace stone of the following description:

1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.

2. Defective joints.

3. Stone not matching approved samples and mockups.

4. Stone not complying with other requirements indicated.

B. Replace in a manner that results in stone matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean stone as work progresses. Remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean stone as

follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone.
3. Protect adjacent stone and non masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
5. Clean stone by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised II, using job-mixed detergent solution.
6. Clean stone with acidic cleaner recommended by manufacturer and applied according to manufacturer's written instructions.

3.8 EXCESS MATERIALS AND WASTE

A. Excess Stone: Stack excess stone where directed by Resident Engineer.

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SECTION 04 72 00

CAST STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Installation of cast stone units.

1.2 RELATED WORK

A. Setting and pointing mortar: Section 04 05 13, MASONRY MORTARING / Section 04 05 16, MASONRY GROUTING.

B. Joint sealant and application: Section 07 92 00, JOINT SEALANTS.

C. Color and texture specified in Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Samples:

1. Cast stone for each color and finish.

2. Show finish on two 100 mm (4 inch) edges and 300 by 300 mm (12 by 12 inch)

surface.

D. Shop Drawings:

1. Cast stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.

2. Setting drawings with setting mark.

E. Certificates: Test results indicating that the cast stone meets specification requirements and proof of plant certification.

F. Submit manufacturers test results of cast stone previously made by manufacturer.

G. Laboratory Data: Description of testing laboratories facilities and qualifications of its principals and key personnel.

H. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store cast stone under waterproof covers on planking clear of ground.

B. Protect from handling, dirt, stain, and water damage.

C. Mark production units with the identification marks as shown on the shop drawings.

D. Package units and protect them from staining or damage during shipping and storage.

E. Provide an itemized list of product to support the bill of lading.

1.5 WARRANTY

A. Warranty exterior masonry walls against moisture leaks, any defects and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be two years.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. Cast Stone Institute Technical Manual and Cast Stone Institute standard specifications.

C. American Society for Testing and Materials (ASTM):

1. A167-99 (2004) Stainless and Heat Resisting Chromium- Nickel Steel Plate, Sheet, and Strip

2. A185-07 Steel, Welded Wire Fabric, Plain for Concrete

3. A615/A615M-08 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

4. C33-07 Concrete Aggregates

5. C150-07 Portland Cement

6. C503-08 Marble Dimension Stone (Exterior)
7. C568-08 Limestone Dimension Stone
8. C979-05 Pigments for Integrally Colored Concrete
9. C1194-06 Compressive Strength of Architectural Cast Stone
10. C1195-03 Absorption of Architectural Cast Stone
11. C1364-07 Architectural Cast Stone.
12. D2244-07 Calculation of Color Differences from Instrumentally Measured Color Coordinates.

1.7 QUALITY ASSURANCE

A. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. The Manufacturer:

1. Must have ten (5) years minimum continuous operating experience and have facilities for manufacturing cast stone as described herein. Manufacturer shall have sufficient plant facilities to produce the shapes, quantities and size of cast stone required in accordance with the project schedule.
2. Must be a member of the Cast Stone Institute.
3. Must have a certified plant (certification by the Cast Stone Institute).

C. Stone setter: Must have ten (5) years experience setting cast or natural building stone.

D. Testing: One (1) sample from production units may be selected at random from the field for each 500 cubic feet (14 m3) delivered to the job:

1. Three (3) field cut cube specimens from each of these sample shall have an average minimum compressive strength of not less than 85% with no single specimen testing less than 75% of design strength as specified.
2. Three (3) field cut cube specimens from each of these samples shall have an average maximum cold-water absorption of 6%.
3. Field specimens shall be tested in accordance with ASTM C 1194 and C 1195.
4. Manufacturer shall submit a written list of projects similar and at least three (3) years of age, along with Owner, Architect and Contractor references.

1.8 MANUFACTURING TOLERANCES

A. Cross section dimensions shall not deviate by more than + 1/8 in. (3 mm) from approved dimension.

B. Length of units shall not deviate by more than length/360 or + 1/8 in. (3 mm), whichever is greater, not to exceed + 1/4 in (6 mm). Maximum length of any unit shall not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.

C. Warp bow or twist of units shall not exceed length/360 or + 1/8 in. (3 mm), whichever is greater.

D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features – On formed sides of unit, 1/8 in (3 mm), on unformed sides of unit, 3/8 in (9 mm) maximum deviation.

1.9 MOCK-UP

A. Provide full size unit(s) for use in construction of sample wall. The mock-up becomes the standard of workmanship for the project.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CAST STONE

A. Comply with ASTM C 1364.

B. Physical properties: Provide the following:

1. Compressive Strength: ASTM C 1194: 6,500 psi (45 Mpa) minimum for products at 28 days.

2. Absorption : ASTM C 1195: 6% maximum by the cold water method, or 10% maximum by the boiling method for products as 28 days.

3. Air Content: ASTM C173 or C231, for wet cast product shall be 4-8% for units exposed to freeze-thaw environments. Air entrainment is not required for vibrant dry tamp (VDT) products.

4. Freeze thaw: ASTM C 1364L The cumulative percent weight loss (CPWL) shall be less than 5% after 300 cycles of freezing and thawing.

5. Linear Shrinkage: ASTM C 426L Shrinkage shall not exceed 0.065%.

C. Job site testing : One (1) sample from production units may be selected at random from the field for each 500 cubic feet (14m3) delivered to the job site:

1. Three (3) field cut cube specimens from each of these samples shall have an average minimum compressive strength of not less than 85% with no single specimen testing less than 75% of design strength as allowed by ACI 318.

2. Three (3) field cut cube specimens from each of these samples shall have an average maximum cold-water absorption of 6%.

3. Field specimens shall be tested in accordance with ASTM C 1194 and C 1195.

2.2 RAW MATERIALS

A. Portland cement: Type I or Type III, white and/or grey, ASTM C 150.

B. Coarse aggregates: Granite, quartz or limestone, ASTM C 33, except for gradation, and are optional for the vibrant dry tamp (VDT) casting method.

C. Fine aggregates: Manufactured or natural sands, ASTM C 33, except for gradation.

D. Colors: Inorganic iron oxide pigments, ASTM C 979 except that carbon black pigments shall not be used.

E. Admixtures- Comply with the following:

1. ASTM C 260 for air-entraining admixtures.

2. ASTM C 494/C 495 M Types A-G for water reducing, retarding, accelerating and high range admixtures.

3. Other admixtures: integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.

4. ASTM C 618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.

5. ASTM C 989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.

F. Water: Potable.

G. Reinforcing Bars:

1. ASTM A 615/A 615M. Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 1.5 in. (37 mm).

2. Welded Wire Fabric: ASTM A 185 where applicable for wet cast units.

H. All anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in a non-corrosive material such as zinc plated, galvanized steel, brass, or stainless steel Type 302 or 304.

2.3 COLOR AND FINISH

A. Match sample on file.

B. All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 in. (0.8 mm) and the density of such voids shall be less than 3 occurrences per any 1 in (25 mm) and not obvious under direct daylight illumination at a 5 ft. (1.5 m) distance.

C. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 ft (3 m) distance.

D. ASTM D 2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.

1. Total color difference “ not greater than 6 units.

2. Total hue difference-not greater than 2 units.

2.4 REINFORCING

A. Reinforce the units as required by the drawings and for safe handling and

structural stress.

1. Minimum reinforcing shall be 0.25 percent of the cross section area.

B. Reinforcement shall be non-corrosive where faces exposed to weather are covered with less than 1.5 in. (38 mm) of concrete material. All reinforcement shall have minimum coverage of twice the diameter of the bars.

C. Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under direct daylight illumination from a 20 ft (6 m) distance.

D. The occurrence of crazing or efflorescence shall not constitute a cause for rejection.

E. Remove cement film, if required, from exposed surface prior to packaging for shipment.

2.5 CURING

A. Cure units in a warm curing chamber 1000° F (537.8° C) at 95 percent relative humidity for approximately 12 hours, or cure in a 95 percent moist environment at a minimum 700° F (371.1° C) for 16 hours after casting. Additional yard curing at 95 percent relative humidity shall be 350-degree-days (i.e. 7 days @ 500° F (260.0° C) or 5 days @ 700° F (371.1° C) prior to shipping. Form cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installing Contractor shall check cast stone materials for fit and finish prior to installation. Do not set unacceptable units.

3.2 SETTING TOLERANCES

A. Comply with Cast Stone Institute SM Technical Manual.

B. Set stones 1/8 in. (3 mm) or less, within the plane of adjacent units.

C. Joints, plus – 1/6 in. (1.5 mm), minus – 1/8 in. (3 mm).

3.3 JOINTING

A. Joint size:

1. At stone/stone joints in vertical position 1/4 in. (6 mm) (3/8 in. (9.5 mm) optional).

2. Stone/stone joint exposed on top 3/8 in. (.5 mm).

B. Joint Materials:

1. Mortar, Type N, ASTM C 270.

2. Use a full bed of mortar at all bed joints.

3. Flush vertical joints full with mortar.

4. Leave all joints with exposed tops or under relieving angles open for sealant.

5. Leave head joints in coping and projecting components open for sealant.

C. Location of joints:

1. As shown on drawings drawings.

2. At control and expansion joints unless otherwise shown.

3.4 SETTING

A. Drench units with clean water prior to setting.

B. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

C. Set units in full bed of mortar, unless otherwise detailed.

D. Rake mortar joints 3/4 in. (18 mm) for pointing.

E. Remove excess mortar from unit faces immediately after setting.

F. Tuck point unit joints to a slight concave profile.

3.5 JOINT PROTECTION

A. Comply with requirements of Section 07 92 00, JOINT SEALANTS.

B. Prime ends of units, insert properly sized backing rod and install required sealant.

3.6 REPAIR AND CLEANING

A. Repair chips with touchup materials furnished by manufacturer.

B. Saturate units to be cleaned prior to applying an approved masonry cleaner.

C. Consult with manufacturer for appropriate cleaners.

3.7 INSPECTION AND ACCEPTANCE

A. Inspect finished installation according to Bulletin #36 published by the Cast Stone Institute.

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SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies structural steel shown and classified by Section 2, Code of Standard Practice for Steel Buildings and Bridges.

1.2 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
B. Painting: Section 09 91 00, PAINTING.
C. Steel Joist: Section 05 21 00, STEEL JOIST FRAMING.
D. Steel Decking: Section 05 31 00, STEEL DECKING.
E. Composite Steel Deck: Section 05 36 00, COMPOSITE METAL DECKING.
F. Fireproofing: Section 07 81 00, APPLIED FIREPROOFING.

1.3 QUALITY ASSURANCE:

A. Fabricator and erector shall maintain a program of quality assurance in conformance with Section 8, Code of Standard Practice for Steel Buildings and Bridges. Work shall be fabricated in an AISC certified Category Conventional Steel Structures fabrication plant.
B. Before authorizing the commencement of steel erection, the controlling contractor shall ensure that the steel erector is provided with the written notification required by 29 CFR 1926.752. Provide copy of this notification to the Resident Engineer.
C. LEED Building Performance Requirements:
    1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
    2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
    3. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the

weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

4. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.4 TOLERANCES:

Fabrication tolerances for structural steel shall be held within limits established by ASTM A6, by Section 7, Code of Standard Practice for Buildings and Bridges, and by Standard Mill Practice - General Information (AISC LRFD Manual, Second Edition, Page 1-183), except as follows:

A. Elevation tolerance for column splice points at time member is erected is 10 mm (3/8 inch).
B. Elevation tolerance for top surface of steel beams and girders at connections to columns at time floor is erected is 13 mm (1/2 inch).
C. Elevation tolerance for closure plates at the building perimeter and at slab openings prior to concrete placement is 6 mm (1/4 inch).

1.5 DESIGN:

A. Connections: Design and detail all connections for each member size, steel grade and connection type to resist the loads and reactions indicated on the drawings or specified herein. Use details consistent with the details shown on the Drawings, supplementing where necessary. The details shown on the Drawings are conceptual and do not indicate the required weld sizes or number of bolts unless specifically noted. Use rational engineering design and standard practice in detailing, accounting for all loads and eccentricities in both the connection and the members. Promptly notify the Resident Engineer of any location where the connection design criteria is not clearly indicated. The design of all connections is subject to the review and acceptance of the Resident Engineer. Submit structural calculations prepared and sealed by a qualified engineer registered in the state where the project is located. Submit calculations for review before preparation of detail drawings.

1.6 REGULATORY REQUIREMENTS:

A. AISC: Specification for Structural Steel Buildings - LRFD Specification for Structural Steel Buildings.
B. AISC: Code of Standard Practice for Steel Buildings and Bridges.

1.7 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop and Erection Drawings: Complete

C. Certificates:

1. Structural steel.
2. Steel for all connections.
3. Welding materials.
4. Shop coat primer paint.

D. Test Reports:

1. Welders' qualifying tests.

E. Design Calculations and Drawings:

1. Connection calculations, if required.

F. Record Surveys.

G. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer

literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

1.8 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Institute of Steel Construction (AISC):

1. Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design (Second Edition, 2005)
2. Load and Resistance Factor Design Specification for Structural Steel Buildings (Second Edition, 1995)
3. Code of Standard Practice for Steel Buildings and Bridges (2010).

C. American National Standards Institute (ANSI):

B18.22.1-65(R2008).....Plain Washers
B18.22M-81(R2000).....Metric Plain Washers

D. American Society for Testing and Materials (ASTM):

A6/A6M-09.....Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
A36/A36M-08.....Standard Specification for Carbon Structural Steel
A53/A53M-10.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A123/A123M-09.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A242/A242M-04(R2009)....Standard Specification for High-Strength Low-Alloy Structural Steel
A283/A283M-03(R2007)....Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
A307-10.....Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A325-10.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A490-10.....Standard Specification for Heat-Treated Steel Structural Bolts 150 ksi Minimum Tensile Strength

A500/A500M-10.....Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

A501-07.....Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

A572/A572M-07.....Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

A992/A992M-06.....Standard Specification for Structural Steel Shapes

E. American Welding Society (AWS):
D1.1/D1.1M-10.....Structural Welding Code-Steel

F. Research Council on Structural Connections (RCSC) of The Engineering Foundation:
Specification for Structural Joints Using ASTM A325 or A490 Bolts

G. Military Specifications (Mil. Spec.):
MIL-P-21035.....Paint, High Zinc Dust Content, Galvanizing, Repair

H. Occupational Safety and Health Administration (OSHA):
29 CFR Part 1926-2001...Safety Standards for Steel Erection

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Structural Steel: ASTM A992 .

B. Structural Tubing: ASTM A500, Grade B.

C. Structural Tubing: ASTM A501.

D. Steel Pipe: ASTM A53, Grade B.

E. Bolts, Nuts and Washers:

1. High-strength bolts, including nuts and washers: ASTMA325 and A490.
2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.
3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ANSI Standard B18.22.1.

F. Zinc Coating: ASTM A123.

G. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035.

PART 3 - EXECUTION

3.1 CONNECTIONS (SHOP AND FIELD):

A. Welding: Welding in accordance with AWS D1.1. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.

B. High-Strength Bolts: High-strength bolts tightened to a bolt tension not less than proof load given in Specification for Structural Joints Using

ASTM A325 or A490 Bolts. Tightening done with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers). Tighten bolts in connections identified as slip-critical using Direct Tension Indicators or the turn-of-the-nut method. Twist-off torque bolts are not an acceptable alternate fastener for slip critical connections.

3.2 FABRICATION:

Fabrication in accordance with Chapter M, Specification for Steel Buildings - Load and Resistance Factor Design.

3.3 SHOP PAINTING:

A. General: Shop paint steel with primer in accordance with Section 6, Code of Standard Practice for Steel Buildings and Bridges.

B. Shop paint for steel surfaces is specified in Section 09 91 00, PAINTING.

C. Do not apply paint to following:

1. Surfaces within 50 mm (2 inches) of joints to be welded in field.
2. Surfaces which will be encased in concrete.
3. Surfaces which will receive sprayed on fireproofing.
4. Top flange of members which will have shear connector studs applied.

D. Structural steel in the interstitial space that does not receive sprayed on fireproofing shall be painted with primer in accordance with general requirement of shop painting.

E. Zinc Coated (Hot Dip Galvanized) per ASTM A123 (after fabrication): Touch-up after erection: Clean and wire brush any abraded and other spots worn through zinc coating, including threaded portions of bolts and welds and touch-up with galvanizing repair paint.

3.4 ERECTION:

A. General: Erection in accordance with Section 7, Code of Standard Practice for Steel Buildings and Bridges.

B. Temporary Supports: Temporary support of structural steel frames during erection in accordance with Section 7, Code of Standard Practice for Steel Buildings and Bridges.

3.5 FIELD PAINTING:

A. After erection, touch-up steel surfaces specified to be shop painted. After welding is completed, clean and prime areas not painted due to field welding.

B. Finish painting of steel surfaces is specified in Section 09 91 00, PAINTING.

3.6 SURVEY:

Upon completion of finish bolting or welding on any part of the work, and prior to start of work by other trades that may be supported, attached, or applied to the structural steel work, submit a certified report of survey to Resident Engineer for approval. Reports shall be prepared by Registered Land Surveyor or Registered Civil Engineer as specified in Section 01 00 00, GENERAL REQUIREMENTS. Report shall specify that location of structural steel is acceptable for plumbness, level and alignment within specified tolerances specified in the AISC Manual.

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SECTION 05 21 00

STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies open web, longspan, and deep longspan steel joists.

1.2 RELATED WORK:

A. Structural Steel: Section 05 12 00, STRUCTURAL STEEL FRAMING.

B. Finish Painting: Section 09 91 00, PAINTING.

1.3 DESIGN REQUIREMENTS:

Design all elements with the latest published version of applicable Codes.

1.3 TOLERANCES:

Deviation from a straight line between ends of any installed joist shall not exceed 10 mm in 3 m (3/8 inch in 10 feet).

1.4 REGULATORY REQUIREMENTS:

STEEL JOIST INSTITUTE: Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders, (Latest Edition).

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop and Erection Drawings: Complete.

1. Fabrication drawings including details and schedules for the fabrication and assembly of each joist.
2. Erection drawings showing the size and location of each joist, bridging, cross bracing, bearing details, connections, welds, bolts and bearing plates.

C. Certificates: STEEL JOIST INSTITUTE compliance.

D. Design Calculations: If requested by the Resident Engineer, submit complete calculations covering the design of all members and connections. Calculations must be specifically applicable to the joists supplied.

E. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).
c. Provide material costs for the materials included in the contractor's or subcontractor's work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the amount of recycled content.
3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

1.6 QUALITY ASSURANCE:

Provide documentation that the joist manufacturer is a member of the Steel Joist Institute and has satisfactorily completed work of a similar scope and nature.

LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled

content shall be in accordance with the LEED Building Submittal Requirements of this Section.

4. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.7 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Institute of Steel Construction (AISC):

1. Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design (Latest Edition).
2. Load and Resistance Factor Design Specification for Structural Steel Buildings (Latest Edition).

C. American Society for Testing and Materials (ASTM):

A307-07.....Carbon Steel Bolts and Studs, 400 MPa (60,000 psi) Tensile Strength

A325-09.....Structural Bolts, Steel, Heat Treated, 800/700 MPa (120/105 ksi) Minimum Tensile Strength

A490-08.....Heat-Treated Steel Structural Bolts, 1000 MPA (150 ksi) Minimum Tensile Strengths

D. American Welding Society (AWS):

D1.1-08.....Structural Welding Code – Steel

E. SSPC: The Society for Protective Coatings:

Steel Structures Painting Manual, Volumes 1 and 2

F. Steel Joist Institute (STEEL JOIST INSTITUTE):

Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders (Latest Edition).

G. U.S. Army Corps of Engineers:

CRD-C-621.....Specification for Non-Shrink Grout

PART 2 - PRODUCTS

2.1 OPEN WEB STEEL JOISTS:

K-Series conforming to STEEL JOIST INSTITUTE standard specifications.

2.2 ACCESSORIES – FITTINGS:

A. Accessories and fittings, including end supports and bridging, in accordance with standard STEEL JOIST INSTITUTE specification under which joists were designed.

B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular hexagon type, low carbon steel.

C. High-strength bolts, including nuts and washers: ASTM A325 or A490 heavy hexagon structural bolts.

2.4 BEDDING MORTAR:

A. For joist ends bearing on concrete or masonry, provide bedding mortar as follows:
   1. Portland cement and sand, mixed at a ratio of 1 part cement to 3 parts sand, by volume, with enough water for placement and hydration.
   2. Non-metallic, shrinkage-resistant mortar; premixed, non-corrosive, non-staining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C-621.

PART 3 - EXECUTION

3.1 FABRICATION:

A. Fabrication and assembly in accordance with applicable standard STEEL JOIST INSTITUTE specification:
   1. Make chord splices with full penetration welds capable of developing the ultimate strength in tension of the parent material. Make no allowance for the strength of back-up bars or other material incidental to welding.
   2. Provide shop-welded connection plates at panel points to receive supplemental framing.
   3. Holes in Chord Members: Provide holes in chord members where shown for securing other work to steel joists; however, deduct area of holes from the area of chord when calculating strength of member.
   4. Extended Ends: Provide extended ends on joists where shown, complying with manufacturer’s standards and requirements of applicable STEEL JOIST INSTITUTE specifications.
   5. Ceiling Extensions: Provide ceiling extension in areas having ceilings attached directly to joist bottom chord. Provide either an extended bottom chord element or a separate unit, to suit manufacturer’s standards, of sufficient strength to support ceiling construction. Extend ends to within 12 mm (1/2 inch) of finished wall surface unless otherwise indicated.
   6. Bridging: Provide horizontal or diagonal type bridging for joists and joist girders, complying with STEEL JOIST INSTITUTE specifications. Provide bridging anchors for ends of bridging lines terminating at walls or beams. Provide bridging adequate to resist the loads indicated on the Contract Documents.
   7. End Anchorage: Provide end anchorages, including bearing plates, to secure joists to adjacent construction, complying with STEEL JOIST

INSTITUTE specifications, unless otherwise indicated. Design all end anchorages to resist a minimum net uplift of 1.6 kPa (35 pounds per square foot) of supported area.

8. Header Units: Provide header units to support all joists at openings in floor or roof system not framed with steel shapes.
9. Provide supplemental steel support framing for metal deck where normal deck bearing is precluded by other framing members and minor openings.

3.2 SHOP PAINTING:

A. Shop painting in accordance with applicable STEEL JOIST INSTITUTE standard specification.

B. Shop paint joists and accessories with a rust-inhibiting primer paint. For joists which will be finish painted, limit paint to a primer which is compatible with specified finish paint. In high humidity areas, shop paint joists with a zinc-rich primer to receive top coats per the paint system manufacturer’s recommendations.

3.3 ERECTION:

A. Installation of joists in accordance with applicable STEEL JOIST INSTITUTE standard specification.

B. Handle joists in a manner to avoid damaging of joists. Remove damaged joists from site, except when field repair is approved and such repairs are satisfactorily made in accordance with manufacturer's recommendations.

C. Accurately set joists and end anchorage in accordance with the applicable STEEL JOIST INSTITUTE standard specification. Secure joists resting on masonry or concrete bearing surfaces by welding or bolting to the steel bearing plates as indicated on the Contract Documents. Secure bridging and anchoring in place prior to application of any construction loads. Distribute any temporary loads so that carrying capacity of any joist is not exceeded. Loads shall not be applied to bridging where joist lengths are 12 m (40 feet) and longer. Where joist lengths are 12 m (40 feet) and longer, install a center row of bolted diagonal bridging to provide lateral stability before slackening of hoisting lines.

3.4 FIELD PAINTING:

A. Clean abraded, corroded, and field welded areas and touch up with same type of paint used in shop painting.

B. Finish painting of steel surfaces is specified in Section 09 91 00, PAINTING.

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SECTION 05 31 00

STEEL DECKING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies material and services required for installation of steel decking as shown and specified.

1.2 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Finish Painting: Section 09 91 00, PAINTING.

1.3 DESIGN REQUIREMENTS:

A. Design steel decking in accordance with AISI publication, "Specification for the Design of Cold-formed Steel Structural Members" except as otherwise shown or specified.

B. Design all elements with the latest published version of applicable codes.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: Shop and erection drawings showing decking unit layout, connections to supporting members, and similar information necessary for completing installation as shown and specified, including supplementary framing, sump pans, ridge and valley plates, cant strips, cut openings, special jointing or other accessories. Show welding, side lap, closure, deck reinforcing and closure reinforcing details. Show openings required for work of other trades, including openings not shown on structural drawings. Indicate where temporary shoring is required to satisfy design criteria.

C. Manufacturer's Literature and Data: Showing steel decking section properties and specifying structural characteristics.

D. Certification: For each type and gauge of metal deck supporting concrete slab or fill, furnish certification of the specified fire ratings. Certify that the units supplied are U.L. listed as a “Steel Floor and Form Unit”.

E. Insurance Certification: Assist the Government in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance.

F. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013300 – Submittal Requirements under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

1.5 QUALITY ASSURANCE:

A. Underwriters’ Label: Provide metal floor deck units listed in Underwriters’ Laboratories “Fire Resistance Directory”, with each deck unit bearing the UL label and marking for specific system detailed.

B. FM Listing: Provide metal roof deck units which have been evaluated by Factory Mutual Global and are listed in “Factory Mutual Research Approval Guide” for “Class 1” fire rated construction.

C. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division

1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.
4. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.6 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Society for Testing and Materials (ASTM):

A36/A36M-08.....Standard Specification for Carbon Structural Steel

A611-97.....Standard Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled

A653/A653M-08.....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process

C. American Institute of Steel Construction (AISC):

1. Load and Resistance Factor Design Specification for Structural Steel Buildings (Latest Edition).

D. American Iron and Steel Institute (AISI):

1. Specification and Commentary for the Design of Cold-Formed Steel Structural Members

E. American Welding Society (AWS):

D1.3-08.....Structural Welding Code - Sheet Steel

F. Factory Mutual (FM Global):

1. Loss Prevention Data Sheet 1-28: Wind Loads to Roof Systems and Roof Deck Securement
2. Factory Mutual Research Approval Guide (2002)

G. Military Specifications (Mil. Spec.)
MIL-P-21035B.....Paint, High Zinc Dust Content, Galvanizing Repair

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Steel Decking: ASTM A653, Structural Quality.
B. Galvanizing: ASTM A653, G60.
C. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035B.
D. Primer for Shop Painted Sheets: Manufacturer's standard primer (2 coats). When finish painting of steel decking is specified in Section 09 91 00, PAINTING primer coating shall be compatible with specified finish painting.
E. Miscellaneous Steel Shapes: ASTM A36.
F. Welding Electrode: E60XX minimum.
G. Sheet Metal Accessories: ASTM A653, galvanized, unless noted otherwise. Provide accessories of every kind required to complete the installation of metal decking in the system shown. Finish sheet metal items to match deck including, but not limited to, the following items:
   1. Metal Cover Plates: For end-abutting deck units, to close gaps at changes in deck direction, columns, walls and openings. Same quality as deck units but not less than 1.3 mm (18 gauge) sheet steel.
   2. Continuous Sheet Metal Edging: At openings, concrete slab edges and roof deck edges. Same quality as deck units but not less than 1.3 mm (18 gauge) steel. Side and end closures supporting concrete and their attachment to supporting steel shall be designed by the manufacturer to safely support the wet weight of concrete and construction loads. The deflection of cantilever closures shall be limited to 3 mm (1/8 inch) maximum.
   3. Metal Closure Strips: For openings between decking and other construction, of not less than 1.3 mm (18 gauge) sheet steel of the same quality as the deck units. Form to the configuration required to provide tight-fitting closures at open ends of flutes and sides of decking.

4. Ridge and Valley Plates: Provide 1.3 mm (18 gauge), minimum 100 mm (4 inch) wide ridge and valley plates where roof slope exceeds 40 mm per meter (1/2 inch per foot).
5. Cant Strips: Provide bent metal 45 degree leg cant strips where indicated on the Drawings. Fabricate cant strips from 1 mm (20 gauge) metal with a minimum 125 mm (5 inch) face width.
6. Seat Angles for Deck: Provide where a beam does not frame into a column.
7. Sump Pans for Roof Drains: Fabricated from single piece of minimum 1.9 mm (14 gauge) galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain, unless otherwise shown. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 75 mm (3 inches) wide. Recess pans not less than 38 mm (1 1/2 inches) below roof deck surface, unless otherwise shown or required by deck configuration. Holes for drains will be cut in the field.

2.2 REQUIREMENTS:

A. Provide steel decking of the type, depth, gauge, and section properties as shown.
B. Metal Roof Deck: Single pan fluted units with flat horizontal top surfaces utilized to act as a permanent support for all superimposed loads. Comply with the depth and minimum gage requirements as shown on the Contract Documents.
   1. Wide Rib (Type B) deck.
   2. Finish: Galvanized G-60.
C. Do not use steel deck for hanging supports for any type or kind of building components including suspended ceilings, electrical light fixtures, plumbing, heating, or air conditioning pipes or ducts or electrical conduits.

PART 3 - EXECUTION

3.1 ERECTION:

A. Do not start installation of metal decking until corresponding steel framework has been plumbed, aligned and completed and until temporary shoring, where required, has been installed. Remove any oil, dirt, paint, ice, water and rust from steel surfaces to which metal decking will be welded.
B. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.

C. Do not use floor deck units for storage or working platforms until permanently secured. Do not overload deck units once placed. Replace any deck units that become damaged after erection and prior to casting concrete at no cost to the Government.

D. Provide steel decking in sufficient lengths to extend over 3 or more spans.

E. Place steel decking units at right angles to supporting members. End laps of sheets of roof deck shall be a minimum of 50 mm (2 inches) and shall occur over supports.

F. Fastening Deck Units:

1. Fasten floor deck units to steel supporting members by not less than 16 mm (5/8 inch) diameter puddle welds or elongated welds of equal strength, spaced not more than 305 mm (12 inches) o.c. with a minimum of two welds per unit at each support. Where two units abut, fasten each unit individually to the supporting steel framework.
2. Tack weld or use self-tapping No. 8 or larger machine screws at 915 mm (3 feet) o.c. for fastening end closures. Only use welds to attach longitudinal end closures.
3. Weld side laps of adjacent floor deck units that span more than 1524 mm (5 feet). Fasten at midspan or 915 mm (3 feet) o.c., whichever is smaller.
4. Fasten roof deck units to steel supporting members by not less than 16 mm (5/8 inch) diameter puddle welds or elongated welds of equal strength, spaced not more than 305 mm (12 inches) o.c. at every support, and at closer spacing where required for lateral force resistance by diaphragm action. Attach split or partial panels to the structure in every valley. In addition, secure deck to each supporting member in ribs where side laps occur. Power driven fasteners may be used in lieu of welding for roof deck if strength equivalent to the welding specified above is provided. Submit test data and design calculations verifying equivalent design strength.
5. Mechanically fasten side laps of adjacent roof deck units with spans greater than 1524 mm (5 feet) between supports, at intervals not exceeding 915 mm (3 feet) o.c., or midspan, whichever is closer, using self-tapping No. 8 or larger machine screws.
6. Provide any additional fastening necessary to comply with the requirements of Underwriters Laboratories and/or Factory Mutual to achieve the required ratings.

7. Uplift Loading: Install and anchor roof deck units to resist gross uplift loading of 2.1 kPa (45 psf) at eave overhang and 1.4 kPa (30 psf) for other roof areas.

G. Cutting and Fitting:

1. Cut all metal deck units to proper length in the shop prior to shipping.
2. Field cutting by the metal deck erector is restricted to bevel cuts, notching to fit around columns and similar items, and cutting openings that are located and dimensioned on the Structural Drawings.
3. Other penetrations shown on the approved metal deck shop drawings but not shown on the Structural Drawings are to be located, cut and reinforced by the trade requiring the opening.
4. Make all cuts neat and trim using a metal saw, drill or punchout device; cutting with torches is expressly prohibited.
5. Do not make any cuts in the metal deck that are not shown on the approved metal deck drawings. If an additional opening not shown on the approved shop drawings is required, submit a sketch, to scale, locating the required new opening and any other openings and supports in the immediate area. Do not cut the opening until the sketch has been reviewed and accepted by the Resident Engineer. Provide any additional reinforcing or framing required for the opening at no cost to the Government. Failure to comply with these requirements is cause for rejection of the work and removal and replacement of the affected metal deck.
6. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work shown.

3.2 WELDING:

Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.3.

3.3 FIELD REPAIR:

1. Areas scarred during erection.
2. Welds to be thoroughly cleaned and touched-up. Touch-up paint for zinc-coated units shall be zinc rich galvanizing repair paint. Touch-up paint for shop painted units of same type used for shop painting.

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SECTION 05 36 00

COMPOSITE METAL DECKING

PART 1 – GENERAL

1.1 DESCRIPTION:

This section specifies material and services required for installation of composite steel decking including shear connector studs and miscellaneous closures required to prepare deck for concrete placement as shown and specified.

1.2 RELATED WORK:

Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

1.3 DESIGN REQUIREMENTS:

A. Design steel decking in accordance with American Iron And Steel Institute publication "Specifications for the Design of Cold Formed Steel Structural Members", except as otherwise shown or specified.

B. Design all elements with the latest published version of applicable codes.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: Shop and erection drawings showing decking unit layout, connections to supporting members, and information necessary to complete the installation as shown and specified, including supplementary framing, cant strips, cut openings, special jointing or other accessories. Show welding, side lap, closure, deck reinforcing and closure reinforcing details. Show openings required for work of other trades, including openings not shown on structural drawings. Indicate where temporary shoring is required to satisfy design criteria.

C. Manufacturer's Literature and Data: Showing steel decking section properties and specifying structural characteristics as specified herein.

D. Manufacturer's written recommendations for:

1. Shape of decking section to be used.
2. Cleaning of steel decking prior to concrete placement.

E. Test Report - Establishing structural characteristics of composite concrete and steel decking system.
F. Test Report - Stud base qualification.
G. Welding power setting recommendation by shear stud manufacturer.
H. Shear Stud Layouts: Submit drawings showing the number, pattern, spacing and configuration of the shear studs for each beam and girder.
I. Certification: For each type and gauge of metal deck supporting concrete slab or fill, furnish certification of the specified fire ratings. Certify that the units supplied are U.L. listed as a “Steel Floor and Form Unit”.
J. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:
   1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:
      a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
      b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).
      c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.
   2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.
   3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.
   4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

1.5 QUALITY ASSURANCE:

LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.
4. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.6 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only. Refer to the latest edition of all referenced Standards and codes.

B. American Iron and Steel Institute (AISI):
Specification and Commentary for the Design of Cold-Formed Steel Structural Members (Latest Edition).

C. American Society of Testing and Materials (ASTM):
A36/A36M-08.....Standard Specification for Carbon Structural Steel
A108-07.....Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality
A653/A653M-10.....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process

D. American Institute of Steel Construction (AISC):
1. Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design (Latest Edition)

2. Load and Resistance Factor Design Specification for Structural Steel Buildings (Latest Edition)

E. American Welding Society (AWS):
D1.1/D1.1M-10.....Structural Welding Code - Steel
D1.3/D1.3M-08.....Structural Welding Code - Sheet Steel

E. Military Specifications (Mil. Spec.):
MIL-P-21035B.....Paint, High Zinc Dust Content, Galvanizing Repair

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Steel Decking and all Flashings: ASTM A653, Structural Quality suitable for shear stud weld-through techniques.

B. Galvanizing: ASTM A653, G60.

C. Shear connector studs: ASTM A108, Grades 1015-1020, yield 350 Mpa (50,000 psi) minimum, tensile strength - 400 Mpa (60,000 psi) minimum, reduction of area 50 percent minimum. Studs of uniform diameter; heads shall be concentric and normal to shaft; stud, after welding free from any substance or defect which would interfere with its function as a shear connector. Studs shall not be painted or galvanized. Size of studs shall be as shown on drawings. Studs manufactured by a company normally engaged in the manufacturer of shear studs and can furnish equipment suitable for weld-through installation of shear studs.

D. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035B.

E. Miscellaneous Steel Shapes: ASTM A36.

F. Welding Electrode: E60XX minimum.

G. Sheet Metal Accessories: ASTM A653, galvanized, unless noted otherwise. Provide accessories of every kind required to complete the installation of metal decking in the system shown. Finish sheet metal items to match deck including, but not limited to, the following items:

1. Metal Cover Plates: For end-abutting deck units, to close gaps at changes in deck direction, columns, walls and openings. Same quality as deck units but not less than 1.3 mm (18 gauge) sheet steel.

2. Continuous sheet metal edging: at openings and concrete slab edges. Same quality as deck units but not less than 1.3 mm (18 gauge) steel. Side and end closures supporting concrete and their attachment to supporting steel shall be designed by the manufacturer to safely support the wet weight of concrete and construction loads. The deflection of cantilever closures shall be limited to 3 mm (1/8 inch) maximum.

3. Metal Closure Strips: For openings between decking and other construction, of not less than 1.3 mm (18 gauge) sheet steel of the same quality as the deck units. Form to the configuration required to provide tight-fitting closures at open ends of flutes and sides of decking.
4. Seat angles for deck: Where a beam does not frame into a column.

2.2 REQUIREMENTS:

A. Steel decking depth, gage, and section properties to be as shown. Provide edges of deck with vertical interlocking male and female lip providing for a positive mechanical connection.
B. Fabricate deck units with integral embossments to provide mechanical bond with concrete slab. In combination with concrete slab, capable of supporting total design loads on spans shown.
C. Steel decking capable of safely supporting total, normal construction service loads without damage to decking unit.
D. Steel decking units shall include an integral system which provides a simple point of attachment for light duty hanger devices for flexibility for attaching hangers for support of acoustical, lathing, plumbing, heating, air conditioning and electrical items. System shall provide for minimum spacing pattern of 300 mm (12 inches) on centers longitudinally and 600 mm or 900 mm (24 or 36 inches) on centers transversely. Suspension system shall be capable of safely supporting a maximum allowable load of 45 kg (100 pounds) concentrated at any one hanger attachment point. System may consist of fold-down type hanger tabs or a lip hanger.

PART 3 - EXECUTION

3.1 ERECTION:

A. Do not start installation of metal decking until corresponding steel framework has been plumbed, aligned and completed and until temporary shoring, where required, has been installed. Remove any oil, dirt, paint, ice, water and rust from steel surfaces to which metal decking will be welded.
B. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
C. Do not use floor deck units for storage or working platforms until permanently secured. Do not overload deck units once placed. Replace any deck units that become damaged after erection and prior to casting concrete at no cost to the Government.
D. Erect steel deck in accordance with manufacturer's printed instructions.

E. Ship steel deck units to project in standard widths and cut to proper length.
F. Provide steel decking in sufficient lengths to extend over 3 or more spans, except where structural steel layout does not permit.
G. Place steel decking units on supporting steel framework and adjust to final position before being permanently fastening. Bring each unit to proper bearing on supporting beams. Place deck units in straight alignment for entire length of run of flutes and with close registration of flutes of one unit with those of abutting unit. Maximum space between ends of abutting units is 13 mm (1/2 inch). If space exceeds 13 mm (1/2 inch), install closure plates at no additional cost to Government.
H. Ceiling hanger loops, if used, must be flattened or removed to obtain bearing of units on structural steel.

I. Fastening Deck Units:
   1. Fasten floor deck units to steel supporting members by not less than 16 mm (5/8 inch) diameter puddle welds or elongated welds of equal strength, spaced not more than 305 mm (12 inches) o.c. with a minimum of two welds per unit at each support. Where two units abut, fasten each unit individually to the supporting steel framework.
   2. Tack weld or use self-tapping No. 8 or larger machine screws at 915 mm (3 feet) o.c. for fastening end closures. Only use welds to attach longitudinal end closures.
   3. Weld side laps of adjacent floor deck units that span more than 1524 mm (5 feet). Fasten at midspan or 915 mm (3 feet) o.c., whichever is smaller.
J. Welding to conform to AWS D1.3 and done by competent experienced welding mechanics.
K. Areas scarred during erection and welds shall be thoroughly cleaned and touched-up with zinc rich galvanizing repair paint. Paint touch-up is not required for welds or scars that are to be in direct contact with concrete.
L. Provide metal concrete stops at edges of deck as required.
M. Cutting and Fitting:
   1. Cut all metal deck units to proper length in the shop prior to shipping.
   2. Field cutting by the metal deck erector is restricted to bevel cuts, notching to fit around columns and similar items, and cutting openings that are located and dimensioned on the structural drawings.

3. Other penetrations shown on the approved metal deck shop drawings but not shown on the structural drawings are to be located, cut and reinforced by the trade requiring the opening.
4. Make all cuts neat and trim using a metal saw, drill or punchout device; cutting with torches is expressly prohibited.
5. Do not make any cuts in the metal deck that are not shown on the approved metal deck drawings. If an additional opening not shown on the approved shop drawings is required, submit a sketch, to scale, locating the required new opening and any other openings and supports in the immediate area. Do not cut the opening until the sketch has been reviewed and accepted by the Resident Engineer. Provide any additional reinforcing or framing required for the opening at no cost to the Government. Failure to comply with these requirements is cause for rejection of the work and removal and replacement of the affected metal deck.
6. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other work shown.

N. Installation of shear connector studs through previously installed metal deck to conform to AWS D1.1, Section 7, except all studs will be installed with automatically timed welding equipment and as specified below:
1. Do not place reinforcing steel temperature mesh or other materials and equipment which will interfere with stud installation on steel deck until shear connector studs are installed.
2. Steel deck sheets shall be free of oil, rust, dirt, and paint. Release water in deck’s valley so that it does not become entrapped between deck and beam. Surface to which stud is to be welded shall be clean and dry.
3. Rest metal deck tightly upon top flange of structural member with bottom of deck rib in full contact with top of beam flange.
4. Weld studs only through a single thickness of deck. Place decking so that a butt joint is obtained. Place studs directly over beam web, where one row of studs are required.
5. Ferrules specially developed for the weld-through technique must be used. Ferrules shall be appropriate for size of studs used and be removed after welding.
6. Submit report of successful test program for stud base qualification as required by AWS D1.1, Appendix K.

3.2 CLEANING:

Clean deck in accordance with manufacturer's recommendation before concrete placement.

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SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies materials and services required for installation of cold-formed steel, including tracks and required accessories as shown and specified. This Section includes the following:

1. Exterior load-bearing steel stud walls.
2. Interior load-bearing steel stud walls.
3. Exterior non-load-bearing steel stud curtain wall.
4. Steel joists.

1.2 RELATED WORK:

A. Structural steel framing: Section 05 12 00, STRUCTURAL STEEL FRAMING.

B. Open web steel joists: Section 05 21 00, STEEL JOIST FRAMING.

C. Non-load-bearing metal stud framing assemblies: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

D. Gypsum board assemblies: Section 09 29 00, GYPSUM BOARD.

1.3 DESIGN REQUIREMENTS:

A. Design steel in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.

B. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.

1. Design Loads: As indicated.
2. Design framing systems to withstand design loads without deflections greater than the following:

a. Exterior Load-Bearing Walls: Lateral deflection of 1/360 of the wall height and to the BIA or l/600, whichever is greater, for stone veneer load bearing wall systems.

b. Interior Load-Bearing Walls: Lateral deflection of 1/360 of the wall height.

c. Exterior Non-load-Bearing Curtain wall: Lateral deflection of 1/360 of the wall height.

d. Floor/Ceiling Joists: Vertical deflection of 1/360 of the span.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 67 degrees C (120 degrees F).

4. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.

5. Design exterior non-load-bearing curtain wall framing to accommodate lateral deflection without regard to contribution of sheathing materials.

6. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: Shop and erection drawings showing steel unit layout, connections to supporting members, and information necessary to complete installation as shown and specified.

C. Manufacturer’s Literature and Data: Showing steel component sections and specifying structural characteristics.

D. For cold-formed metal framing indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.

E. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. **A completed LEED Building Materials Certification Form, per Section 013300 – Submittal Requirements under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:**

   a. **The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.**
   b. **The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).**
   c. **Provide material costs for the materials included in the contractor's or subcontractor's work. Material cost does not include costs associated with labor and equipment.**

2. **Letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the amount of recycled content.**

3. **Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.**

4. **Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).**

1.5 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Iron and Steel Institute (AISI):

Specification and Commentary for the Design of Cold-Formed Steel Structural Members (1996)

C. American Society of Testing and Materials (ASTM):

A36/A36M-08.....Standard Specifications for Carbon Structural Steel

A123/A123M-09.....Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153/A153M-09.....Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A307-10.....Standard Specifications for Carbon Steel Bolts and Studs

A653/A653M-10.....Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

C1107/C1107M-08.....Standard Specifications for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

E488-96(R2003).....Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

E1190-95(R2007).....Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members

D. American Welding Society (AWS):

D1.3/D1.3M-08.....Structural Welding Code-Sheet Steel

E. Military Specifications (Mil. Spec.):

MIL-P-21035B.....Paint, High Zinc Dust Content, Galvanizing Repair

1.7 QUALITY ASSURANCE:

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within

a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. **Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.**

4. **Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.**

PART 2 – PRODUCTS

2.1 MATERIALS:

A. Sheet Steel for joists, studs and accessories 16 gage and heavier: ASTM A653, structural steel, zinc coated G90 , with a yield of 340 Mpa (50 ksi) minimum.

B. Sheet Steel for joists, studs and accessories 18 gage and lighter: ASTM A653, structural steel, zinc coated G90, with a yield of 230 Mpa (33 ksi) minimum.

C. Galvanizing Repair Paint: MIL-P-21035B.

D. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, non-staining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, with fluid consistency and a 30 minute working time.

2.2 WALL FRAMING:

A. Steel Studs: Manufacturer’s standard C-shaped steel studs of web depth indicated, with lipped flanges, and complying with the following:

1. Design Uncoated-Steel Thickness:

   1.20 mm (0.0474 inch)

   1.52 mm (0.0598 inch)

   2.66 mm (0.1046 inch)

2. Flange Width:

   (1-5/8 inches)

3. Web: Punched.

B. Steel Track: Manufacturer’s standard U-shaped steel track, unpunched, of web depths indicated, with straight flanges, and complying with the following:

1. Design Uncoated-Steel Thickness: Matching steel studs.

2. Flange Width: Manufacturer’s standard deep flange where indicated, standard flange elsewhere.

2.3 JOIST FRAMING:

A. Steel Joists: Manufacturer’s standard C-shaped steel joists, unpunched, of web depths indicated, with lipped flanges, and complying with the following:

1. Design Uncoated-Steel Thickness: 0.91 mm (0.0358 inch).

   1.20 mm (0.0474 inch). 1.52 mm (0.0598 inch. 1.90 mm 0.0747 inch).2.66 mm (0.1046 inch.

2. Flange Width: 41 mm (1 5/8 inches) minimum.

B. Steel Joist Track: Manufacturer’s standard U-shaped steel joist track, un- punched, of web depths indicated, with straight flanges, and complying with the following:

1. Design Uncoated-Steel Thickness: Matching steel joists.

2. Flange Width: 41 mm (1 5/8-inches) minimum.

2.4 FRAMING ACCESSORIES:

A. Fabricate steel framing accessories of the same material and finish used for framing members, with a minimum yield strength of 230 MPa (33 ksi).

B. Provide accessories of manufacturer’s standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.

2. Bracing, bridging, and solid blocking.

3. Web stiffeners.

4. Gusset plates.

5. Deflection track and vertical slide clips.

6. Stud kickers and girts.

7. Joist hangers and end closures.

8. Reinforcement plates.

2.5 ANCHORS, CLIPS, AND FASTENERS:

A. Steel Shapes and Clips: ASTM A36, zinc coated by the hot-dip process according to ASTM A123.

B. Cast-in-Place Anchor Bolts and Studs: ASTM A307, Grade A, zinc coated by the hot-dip process according to ASTM A153.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the design load, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws. Low-profile head beneath sheathing, manufacturer’s standard elsewhere.

2.6 REQUIREMENTS:

A. Welding in accordance with AWS D1.3

B. Furnish members and accessories by one manufacturer only.

PART 3 - EXECUTION

3.1 FABRICATION:

A. Framing components may be preassembled into panels. Panels shall be square with components attached.

B. Cut framing components squarely or as required for attachment. Cut framing members by sawing or shearing; do not torch cut.

C. Hold members in place until fastened.

D. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

1. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

2. Locate mechanical fasteners and install according to cold-formed metal framing manufacturer’s instructions with screw penetrating joined members by not less than 3 exposed screw threads.

E. Where required, provide specified insulation in double header members and double jamb studs which will not be accessible after erection.

3.2 ERECTION:

A. Handle and lift prefabricated panels in a manner as to not distort any member.

B. Securely anchor tracks to supports as shown.

C. At butt joints, securely anchor two pieces of track to same supporting member or butt-weld or splice together.

D. Plumb, align, and securely attach studs to flanges or webs of both upper and lower tracks.

E. All axially loaded members shall be aligned vertically to allow for full transfer of the loads down to the foundation. Vertical alignment shall be maintained at floor/wall intersections.

F. Install jack studs above and below openings and as required to furnish support. Securely attach jack studs to supporting members.

G. Install headers in all openings that are larger than the stud spacing in that wall.

H. Attach bridging for studs in a manner to prevent stud rotation. Space bridging rows as shown.

I. Studs in one piece for their entire length, splices will not be permitted.

J. Provide a load distribution member at top track where joist is not located directly over bearing stud.

K. Provide joist bridging and web stiffeners at reaction points where shown.

L. Provide end blocking where joist ends are not restrained from rotation.

M. Provide an additional joist under parallel partitions, unless otherwise shown, when partition length exceeds one-half joist span and when floor and roof openings interrupt one or more spanning members.

N. Provide temporary bracing and leave in place until framing is permanently stabilized.

O. Do not bridge building expansion joints with cold-formed metal framing. Independently frame both sides of joints.

P. Fasten reinforcement plate over web penetrations that exceed size of manufacturer’s standard punched openings.

3.3 TOLERANCES:

A. Vertical alignment (plumbness) of studs shall be within 1/960th of the span.

B. Horizontal alignment (levelness) of walls shall be within 1/960th of their respective lengths.

C. Spacing of studs shall not be more than 3 mm (1/8 inch) +/- from the designed spacing providing that the cumulative error does not exceed the requirements of the finishing materials.

D. Prefabricated panels shall be not more than 3 mm (1/8 inch) +/- out of square within the length of that panel.

3.4 FIELD REPAIR:

Touch-up damaged galvanizing with galvanizing repair paint.

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SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.

B. Items specified.

1. Support for Wall and Ceiling Mounted Items: (12, 14A, 14C)
2. Covers and Frames for Pits and Trenches.
3. Loose Lintels
4. Shelf Angles
5. Plate Door Sill
6. Safety Nosings
7. Ladders
8. Railings: (10)
9. Steel Counter or Bench Top Frame and Leg

1.2 RELATED WORK

A. Railings attached to steel stairs: Section 05 51 00, METAL STAIRS.

B. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES.

C. Prime and finish painting: Section 09 91 00, PAINTING.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items

1. A completed LEED Building Materials Certification Form, per Section 013300 – Submittal Requirements under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

C. Manufacturer's Literature and Data:

Grating, each type	Floor plate
	Wheel guards
	Safety nosing

D. Shop Drawings:

1. Each item specified, showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors.
2. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.
3. Provide templates and rough-in measurements as required.

E. Manufacturer's Certificates:

1. Anodized finish as specified.
2. Live load designs as specified.

F. Design Calculations for specified live loads including dead loads.

G. Furnish setting drawings and instructions for installation of anchors to be preset into concrete and masonry work, and for the positioning of items having anchors to be built into concrete or masonry construction.

1.4 QUALITY ASSURANCE

A. LEED Building Performance Requirements

1. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section\
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.
4. Adhesives or sealants used for work in this section for interior

applications shall meet the requirements of Division 1, Section 018113: "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable.

B. Each manufactured product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.

C. Each product type shall be the same and be made by the same manufacturer.

D. Assembled product to the greatest extent possible before delivery to the site.

E. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Mechanical Engineers (ASME):
B18.6.1-97 Wood Screws
B18.2.2-87(R2005) Square and Hex Nuts

C. American Society for Testing and Materials (ASTM):

A36/A36M-05	Structural Steel
A123-02	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A167-99(R2004)	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
A269-07	Seamless and Welded Austenitic Stainless Steel Tubing for General Service
A307-07	Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
A312/A312M-06	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
A391/A391M-01	Grade 80 Alloy Steel Chain
A653/A653M-07	Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
A786/A786M-05	Rolled Steel Floor Plate
B221-06	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
B456-03	Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
B632-02	Aluminum-Alloy Rolled Tread Plate
C1107-07	Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
F436-07	Hardened Steel Washers
F468-06	Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
F593-02	Stainless Steel Bolts, Hex Cap Screws, and Studs
F1667-05	Driven Fasteners: Nails, Spikes and Staples

D. American Welding Society (AWS):

D1.1-04 Structural Welding Code Steel
D1.2-03 Structural Welding Code Aluminum
D1.3-98 Structural Welding Code Sheet Steel

E. National Association of Architectural Metal Manufacturers (NAAMM)
AMP521-01 Pipe Railing Manual
AMP 500-505-1988 Metal Finishes Manual
MBG 531-00 Metal Bar Grating Manual
MBG 532-00 Heavy Duty Metal Bar Grating Manual

F. Structural Steel Painting Council (SSPC):
SP 1-05 No. 1, Solvent Cleaning
SP 2-05 No. 2, Hand Tool Cleaning
SP 3-05 No. 3, Power Tool Cleaning

G. Federal Specifications (Fed. Spec):
RR-T-650E Treads, Metallic and Nonmetallic, Nonskid

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. In addition to the dead loads, design fabrications to support the following live loads unless otherwise specified.

B. Ladders and Rungs: 120 kg (250 pounds) at any point.

C. Railings and Handrails: 900 N (200 pounds) in any direction at any point.

D. Floor Plates, Gratings, and Covers: 500 kg/m^2 (100 pounds per square foot).

2.2 MATERIALS

A. Structural Steel: ASTM A36.

B. Stainless Steel: ASTM A167, Type 302 or 304.

C. Aluminum, Extruded: ASTM B221, Alloy 6063-T5 unless otherwise specified. For structural shapes use alloy 6061-T6 and alloy 6061-T4511.

D. Floor Plate:

1. Steel ASTM A786.

2. Aluminum: ASTM B632.

E. Steel Pipe: ASTM A53.

1. Galvanized for exterior locations.

2. Type S, Grade A unless specified otherwise.

3. NPS (inside diameter) as shown.

F. Primer Paint: As specified in Section 09 91 00, PAINTING.

G. Stainless Steel Tubing: ASTM A269, type 302 or 304.

H. Modular Channel Units:

1. Factory fabricated, channel shaped, cold formed sheet steel shapes, complete with fittings bolts and nuts required for assembly.

2. Form channel with in turned pyramid shaped clamping ridges on each side.

3. Provide case hardened steel nuts with serrated grooves in the top edges designed to be inserted in the channel at any point and be given a quarter turn so as to engage the channel clamping ridges. Provide each nut with a spring designed to hold the nut in place.
4. Factory finish channels and parts with oven baked primer when exposed to view. Channels fabricated of ASTM A525, G90 galvanized steel may have primer omitted in concealed locations. Finish screws and nuts with zinc coating.
5. Fabricate snap-in closure plates to fit and close exposed channel openings of not more than 0.3 mm (0.0125 inch) thick stainless steel.

I. Grout: ASTM C1107, pourable type.

2.3 HARDWARE

A. Rough Hardware:

1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G-90 where specified.
2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal or stainless is used.

B. Fasteners:

1. Bolts with Nuts:
   a. ASME B18.2.2.
   b. ASTM A307 for 415 MPa (60,000 psi) tensile strength bolts.
   c. ASTM F468 for nonferrous bolts.
   d. ASTM F593 for stainless steel.
2. Screws: ASME B18.6.1.
3. Washers: ASTM F436, type to suit material and anchorage.
4. Nails: ASTM F1667, Type I, style 6 or 14 for finish work.

2.4 FABRICATION GENERAL

A. Material

1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.
2. Use material free of defects which could affect the appearance or service ability of the finished product.

B. Size:

1. Size and thickness of members as shown.
2. When size and thickness is not specified or shown for an individual part, use size and thickness not less than that used for the same component on similar standard commercial items or in accordance with established shop methods.

C. Connections

1. Except as otherwise specified, connections may be made by welding, riveting or bolting.
2. Field riveting will not be approved.
3. Design size, number and placement of fasteners, to develop a joint strength of not less than the design value.
4. Holes, for rivets and bolts: Accurately punched or drilled and burrs removed.
5. Size and shape welds to develop the full design strength of the parts connected by welds and to transmit imposed stresses without permanent deformation or failure when subject to service loadings.
6. Use Rivets and bolts of material selected to prevent corrosion (electrolysis) at bimetallic contacts. Plated or coated material will not be approved.
7. Use stainless steel connectors for removable members machine screws or bolts.

D. Fasteners and Anchors

1. Use methods for fastening or anchoring metal fabrications to building construction as shown or specified.
2. Where fasteners and anchors are not shown, design the type, size, location and spacing to resist the loads imposed without deformation of the members or causing failure of the anchor or fastener, and suit the sequence of installation.
3. Use material and finish of the fasteners compatible with the kinds of materials which are fastened together and their location in the finished work.
4. Fasteners for securing metal fabrications to new construction only, may be by use of threaded or wedge type inserts or by anchors for welding to the metal fabrication for installation before the concrete is placed or as masonry is laid.
5. Fasteners for securing metal fabrication to existing construction or new construction may be expansion bolts, toggle bolts, power actuated drive pins, welding, self drilling and tapping screws or bolts.

E. Workmanship

1. General:
   a. Fabricate items to design shown.
   b. Furnish members in longest lengths commercially available within the limits shown and specified.
   c. Fabricate straight, true, free from warp and twist, and where applicable square and in same plane.
   d. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items.
   e. Provide openings, cut-outs, and tapped holes for attachment and clearances required for work of other trades.
   f. Prepare members for the installation and fitting of hardware.

g. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.

h. Fabricate surfaces and edges free from sharp edges, burrs and projections which may cause injury.

2. Welding:

a. Weld in accordance with AWS.

b. Welds shall show good fusion, be free from cracks and porosity and accomplish secure and rigid joints in proper alignment.

c. Where exposed in the finished work, continuous weld for the full length of the members joined and have depressed areas filled and protruding welds finished smooth and flush with adjacent surfaces.

d. Finish welded joints to match finish of adjacent surface.

3. Joining:

a. Miter or butt members at corners.

b. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.

4. Anchors:

a. Where metal fabrications are shown to be preset in concrete, weld 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 150 mm (6 inches) long with 25 mm (one inch) hooked end, to back of member at 600 mm (2 feet) on center, unless otherwise shown.

b. Where metal fabrications are shown to be built into masonry use 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 250 mm (10 inches) long with 50 mm (2 inch) hooked end, welded to back of member at 600 mm (2 feet) on center, unless otherwise shown.

5. Cutting and Fitting:

a. Accurately cut, machine and fit joints, corners, copes, and miters.

b. Fit removable members to be easily removed.

c. Design and construct field connections in the most practical place for appearance and ease of installation.

d. Fit pieces together as required.

e. Fabricate connections for ease of assembly and disassembly without use of special tools.

f. Joints firm when assembled.

g. Conceal joining, fitting and welding on exposed work as far as practical.

h. Do not show rivets and screws prominently on the exposed face.

i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.

F. Finish:

1. Finish exposed surfaces in accordance with NAAMM Metal Finishes Manual.
2. Aluminum: NAAMM AMP 501.
   a. Mill finish, AA-M10, as fabricated, use unless specified otherwise.
   b. Clear anodic coating, AA-C22A41, chemically etched medium matte, with Architectural Class 1, 0.7 mils or thicker.
   c. Colored anodic coating, AA-C22A42, chemically etched medium matte with Architectural Class 1, 0.7 mils or thicker.
   d. Painted: AA-C22R10.
3. Steel and Iron: NAAMM AMP 504.
   a. Zinc coated (Galvanized): ASTM A123, G90 unless noted otherwise.
   b. Surfaces exposed in the finished work:
      1) Finish smooth rough surfaces and remove projections.
      2) Fill holes, dents and similar voids and depressions with epoxy type patching compound.
   c. Shop Prime Painting:
      1) Surfaces of Ferrous metal:
         a) Items not specified to have other coatings.
         b) Galvanized surfaces specified to have prime paint.
         c) Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3.
         d) Clean of oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1.
         e) After cleaning and finishing apply one coat of primer as specified in Section 09 91 00, PAINTING.
      2) Non ferrous metals: Comply with MAAMM-500 series.
4. Stainless Steel: NAAMM AMP-504 Finish No. 4.
5. Chromium Plating: ASTM B456, satin or bright as specified, Service Condition No. SC2.

G. Protection:
1. Insulate aluminum surfaces that will come in contact with concrete, masonry, plaster, or metals other than stainless steel, zinc or white bronze by giving a coat of heavy-bodied alkali resisting bituminous paint or other approved paint in shop.
2. Spot prime all abraded and damaged areas of zinc coating which expose the bare metal, using zinc rich paint on hot-dip zinc coat items and zinc dust primer on all other zinc coated items.

2.5 SUPPORTS

A. General:
1. Fabricate ASTM A36 structural steel shapes as shown.
2. Use clip angles or make provisions for welding hangers and braces to

overhead construction.

3. Field connections may be welded or bolted.

B. For Ceiling Hung Toilet Stall:

1. Use a continuous steel channel above pilasters with hangers centered over pilasters.
2. Make provision for installation of stud bolts in lower flange of channel.
3. Provide a continuous steel angle at wall and channel braces spaced as shown.
4. Use threaded rod hangers.
5. Provide diagonal angle brace where the suspended ceiling over toilet stalls does not extend to side wall of room.

C. For Wall Mounted Items:

1. For items supported by metal stud partitions.
2. Steel strip or hat channel minimum of 1.5 mm (0.0598 inch) thick.
3. Steel strip minimum of 150 mm (6 inches) wide, length extending one stud space beyond end of item supported.
4. Steel hat channels where shown. Flange cut and flatted for anchorage to stud.
5. Structural steel tube or channel for grab bar at water closets floor to structure above with clip angles or end plates formed for anchors.
6. Use steel angles for thru wall counters. Drill angle for fasteners at ends and not over 100 mm (4 inches) on center between ends.

2.6 FRAMES

A. Elevator Entrance Wall Opening.

1. Fabricate of channel shapes, plates, and angles as shown.
2. Weld or bolt head to jamb as shown.
3. Weld clip angles to bottom of frame and top of jamb members extended to structure above for framed construction.
   a. Provide holes for anchors.
   b. Weld head to jamb members.

2.7 GUARDS

A. Edge Guard Angles for Openings in slabs.

1. Fabricate from steel angles of sizes and with anchorage shown.
2. Where size of angle is not shown, provide 50 x 50 x 6 mm (2 x 2 x 1/4 inch) steel angle with 32 x 5 mm (1-1/4 x 3/16 inch) strap anchors, welded to back.
3. Miter or butt angles at corners and weld.
4. Use one anchor near end and three feet on centers between end anchors.

2.8 COVERS AND FRAMES FOR PITS AND TRENCHES

A. Fabricate covers to support live loads specified.

B. Galvanized steel members after fabrication in accordance with ASTM A123, G-90 coating.

C. Steel Covers:

1. Use 6 mm (1/4 inch) thick floor plate for covers unless otherwise shown. Use gratings where shown as specified in paragraph GRATINGS. Use smooth floor plate unless noted otherwise.

2. Provide clearance at all sides to permit easy removal of covers.

3. Make cutouts within 6 mm (1/4 inch) of penetration for passage of pipes and ducts.

4. Drill covers for flat head countersunk screws.

5. Make cover sections not to exceed 2.3 m2 (25 square feet) in area and 90 kg (200 pounds) in weight.

6. Fabricate trench cover sections not be over 900 mm (3 feet) long and if width of trench is more than 900 mm (3 feet) or over, equip one end of each section with an angle or "T" bar stiffener to support adjoining plate.

7. Use two, 13 mm (1/2 inch) diameter steel bar flush drop handles for each cover section.

D. Steel Frames:

1. Form frame from structural steel angles as shown. Where not shown use 63 x 63 x 6 mm (2-1/2 x 2-1/2 x 1/4 inch) angles for frame openings over 1200 mm (4 feet) long and 50 x 50 x 6 mm (2 ix 2 x 1/4 inch) for frame openings less than 1200 mm (4 feet).

2. Fabricate intermediate supporting members from steel "T's" or angles; located to support cover section edges.

3. Where covers are required use steel border bars at frames so that top of cover will be flush with frame and finish floor.

4. Weld steel strap anchors to frame. Space straps not over 600 mm (24 inches) o.c., not shown otherwise between end anchors. Use 6 x 25 x 200 mm (1/4 x 1 x 8 inches) with 50 mm (2 inch) bent ends strap anchors unless shown otherwise.

5. Drill and tap frames for screw anchors where plate covers occur.

2.9 LOOSE LINTELS

A. Furnish lintels of sizes shown. Where size of lintels is not shown, provide the sizes specified.

B. Fabricate lintels with not less than 150 mm (6 inch) bearing at each end for nonbearing masonry walls, and 200 mm (8 inch) bearing at each end for bearing walls.

C. Provide one angle lintel for each 100 mm (4 inches) of masonry thickness as follows except as otherwise specified or shown.

1. Openings 750 mm to 1800 mm (2-1/2 feet to 6 feet) - 100 x 90 x 8 mm (4

x 3-1/2 x 5/16 inch).

2. Openings 1800 mm to 3000 mm (6 feet to 10 feet) - 150 x 90 x 9 mm (6 x 3-1/2 x 3/8 inch).

D. For 150 mm (6 inch) thick masonry openings 750 mm to 3000 mm (2-1/2 feet to 10 feet) use one angle 150 x 90 x 9 mm (6 x 3-1/2 x 3/8 inch).

E. Provide bearing plates for lintels where shown.

F. Weld or bolt upstanding legs of double angle lintels together with 19 mm (3/4 inch bolts) spaced at 300 mm (12 inches) on centers.

G. Insert spreaders at bolt points to separate the angles for insertion of metal windows, louver, and other anchorage.

H. Where shown or specified, punch upstanding legs of single lintels to suit size and spacing of anchor bolts.

I. Elevator Entrance:

1. Fabricate lintel from plate bent to channel shape, and provide a minimum of 100 mm (4 inch) bearing each end.

2. Cut away the front leg of the channel at each end to allow for concealment behind elevator hoistway entrance frame.

2.10 PLATE DOOR SILL

A. Fabricate of checkered plate as detailed.

1. Aluminum Plate: ASTM B632, 3 mm (0.125 inch) thick.

2. Steel Plate: ASTM A786, 3 mm (0.125 inch thick), galvanized G90.

B. Fabricate for anchorage with flat head countersunk bolts at each end and not over 300 mm (12 inches), o.c.

2.11 SAFETY NOSINGS

A. Fed. Spec. RR-T-650, Type C.

1. Aluminum: Class 2, Style 2.

2. Cast iron: Class 4.

B. Fabricate nosings for exterior use from cast aluminum, and nosings for interior use from either cast aluminum or cast iron. Use one Class throughout.

C. Fabricate nosings approximately 100 mm (4 inches) wide with not more than 9 mm (3/8 inch) nose.

D. Provide nosings with integral type anchors spaced not more than 100 mm (4 inches) from each end and intermediate anchors spaced approximately 375 mm (15 inches) on center.

E. Fabricate nosings to extend within 100 mm (4 inches) of ends of concrete stair treads except where shown to extend full width.

F. Fabricate nosings to extend full width between stringers of metal stairs and full width of door openings.

G. On curved steps fabricate to terminate at point of curvature of steps having short radius curved ends.

2.12 LADDERS

A. Steel Ladders:

1. Fixed-rail type with steel rungs shouldered and headed into and welded to rails.
2. Fabricate angle brackets of 50 mm (2 inch) wide by 13 mm (1/2 inch) thick steel; brackets spaced maximum of 1200 mm (4 feet) apart and of length to hold ladder 175 mm (7 inches) from wall to center of rungs. Provide turned ends or clips for anchoring.
3. Provide holes for anchoring with expansion bolts through turned ends and brackets.
4. Where shown, fabricate side rails curved, twisted and formed into a gooseneck.
5. Galvanize exterior ladders after fabrication, ASTM A123, G-90.

B. Ladder Rungs:

1. Fabricate from 25 mm (one inch) diameter steel bars.
2. Fabricate so that rungs will extend at least 100 mm (4 inches) into wall with ends turned 50 mm (2 inches), project out from wall 175 mm (7 inches), be 400 mm (16 inches) wide and be designed so that foot cannot slide off end.
3. Galvanized after fabrication, ASTM A123, G-90 rungs for exterior use and for access to pits.

2.13 RAILINGS

A. In addition to the dead load design railing assembly to support live load specified.

B. Fabrication General:

1. Provide continuous welded joints, dressed smooth and flush.
2. Standard flush fittings, designed to be welded, may be used.
3. Exposed threads will not be approved.
4. Form handrail brackets to size and design shown.
5. Exterior Post Anchors.
   a. Fabricate tube or pipe sleeves with closed ends or plates as shown.
   b. Where inserts interfere with reinforcing bars, provide flanged fittings welded or threaded to posts for securing to concrete with expansion bolts.
   c. Provide heavy pattern sliding flange base plate with set screws at base of pipe or tube posts. Base plates are not required on pipe sleeves where ornamental railings occur.
6. Interior Post Anchors:
   a. Provide flanged fittings for securing fixed posts to floor with expansion bolts, unless shown otherwise.
   b. Weld or thread flanged fitting to posts at base.

c. For securing removable posts to floor, provide close fitting sleeve insert or inverted flange base plate with stud bolts or rivets concrete anchor welded to the base plate.

d. Provide sliding flange base plate on posts secured with set screws.

e. Weld flange base plate to removable posts set in sleeves.

C. Handrails:

1. Close free ends of rail with flush metal caps welded in place except where flanges for securing to walls with bolts are shown.

2. Make provisions for attaching handrail brackets to wall, posts, and handrail as shown.

D. Steel Pipe Railings:

1. Fabricate of steel pipe with welded joints.

2. Number and space of rails as shown.

3. Space posts for railings not over 1800 mm (6 feet) on centers between end posts.

4. Form handrail brackets from malleable iron.

5. Fabricate removable sections with posts at end of section.

6. Removable Rails:

a. Provide "U" shape brackets at each end to hold removable rail as shown. Use for top and bottom horizontal rail when rails are joined together with vertical members.

b. Secure rail to brackets with 9 mm (3/8 inch) stainless steel through bolts and nuts at top rail only when rails joined with vertical members.

c. Continuously weld brackets to post.

d. Provide slotted bolt holes in rail bracket.

e. Weld bolt heads flush with top of rail.

f. Weld flanged fitting to post where posts are installed in sleeves.

7. Opening Guard Rails:

a. Fabricate rails with flanged fitting at each end to fit between wall opening jambs.

b. Design flange fittings for fastening with machine screws to steel plate anchored to jambs.

c. Fabricate rails for floor openings for anchorage in sleeves.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.

B. Items set into concrete or masonry.

1. Provide temporary bracing for such items until concrete or masonry is set.
2. Place in accordance with setting drawings and instructions.
3. Build strap anchors, into masonry as work progresses.

C. Set frames of gratings, covers, corner guards, trap doors and similar items flush with finish floor or wall surface and, where applicable, flush with side of opening.

D. Field weld in accordance with AWS.

1. Design and finish as specified for shop welding.
2. Use continuous weld unless specified otherwise.

E. Install anchoring devices and fasteners as shown and as necessary for securing metal fabrications to building construction as specified. Power actuated drive pins may be used except for removable items and where members would be deformed or substrate damaged by their use.

F. Spot prime all abraded and damaged areas of zinc coating as specified and all abraded and damaged areas of shop prime coat with same kind of paint used for shop priming.

G. Isolate aluminum from dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.

H. Secure escutcheon plate with set screw.

3.2 INSTALLATION OF SUPPORTS

A. Anchorage to structure.

1. Secure angles or channels and clips to overhead structural steel by continuous welding unless bolting is shown.
2. Secure supports to concrete inserts by bolting or continuous welding as shown.
3. Secure supports to mid height of concrete beams when inserts do not exist with expansion bolts and to slabs, with expansion bolts. unless shown otherwise.
4. Secure steel plate or hat channels to studs as detailed.

B. Ceiling Hung Toilet Stalls:

1. Securely anchor hangers of continuous steel channel above pilasters to structure above.
2. Bolt continuous steel angle at wall to masonry or weld to face of each metal stud.
3. Secure brace for steel channels over toilet stall pilasters to wall angle supports with bolts at each end spaced as shown.
4. Install diagonal angle brace where the suspended ceiling over toilet stalls does not extend to side wall of room.
5. Install stud bolts in lower flange of channel before installing furred down ceiling over toilet stalls.
6. Install support for ceiling hung pilasters at entrance screen to toilet

room similar to toilet stall pilasters.

C. Supports for Wall Mounted items:

1. Locate center of support at anchorage point of supported item.
2. Locate support at top and bottom of wall hung cabinets.
3. Locate support at top of floor cabinets and shelving installed against walls.
4. Locate supports where required for items shown.

3.3 COVERS AND FRAMES FOR PITS AND TRENCHES

A. Set frame and cover flush with finish floor.

B. Secure plates to frame with flat head countersunk screws.

C. Set gratings loose in drainage trenches or over pits unless shown anchored.

3.4 DOOR FRAMES

A. Secure clip angles at bottom of frames to concrete slab with expansion bolts as shown.

B. Level and plumb frame; brace in position required.

C. At masonry, set frames in walls so anchors are built-in as the work progresses unless shown otherwise.

D. Set frames in formwork for frames cast into concrete.

E. Where frames are set in prepared openings, bolt to wall with spacers and expansion bolts.

3.5 OTHER FRAMES

A. Set frame flush with surface unless shown otherwise.

B. Anchor frames at ends and not over 450 mm (18 inches) on centers unless shown otherwise.

C. Set in formwork before concrete is placed.

1. Install Guard Angles at Edges of Dock Leveler Overhead Doors where shown.

3.6 GRATINGS

A. Set grating flush with finish floor; top of curb, or areaway wall. Set frame so that horizontal leg of angle frame is flush with face of wall except when frame is installed on face of wall.

B. Set frame in formwork before concrete is placed.

C. Where grating terminates at a wall bolt frame to concrete or masonry with expansion bolts unless shown otherwise.

D. Secure removable supporting members in place with stainless steel bolts.

E. Bolt gratings to supports.

3.7 STEEL LINTELS

A. Use lintel sizes and combinations shown or specified.

B. Install lintels with longest leg upstanding, except for openings in 150 mm (6 inch) masonry walls install lintels with longest leg horizontal.

C. Install lintels to have not less than 150 mm (6 inch) bearing at each end for nonbearing walls, and 200 mm (8 inch) bearing at each end for bearing walls.

3.8 SHELF ANGLES

A. Anchor shelf angles with 19 mm (3/4 inch) bolts unless shown otherwise in adjustable malleable iron inserts, set level at elevation shown.

B. Provide expansion space at end of members.

3.9 SAFETY NOSINGS

A. Except as specified and where preformed rubber treads are shown or specified install safety nosings at the following:

1. Exterior concrete steps.
2. Door sills of areaway entrances curbs.
3. Exposed edges of curbs of door sills at transformer and service rooms.
4. Interior concrete steps, including concrete filled treads of metal stairs of service stairs.

B. Install flush with horizontal and vertical surfaces.

C. Install nosing to within 100 mm (4 inches) of ends of concrete stair treads, except where shown to extend full width.

D. Extend nosings full width of door openings.

E. Extend nosings, full width between stringers of metal stairs, and terminate at point of curvature of steps having short radius curved ends.

3.10 LADDERS

A. Anchor ladders to walls and floors with expansion bolts through turned lugs or angle clips or brackets.

B. In elevator pits, set ladders to clear all elevator equipment where shown on the drawings.

1. Where ladders are interrupted by division beams, anchor ladders to beams by welding, and to floors with expansion bolts.
2. Where ladders are adjacent to division beams, anchor ladders to beams with bent steel plates, and to floor with expansion bolts.

C. Ladder Rungs:

1. Set ladder rungs into formwork before concrete is placed.[**Build ladder rungs into masonry as the work progresses.**]
2. Set step portion of rung 150 mm (6 inches) from wall.
3. Space rungs approximately 300 mm (12 inches) on centers.
4. Where only one rung is required, locate it 400 mm (16 inches) above the floor.

3.11 RAILINGS

A. Steel Posts:

1. Secure fixed posts to concrete with expansion bolts through flanged fittings except where sleeves are shown with pourable grout.
2. Install sleeves in concrete formwork.
3. Set post in sleeve and pour grout to surface. Apply beveled bead of urethane sealant at perimeter of post or under flange fitting as specified in Section 07 92 00, JOINT SEALANTS—on exterior posts.
4. Secure removable posts to concrete with either machine screws through flanged fittings which are secured to inverted flanges embedded in and set flush with finished floor, or set posts in close fitting pipe sleeves without grout.
5. Secure sliding flanged fittings to posts at base with set screws.
6. Secure fixed flanged fittings to concrete with expansion bolts.
7. Secure posts to steel with welds.

B. Aluminum Railing, Stainless Steel Railing, and Ornamental Railing Posts:

1. Install pipe sleeves in concrete formwork.
2. Set posts in sleeve and pour grout to surface on exterior locations and to within 6 mm (1/4 inch) of surface for interior locations except to where posts are required to be removable.
3. Apply beveled bead of urethane sealant over sleeve at post perimeter for exterior posts and flush with surface for interior posts as specified in Section 07 92 00, JOINT SEALANTS.

C. Anchor to Walls:

1. Anchor rails to concrete or solid masonry with machine screws through flanged fitting to steel plate.
   a. Anchor steel plate to concrete or solid masonry with expansion bolts.
   b. Anchor steel plate to hollow masonry with toggle bolts.
2. Anchor flanged fitting with toggle bolt to steel support in frame walls.

D. Removable Rails:

1. Rest rails in brackets at each end and secure to bracket with stainless steel bolts and nuts where part of a continuous railing.
2. Rest rail posts in sleeves where not part of a continuous railing. Do not grout posts.

E. Gates:

1. Hang gate to swing as shown.
2. Bolt gate hinges to jamb post with clamp on or through bolts.

F. Handrails:

1. Anchor brackets for metal handrails as detailed.
2. Install brackets within 300 mm (12 inches) of return of walls, and at evenly spaced intermediate points not exceeding 1200 mm (4 feet) on

centers unless shown otherwise.

3. Expansion bolt to concrete or solid masonry.
4. Toggle bolt to installed supporting frame wall and to hollow masonry unless shown otherwise.

3.12 STEEL COMPONENTS FOR MILLWORK ITEMS

A. Coordinate and deliver to Millwork fabricator for assembly where millwork items are secured to metal fabrications.

3.13 CLEAN AND ADJUSTING

A. Adjust movable parts including hardware to operate as designed without binding or deformation of the members centered in the opening or frame and, where applicable, contact surfaces fit tight and even without forcing or warping the components.

B. Clean after installation exposed prefinished and plated items and items fabricated from stainless steel, aluminum and copper alloys, as recommended by the metal manufacture and protected from damage until completion of the project.

- - - E N D - - -

SECTION 05 51 00

METAL STAIRS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section specifies steel stairs with railings.

B. Types:

1. Closed riser stairs with concrete filled treads and platforms.

1.2 RELATED WORK

A. Concrete fill for treads and platforms: Section 03 30 00, CAST-IN-PLACE CONCRETE.

B. Wall handrails and railings for other than steel stairs: Section 05 50 00, METAL FABRICATIONS.

C. Requirements for shop painting: Section 09 91 00, PAINTING.

1.3 SUBMITTALS

A. LEED Building Performance Requirements

1. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section\

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

4. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Shop Drawings: Show design, fabrication details, installation, connections, material, and size of members.

1.4 APPLICATION PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation.

B. American Society for Testing and Materials (ASTM):

1. A36/A36M-05 Structural Steel
2. A47-99 (R2004) Ferritic Malleable Iron Castings
3. A48-03 Gray Iron Castings
4. A53-06 Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless
5. A307-07 Carbon Steel Bolts and Studs, 60000 psi Tensile Strength
6. A653/653M-07 Steel Sheet, Zinc Coated (Galvanized) or Zinc Alloy Coated (Galvannealed) by the Hot-Dip Process
7. A563-07 Carbon and Alloy Steel Nuts
8. A1008-07 Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low-Alloy
9. A786/A786M-00 Rolled Steel Floor Plates
10. A1011-04 Steel, Sheet and Strip, Strip, Hot-Rolled Carbon, Structural, High-Strength, Low-Alloy

C. American Welding Society (AWS):

1. D1.1-04 Structural Welding Code-Steel
2. D1.3-98 Structural Welding Code-Sheet Steel

D. The National Association of Architectural Metal Manufactures (NAAMM) Manuals:

1. Metal Bar Gratings (ANSI/NAAMM MBG 531-00)
2. AMP521-01 Pipe Railing Manual, Including Round Tube

E. American Iron and Steel Institute (AISI):

1. 2001 Design of Cold-Formed Steel Structural Members

1.5 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

B. Materials that contain recycled content shall be documented in accordance

with the LEED Building Submittal Requirements of this Section

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Design stairs to support a live load of 500 kg/m2 (100 pounds per square foot).

B. Structural design, fabrication and assembly in accordance with requirements of NAAMM Metal Stairs Manual, except as otherwise specified or shown.

C. Design Grating treads in accordance with NAAMM Metal Bar Grating Manual.

D. Design pipe railings in accordance with NAAMM Pipe Railing Manual for 900 N (200 pounds) in any direction at any point.

2.2 MATERIALS

A. Steel Pipe: ASTM A53, Standard Weight, zinc coated.

B. Steel Grating: Metal bar type grating NAAMM BG.

C. Sheet Steel: ASTM A1008.

D. Structural Steel: ASTM A36.

E. Steel Floor Plate: ASTM 786.

F. Steel Decking: Form from zinc coated steel conforming to ASTM A446, with properties conforming to AISI Specification for the Design of Cold-Formed Steel Structural Members.

G. Steel Plate: ASTM A1011.

2.3 FABRICATION GENERAL

A. Fasteners:

1. Conceal bolts and screws wherever possible.

2. Use countersunk heads on exposed bolts and screws with ends of bolts and screws dressed flush after nuts are set.

B. Welding:

1. Structural steel, AWS D1.1 and sheet steel, AWS D1.3.

2. Where possible, locate welds on unexposed side.

3. Grind exposed welds smooth and true to contour of welded member.

4. Remove welding splatter.

C. Remove sharp edges and burrs.

D. Fit stringers to head channel and close ends with steel plates welded in place where shown.

E. Fit face stringer to newel post by tenoning into newel post, or by notching and fitting face stringer to side of newel where shown.

F. Shop Prime Painting: Prepare surface and apply primer as specified for ferrous metals in Section 09 91 00, PAINTING.

2.4 RAILINGS

A. Fabricate railings, including handrails, from steel pipe with flush.

1. Connections may be standard fittings designed for welding, or coped or mitered pipe with full welds.

2. Wall handrails are provided under Section 05 50 00, METAL FABRICATIONS.

B. Return ends of handrail to wall and close free end.

C. Provide standard terminal castings where fastened to newel.

D. Space intermediate posts not over six feet on center between end post or newel post.

E. Fabricate handrail brackets from cast malleable iron.

F. Provide standard terminal fittings at ends of post and rails.

2.5 CLOSED RISER STAIRS

A. Provide treads, risers, platforms, railings, stringers, headers and other supporting members.

B. Fabricate pans for treads and platforms, and risers from sheet steel Fabricate pans for platforms from steel decking where shown.

C. Form risers with sanitary cove.

D. Fabricate stringers, headers, and other supporting members from structural steel.

E. Construct newel posts of steel tubing having wall thickness not less than 5 mm (3/16 inch), with forged steel caps and drops.

PART 3 - EXECUTION

3.1 STAIR INSTALLATION

A. Provide hangers and struts required to support the loads imposed.

B. Perform job site welding and bolting as specified for shop fabrication.

C. Set stairs and other members in position and secure to structure as shown.

D. Install stairs plumb, level and true to line.

E. Provide steel closure plate to fill any gap between the stringer and surrounding shaft wall. Weld and finish with prime and paint finish of adjoining steel.

3.2 RAILING INSTALLATION

A. Install standard terminal fittings at ends of posts and rails.

B. Secure brackets, posts and rails to steel by welds, and to masonry or concrete with expansion sleeves and bolts, except secure posts at concrete by setting in sleeves filled with commercial non-shrink grout.

C. Set rails horizontal or parallel to rake of stairs to within 3 mm in 3650 mm (1/8 inch in12 feet).

D. Set posts plumb and aligned to within 3 mm in 3650 mm (1/8 inch in 12 feet).

3.3 FIELD PRIME PAINTING

A. When installation is complete, clean field welds and surrounding areas to bright metal, and coat with same primer paint used for shop priming.

B. Touch-up abraded areas with same primer paint used for shop priming.

C. Touch up abraded galvanized areas with zinc rich paint as specified in section 09 9100, PAINTING.

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SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Section specifies wood blocking, framing, sheathing, furring, nailers, and rough hardware.

1.2 RELATED WORK:

A. Milled woodwork: Section 06 20 00, FINISH CARPENTRY.

B. Gypsum sheathing: Section 09 29 00, GYPSUM BOARD.

1.3 SUMBITTALS:

A. LEED BUILDING SUBMITTAL REQUIREMENTS

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   a. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify that no added urea formaldehyde is present in any composite wood materials, agrifiber material or adhesive.

4. Documentation for all new wood products, including FSC Certified. Provide vendor invoices for all permanently installed wood products, FSC Certified or not. Each wood product must be identified on a line-item basis, FSC products must be identified as such on a line item basis, the dollar value of each line item must be shown, the vendors Chain-of-Custody certificate number must be shown on any invoice that includes FSC products.

5. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

6. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content,

then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Shop Drawings showing framing connection details, fasteners, connections and dimensions.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Protect lumber and other products from dampness both during and after delivery at site.

B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

C. Stack plywood and other board products so as to prevent warping.

D. Locate stacks on well drained areas, supported at least 150 mm (6 inches) above grade and cover with well ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

1.5 QUALITY ASSURANCE REQUIREMENTS:

A. LEED Building Performance Requirements:

1. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

2. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section

3. Engineered wood, not including salvaged wood, shall contain a minimum of 10% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

4. All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) to be permanently installed on the interior of project shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI). Certification of these products shall be in accordance with the LEED Building Submittal Requirements of this Section.

5. Adhesives used for work in this section including plastic laminating adhesives shall contain no added Urea Formaldehyde.

6. Wood Materials manufactured, fabricated, and or harvested within 500 miles (by air) of the project site shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

7. Solid wood materials shall be FSC Certified as sustainably harvested by the Forest Stewardship Council Documentation of FSC Certification shall be in accordance with the LEED Building Submittal requirements of this

Section.

8. All wood flooring must be certified as compliant with Floor Score Standard as developed by the Resilient Floor Covering Institute.

9. Adhesives, sealants, paints and coatings used for work in this section shall meet the requirements of Division 1, Section 018113: "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable. VOC Limits include, but are not limited to the following:

Wood Flooring Adhesive	100 g/l
Clear Wood Varnish	350 g/l
Clear Wood Lacquer	550 g/
Wood Stains	250 g/l
Sanding Sealers	275 g/l
Clear Shellac	730 g/l
Pigmented Shellac	550 g/l

1.6 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.

B. American Forest and Paper Association (AFPA):

1. National Design Specification for Wood Construction

2. NDS-05 Conventional Wood Frame Construction

C. American Institute of Timber Construction (AITC):

1. A190.1-07 Structural Glued Laminated Timber

D. American Society of Mechanical Engineers (ASME):

1. B18.2.1-96(R2005) Square and Hex Bolts and Screws

2. B18.2.2-87 Square and Hex Nuts

3. B18.6.1-97 Wood Screws

4. B18.6.4-98(R2005) Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws

E. American Plywood Association (APA):

1. E30-07 Engineered Wood Construction Guide

F. American Society for Testing And Materials (ASTM):

1. A47-99(R2009) Ferritic Malleable Iron Castings

2. A48-03(R2008)Gray Iron Castings

3. A653/A653M-10Steel Sheet Zinc-Coated (Galvanized) or Zinc-IronAlloy Coated (Galvannealed) by the Hot Dip Process

4. C954-10 Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch (2.24 mm) to 0.112 inch (2.84 mm) in thickness

5. C1002-07 Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to

Wood Studs or Metal Studs

6. D143-09 Small Clear Specimens of Timber, Method of Testing

7. D1760-01 Pressure Treatment of Timber Products

8. D2559-10 Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions

9. D3498-11 Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems

10. F844-07 Washers, Steel, Plan (Flat) Unhardened for General Use

11. F1667-08 Nails, Spikes, and Staples Federal Specifications (Fed. Spec.):
MM-L-736C Lumber; Hardwood

12. Commercial Item Description (CID):
A-A-55615 Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)

13. Military Specification (Mil. Spec.):
MIL-L-19140E Lumber and Plywood, Fire-Retardant Treated

14. Truss Plate Institute (TPI):
TPI-85 Metal Plate Connected Wood Trusses

15. U.S. Department of Commerce Product Standard (PS)
PS 1-95 Construction and Industrial Plywood
PS 20-05 American Softwood Lumber Standard

PART 2 - PRODUCTS

2.3 LUMBER:

A. Unless otherwise specified, each piece of lumber bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.

1. Identifying marks in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.

2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.

B. Structural Members: Species and grade as listed in the AFPA, National Design Specification for Wood Construction having design stresses as shown.

C. Lumber Other Than Structural:

1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.

2. Framing lumber: Minimum extreme fiber stress in bending of 1100.

3. Furring, blocking, nailers and similar items 100 mm (4 inches) and narrower Standard Grade; and, members 150 mm (6 inches) and wider, Number 2 Grade.

D. Sizes:

1. Conforming to Prod. Std., PS20.
2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.

E. Moisture Content:

1. At time of delivery and maintained at the site.
2. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.
3. Lumber over 50 mm (2 inches) thick: 25 percent or less.

F. Fire Retardant Treatment:

1. Mil Spec. MIL-L-19140 with piece of treated material bearing identification of testing agency and showing performance rating.
2. Treatment and performance inspection, by an independent and qualified testing agency that establishes performance ratings.

G. Preservative Treatment:

1. Do not treat Heart Redwood and Western Red Cedar.
2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including framing of open roofed structures; sills, sole plates, furring, and sleepers that are less than 600 mm (24 inches) from ground; nailers, edge strips, blocking, crickets, curbs, cant, vent strips and other members used in connection with roofing and flashing materials.
3. Treat other members specified as preservative treated (PT).
4. Preservative treat by the pressure method complying with ASTM D1760, except any process involving the use of Chromated Copper arsenate (CCA) for pressure treating wood is not permitted.

2.4 PLYWOOD

A. Comply with Prod. Std., PS 1.

B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.

C. Sheathing:

1. APA rated Exposure 1 or Exterior; panel grade CD or better.
2. Roof sheathing:
   a. Minimum 9 mm (11/32 inch) thick with span rating 24/0 or 12 mm (15/32 inch) thick with span rating for supports 400 mm (16 inches) on center unless specified otherwise.
   b. Minimum 15 mm (19/32 inch) thick or span rating of 40/20 or 18 mm (23/32 inch) thick or span rating of 48/24 for supports 600 mm (24 inches) on center.

2.5 ROUGH HARDWARE AND ADHESIVES:

A. Anchor Bolts:

1. ASME B18.2.1 and ANSI B18.2.2 galvanized, 13 mm (1/2 inch) unless shown otherwise.

2. Extend at least 200 mm (8 inches) into masonry or concrete with ends bent 50 mm (2 inches).

B. Miscellaneous Bolts: Expansion Bolts: C1D, A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Use 13 mm (1/2 inch) bolt unless shown otherwise.

C. Screws:

1. Wood to Wood: ANSI B18.6.1 or ASTM C1002.

2. Wood to Steel: ASTM C954, or ASTM C1002.

D. Nails:

1. Size and type best suited for purpose unless noted otherwise. Use aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing wood work exposed to weather and on roof blocking.

2. ASTM F1667:

a. Common: Type I, Style 10.

b. Concrete: Type I, Style 11.

c. Barbed: Type I, Style 26.

d. Underlayment: Type I, Style 25.

e. Masonry: Type I, Style 27.

f. Use special nails designed for use with ties, strap anchors, framing connectors, joists hangers, and similar items. Nails not less than 32 mm (1- 1/4 inches) long, 8d and deformed or annular ring shank.

E. Framing and Timber Connectors:

1. Fabricate of ASTM A446, Grade A; steel sheet not less than 1.3 mm (0.052 inch) thick unless specified otherwise. Apply standard plating to steel timber connectors after punching, forming and assembly of parts.

2. Framing Angles: Angle designed with bendable legs to provide three way anchors.

3. Straps:

a. Designed to provide wind and seismic ties with sizes as shown or specified.

b. Strap ties not less than 32 mm (1-1/4 inches) wide.

c. Punched for fastener.

4. Metal Bridging:

a. Optional to wood bridging.

b. V shape deformed strap with not less than 2 nail holes at ends, designed to nail to top and side of framing member and bottom and

side of opposite member.

c. Not less than 19 mm by 125 mm (3/4 by 5 inches) bendable nailing flange on ends.

d. Fabricated of 1 mm (0.04 inch) minimum thick sheet.

5. Joist Hangers:

a. Fabricated of 1.6 mm (0.063 inch) minimum thick sheet, U design unless shown otherwise.

b. Heavy duty hangers fabricated of minimum 2.7 mm (0.108 inch) thick sheet, U design with bent top flange to lap over beam.

6. Timber Connectors: Fabricated of steel to shapes shown.

7. Joist Ties: Mild steel flats, 5 by 32 mm (3/16 by 1-1/4 inch size with ends bent about 30 degrees from horizontal and extending at least 400 mm (16 inches) onto framing. Punch each end for three spikes.

8. Wall Anchors for Joists and Rafters:

a. Mild steel strap, 5 by 32 mm (3/16 by 1-1/4 inch) with wall ends bent 50 mm (2 inches), or provide 9 by 130 mm (3/8 by 5 inch) pin through strap end built into masonry.

b. Strap long enough to extend onto three joists or rafters, and punched for spiking at each bearing.

c. Strap not less than 100 mm (4 inches) embedded end.

9. Joint Plates:

a. Steel plate punched for nails.

b. Steel plates formed with teeth or prongs for mechanically clamping plates to wood.

c. Size for axial eccentricity, and fastener loads.

F. Adhesives:

1. For field-gluing plywood to lumber framing floor or roof systems: ASTM D3498.

2. For structural laminated Wood: ASTM D2559.

PART 3 - EXECUTION

3.3 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS:

A. Conform to applicable requirements of the following:

1. AFPA National Design Specification for Wood Construction for timber connectors.

2. AITC Timber Construction Manual for heavy timber construction.

3. AFPA WCD-number 1, Manual for House Framing for nailing and framing unless specified otherwise.

4. APA for installation of plywood or structural use panels.

5. ASTM F 499 for wood underlayment.

6. TPI for metal plate connected wood trusses.

B. Fasteners:

1. Nails.

   a. Nail in accordance with the Recommended Nailing Schedule as specified in AFPA Manual for House Framing where detailed nailing requirements are not specified in nailing schedule. Select nail size and nail spacing sufficient to develop adequate strength for the connection without splitting the members.

   b. Use special nails with framing connectors.

   c. For sheathing select length of nails sufficient to extend 25 mm (1 inch) into supports.

   d. Use eight penny or larger nails for nailing through 25 mm (1 inch) thick lumber and for toe nailing 50 mm (2 inch) thick lumber.

   e. Use 16 penny or larger nails for nailing through 50 mm (2 inch) thick lumber.

   f. Select the size and number of nails in accordance with the Nailing Schedule except for special nails with framing anchors.

   g. Nailing Schedule; Using Common Nails:

      1) Joist bearing on sill or girder, toe nail three-8d or framing anchor

      2) Bridging to joist, toe nail each end two-8d

      3) Ledger strip to beam or girder three-16d under each joint.

2. Bolts:

   a. Fit bolt heads and nuts bearing on wood with washers.

   b. Countersink bolt heads flush with the surface of nailers.

   c. Embed in concrete and solid masonry or use expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.

   d. Use toggle bolts to hollow masonry or sheet metal.

   e. Use bolts to steel over 2.84 mm (0.112 inch, 11 gage) in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 600 mm (24 inch) intervals between end bolts. Use clips to beam flanges.

3. Drill Screws to steel less than 2.84 mm (0.112 inch) thick.

   a. ASTM C1002 for steel less than 0.84 mm (0.033 inch) thick.

   b. ASTM C 954 for steel over 0.84 mm (0.033 inch) thick.

4. Power actuated drive pins may be used where practical to anchor to solid masonry, concrete, or steel.

5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Use metal plugs, inserts or similar fastening.

6. Screws to Join Wood:

   a. Where shown or option to nails.

   b. ASTM C1002, sized to provide not less than 25 mm (1 inch)

penetration into anchorage member.

c. Spaced same as nails.

7. Installation of Timber Connectors:

a. Conform to applicable requirements of the NFPA National Design Specification for Wood Construction.

b. Fit wood to connectors and drill holes for fasteners so wood is not split.

C. Set sills or plates level in full bed of mortar on masonry or concrete walls.

1. Space anchor bolts 1200 mm (4 feet) on centers between ends and within 150 mm (6 inches) of end. Stagger bolts from side to side on plates over 175 mm (7 inches) in width.

2. Use shims of slate, tile or similar approved material to level wood members resting on concrete or masonry. Do not use wood shims or wedges.

3. Closely fit, and set to required lines.

D. Cut notch, or bore in accordance with NFPA Manual for House-Framing for passage of ducts wires, bolts, pipes, conduits and to accommodate other work. Repair or replace miscut, misfit or damaged work.

E. Blocking Nailers, and Furring:

1. Install furring, blocking, nailers, and grounds where shown.

2. Use longest lengths practicable.

3. Use fire retardant treated wood blocking where shown at openings and where shown or specified.

4. Layers of Blocking or Plates:

a. Stagger end joints between upper and lower pieces.

b. Nail at ends and not over 600 mm (24 inches) between ends.

c. Stagger nails from side to side of wood member over 125 mm (5 inches) in width.

5. [Fabricate roof edge vent strips with 6 mm by 6 mm (1/4 inch by 1/4 inch) notches, 100 mm (4 inches) on center, aligned to allow for venting of[insulating concrete][and][venting base sheet]. Option: Texture 1-11 plywood with parallel grooves 100 mm (4 inches) o.c. may be used.]

6. Lay panels with joints staggered, with edge and ends 3 mm (1/8 inch) apart and nailed over bearings as specified.

7. Set nails not less than 9 mm (3/8 inch) from edges.

8. Install 50 mm by 100 mm (2 inch by 4 inch) blocking spiked between joists, rafters and studs to support edge or end joints of panels.

9. Match and align sheathing which is an extension of work in place to existing.

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SECTION 06 13 23

HEAVY TIMBER CONSTRUCTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes framing using timbers.

B. Heavy timber wood mantels.

C. Related Sections:

1. Division 06 Section "Rough Carpentry" for dimension lumber items associated with heavy timber construction.

1.3 DEFINITIONS

A. Timbers: Lumber of 5 inches nominal or greater in least dimension.

B. Inspection agencies, and the abbreviations used to reference them, include the following:

1. NeLMA - Northeastern Lumber Manufacturers Association.
2. NHLA - National Hardwood Lumber Association.
3. NLGA - National Lumber Grades Authority.
4. SPIB - Southern Pine Inspection Bureau.
5. WCLIB - West Coast Lumber Inspection Bureau.
6. WWPA - Western Wood Products Association.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified as determinted by Structural Engineer's force calculations.

1. Heavy Timber Trusses shall withstand movements of supporting structure indicated on drawings including by not limited to story drift, tweist, column shortnenting, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.

b. Loosening or weakening of fasteners, attachements and other components.

B. Delegated Design: Design heavy timber trusses, including comprehensive engineering analysis by a qualified professional engineer

C. Review by a 3rd Party Engineer. Provide full Third Party Engineer review.

D. ACTION SUBMITTALS

E. Product Data: For timber connectors.

1. For timber connectors, include installation instructions.

F. LEED SUBMITTAL REQUIREMENTS:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify that no added urea formaldehyde is present in any composite wood materials, agrifiber material or adhesive.

4. Documentation for all new wood products, including FSC Certified. Provide vendor invoices for all permanently installed wood products, FSC Certified or not. Each wood product must be identified on a line-item basis, FSC products must be identified as such on a line item basis, the dollar value of each line item must be shown, the vendors Chain-of-Custody certificate number must be shown on any invoice that includes FSC products.

5. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

6. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

7. .

8. Laboratory Test Reports for Credit IEQ 4: For sealers and primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Shop Drawings: For heavy timber construction. Show layout, dimensions of each member, and details of connections.

1. Professional Engineer Stamp from the State of Pennsylvannia

H. Samples: Not less than 5 inches wide by 24 inches long, showing the range of variation to be expected in appearance, including surface texture, of wood products.

I. Warrantees: Lifetime warrantee on all fabrication and installation for the life of the building.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For heavy timber construction specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by ALSC's Board of Review.

B. Certificates of Inspection: Issued by lumber grading agency for exposed timber not marked with grade stamp.

1.6 QUALITY ASSURANCE

A. Timber Standard: Comply with AITC 108, "Standard for Heavy Timber Construction."

B. LEED Building Performance Requirements:

1. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

2. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

3. Engineered wood, not including FSC wood, shall contain a minimum of 10% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

4. All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) to be permanently installed on the interior of project shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI). Certification of these products shall be in accordance with the LEED Building Submittal Requirements of this Section.

5. Adhesives used for work in this section including plastic laminating adhesives shall contain no added Urea Formaldehyde.

6. Wood Materials manufactured, fabricated, and or harvested within 500 miles (by air) of the project site shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

7. Solid wood materials shall be FSC Certified as sustainably harvested by the Forest Stewardship Council Documentation of FSC Certification shall be in accordance with the LEED Building Submittal requirements of this Section.

8. All wood flooring must be certified as compliant with FloorScore Standard

as developed by the Resilient Floor Covering Institute.

9. Adhesives, sealants, paints and coatings used for work in this section shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable. VOC Limits include, but are not limited to the following:

Wood Flooring Adhesive	100 g/l
Clear Wood Varnish	350 g/l
Clear Wood Lacquer	550 g/
Wood Stains	250 g/l
Sanding Sealers	275 g/l
Clear Shellac	730 g/l
Pigmented Shellac	550 g/l

1.7 DELIVERY, STORAGE, AND HANDLING

A. Schedule delivery of heavy timber construction to avoid extended on-site storage and to avoid delaying the Work.

B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 TIMBER

A. General: Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable.

1. Factory mark each item of timber with grade stamp of grading agency.

2. For exposed timber indicated to receive a stained or natural finish, apply grade stamps to surfaces that will not be exposed to view, or omit grade stamps and provide certificates of grade compliance issued by grading agency.

B. Certified Wood: Timber shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

C. Timber Species and Grade: Douglas fir-larch or Douglas fir-larch (North); No. 1 Dense, NLGA, WCLIB, or WWPA.

1. Lumber to be FOHT (Free of Heart Timber)

D. Timber Species and Grade: Any species and grade that, for moisture content provided, complies with required structural properties.

1. Allowable Stress Ratings for 12-Inch Nominal As indicated on Drawings.

E. Moisture Content: Provide timber with 19 percent maximum moisture content at time of dressing.

F. Dressing: Provide dressed timber (S4S) with eased edges (1/8") unless otherwise indicated.

G. Penetrating Sealer: Manufacturer's standard natural linseed oil, transparent, penetrating wood sealer that is compatible with indicated finish.

Low-Emitting Materials: Sealers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 TIMBER CONNECTORS

A. General: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.

B. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A 307, Grade A; provide nuts complying with ASTM A 563; and, where indicated, provide flat washers.

C. Provide shear plates, 4 inches in diameter, complying with ASTM D 5933.

D. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.

1. Primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 FABRICATION

A. Camber: Fabricate horizontal members and inclined members with a slope of less than 1:1, with natural convex bow (crown) up, to provide camber.

B. Shop fabricate members by cutting and restoring exposed surfaces to match specified surfacing. Finish exposed surfaces to remove planing or surfacing marks, and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.

C. Predrill for fasteners and assembly of units.

D. Seal Coat: After fabricating and surfacing each unit, apply a saturation coat of penetrating sealer on surfaces of each unit except for treated wood where the treatment included a water repellent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Erect heavy timber construction true and plumb. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

1. Install heavy timber construction to comply with Shop Drawings.

2. Install horizontal and sloping members with crown edge up and provide not less than 4 inches of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports if not continuous.

B. Preconstruction Conference: Conduct a preconstruction conference including the COTR, Facility Security as deemed appropriate by the facilty COTR, the Contractor, all subcontractors involved in the coordination of installation of the Truss system, the Structural Engineer and the Architect.

1. Schedule meeting following approval of all shop drawings and Engineering reviews.

2. Include in the meeting no later than one month prior to installation:

a. Adherance to OSHA regulations

1) Provide a safety program of roles and responsibilities by the Truss Engineer.

b. Installation and Staging & Rigging Schedule

C. Framing Built into Steel and Framing Structure: Provide 1/2-inch clearance at tops, sides, and ends of members built into steel and framing , bevel cut ends 3 inches; do not embed more than 4 inches unless otherwise indicated.

D. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

E. Fit members by cutting and restoring exposed surfaces to match specified surfacing. Pre-drill for fasteners and assembly of units.

1. Finish exposed surfaces to remove planing or surfacing marks, and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.

F. Install timber connectors as indicated.

1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.

2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3. Wood Plug all truss bolt connections flush to match wood species, grade and finish. Conceal all steel pins with countersunk plugs.

3.2 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged heavy timber construction if repairs are not approved by Architect.

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SECTION 06 20 00

FINISH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies exterior and interior millwork.

B. Items specified.

1. Counter Shelf
2. Cafe
3. Counter or Work Tops
4. Standing and Running Trim

1.2 RELATED WORK

A. Fabricated Metal brackets, bench supports and countertop legs: Section 05 50 00, METAL FABRICATIONS.

B. Framing, furring and blocking: Section 06 10 00, ROUGH CARPENTRY.

C. Wood doors: Section 08 14 00, WOOD DOORS.

D. Color and texture of finish: Section 09 06 00, SCHEDULE FOR FINISHES.

E. Stock Casework: Section 12 32 00, MANUFACTURED WOOD CASEWORK.

F. Other Countertops: Division 11, EQUIPMENT and Division 12, FURNISHINGS.

G. Electrical light fixtures and duplex outlets: Division 26, ELECTRICAL.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).
   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify that no added urea formaldehyde is present in any composite wood materials, agrifiber material or adhesive.

4. Documentation for all new wood products, including FSC Certified. Provide vendor invoices for all permanently installed wood products, FSC Certified or not. Each wood product must be identified on a line-item basis, FSC products must be identified as such on a line item basis, the dollar value of each line item must be shown, the vendors Chain-of-Custody certificate number must be shown on any invoice that includes FSC products.
5. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.
6. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Shop Drawings:

1. Millwork items: Half full size scale for sections and details 1:50 (1/4 inch) for elevations and plans.
2. Show construction and installation.

D. Samples:

1. Plastic laminate finished plywood or particleboard, 150 mm by 300 mm (six inch by twelve inch).

E. Certificates:

1. Indicating preservative treatment of materials meet the requirements specified.
2. Indicating moisture content of materials meet the requirements specified.

F. Manufacturer's literature and data:

1. Finish hardware
2. Electrical components

1.4 DELIVERY, STORAGE AND HANDLING

A. Protect lumber and millwork from dampness, maintaining moisture content specified both during and after delivery at site.

B. Store finishing lumber and millwork in weathertight well ventilated structures or in space in existing buildings designated by Resident Engineer. Store at a minimum temperature of 21^0 C (70^0 F) for not less than 10 days before installation.

C. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Testing and Materials (ASTM):

1. A36/A36M-08 Structural Steel
2. A53-07 Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
3. A167-99 (R2009) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
4. B26/B26M-09 Aluminum-Alloy Sand Castings
5. B221-08 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
6. E84-09 Surface Burning Characteristics of Building Materials
7. F436-07 Hardened Steel Washers

C. American Hardboard Association (AHA):

1. A135.4-04 Basic Hardboard

D. Builders Hardware Manufacturers Association (BHMA):

1. A156.9-03 Cabinet Hardware
2. A156.11-04 Cabinet Locks
3. A156.16-02 Auxiliary Hardware

E. Hardwood Plywood and Veneer Association (HPVA):

1. HP1-09 Hardwood and Decorative Plywood

F. National Particleboard Association (NPA):

1. A208.1-99 Wood Particleboard

G. American Wood-Preservers' Association (AWPA):

1. AWPA C1-03 All Timber Products – Preservative Treatment by Pressure Processes

H. Architectural Woodwork Institute (AWI):

1. AWI-99 Architectural Woodwork Quality Standards and Quality Certification Program

I. National Electrical Manufacturers Association (NEMA):

1. LD 3-05 High-Pressure Decorative Laminates

?. U.S. Department of Commerce, Product Standard (PS):

2. PS1-95 Construction and Industrial Plywood

?. Military Specification (Mil. Spec):

3. MIL-L-19140E Lumber and Plywood, Fire-Retardant Treated

J. Federal Specifications (Fed. Spec.):

1. A-A-1922A Shield Expansion

2. A-A-1936 Contact Adhesive
3. FF-N-836D Nut, Square, Hexagon Cap, Slotted, Castle
4. FF-S-111D(1) Screw, Wood
5. MM-L-736(C) Lumber, Hardwood

PART 2 - PRODUCTS

2.1 LUMBER

A. Grading and Marking:

1. Lumber shall bear the grade mark, stamp, or other identifying marks indicating grades of material.
2. Such identifying marks on a material shall be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
3. The inspection agency for lumber shall be approved by the Board of Review, American Lumber Standards Committee, to grade species used.

B. Sizes:

1. Lumber Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which product is produced.
2. Millwork, standing and running trim, and rails: Actual size as shown or specified.

C. Hardwood: MM-L-736, species as specified for each item.

D. Softwood: PS-20, exposed to view appearance grades:

1. Use C select or D select, vertical grain for transparent finish including stain transparent finish.

2.2 PARTICLEBOARD

A. NPA A208.1

B. Plastic Laminate Particleboard Cores:

1. Use Type 1, Grade 1-M-3, or Type 2, Grade 2-M-2, unless otherwise specified.
2. Use Type 2, Grade 2-M-2, exterior bond, for tops with sinks.

C. General Use: Type 1, Grade 1-M-3 or Type 2, Grade 2-M-2.

2.3 PLASTIC LAMINATE

A. NEMA LD-3.

B. Exposed decorative surfaces including countertops, both sides of cabinet doors, and for items having plastic laminate finish. General Purpose, Type HGL.

C. Cabinet Interiors including Shelving: Both of following options to comply

with NEMA, CLS as a minimum.

1. Resin impregnated decorative paper thermally fused to particle board.

D. Backing sheet on bottom of plastic laminate covered wood tops: Backer, Type HGP.

2.4 ADHESIVE

A. For Plastic Laminate: Fed. Spec. A-A-1936.

B. For Interior Millwork: Unextended urea resin, unextended melamine resin, phenol resin, or resorcinol resin.

2.5 HARDWARE

A. Rough Hardware:

1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electric galvanizing process. Galvanized where specified.

2. Fasteners:

a. Bolts with Nuts: FF-N-836.

b. Expansion Bolts: A-A-1922A.

c. Screws: Fed. Spec. FF-S-111.

B. Finish Hardware

1. Cabinet Hardware: ANSI A156.9.

a. Door/Drawer Pulls: B02011. Door in seismic zones: B03182.

b. Drawer Slides: B05051 for drawers over 150 mm (6 inches) deep, B05052 for drawers 75 mm to 150 mm (3 to 6 inches) deep, and B05053 for drawers less than 75 mm (3 inches) deep.

c. Adjustable Shelf Standards: B4061 with shelf rest B04083.

d. Concealed Hinges: B1601, minimum 110 degree opening.

e. Butt Hinges: B01361, for flush doors, B01381 for inset lipped doors, and B01521 for overlay doors.

f. Cabinet Door Catch: B0371 or B03172.

g. Vertical Slotted Shelf Standard: B04103 with shelf brackets B04113, sized for shelf depth.

2. Cabinet Locks: ANSI A156.11.

a. Drawers and Hinged Door: E07262.

b. Sliding Door: E07162.

3. Auxiliary Hardware: ANSI A156.16.

a. Shelf Bracket: B04041, japanned or enameled finish.

b. Combination Garment rod and Shelf Support: B04051 japanned or enamel finish.

c. Closet Bar: L03131 chrome finish of required length.

4. Steel Channel Frame and Leg supports for Counter top. Fabricated under

Section 05 50 00, METAL FABRICATIONS.

5. Pipe Bench Supports:

   a. Pipe: ASTM A53.

6. Edge Strips Moldings:

   a. Driven type "T" shape with serrated retaining stem; vinyl plastic to match plastic laminate color, stainless steel, or 3 mm (1/8 inch) thick extruded aluminum.

7. Rubber or Vinyl molding

   a. Rubber or vinyl standard stock and in longest lengths practicable.

   b. Design for closures at joints with walls and adhesive anchorage.

   c. Adhesive as recommended by molding manufacturer.

2.6 MOISTURE CONTENT

A. Moisture content of lumber and millwork at time of delivery to site.

   1. Interior finish lumber, trim, and millwork 32 mm (1-1/4 inches) or less in nominal thickness: 12 percent on 85 percent of the pieces and 15 percent on the remainder.

   2. Moisture content of other materials shall be in accordance with the standards under which the products are produced.

2.7 PRESERVATIVE TREATMENT

A. Wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including wood members used for rough framing of millwork items except heart-wood Redwood and Western Red Cedar shall be preservative treated in accordance with AWPA Standards.

2.8 FABRICATION

A. General:

   1. Except as otherwise specified, use AWI Custom Grade for architectural woodwork and interior millwork.

   2. Finish woodwork shall be free from pitch pockets.

   3. Except where special profiles are shown, trim shall be standard stock molding and members of the same species.

   4. Plywood shall be not less than 13 mm (1/2 inch), unless otherwise shown or specified.

   5. Edges of members in contact with concrete or masonry shall have a square corner caulking rebate.

   6. Fabricate members less than 4 m (14 feet) in length from one piece of lumber, back channeled and molded as shown.

   7. Plastic Laminate Work:

      a. Factory glued to a particle board core, thickness as shown or specified.

      b. Cover exposed edges with plastic laminate, except where aluminum,

stainless steel, or plastic molded edge strips are shown or specified. Use plastic molded edge strips on 19 mm (3/4 inch) molded thick or thinner core material.

c. Provide plastic backing sheet on underside of countertops, vanity tops, thru-wall counter including back splashes and end splashes of countertops.

d. Use backing sheet on concealed large panel surface when decorative face does not occur.

B. Counter or Work Tops:

1. Solid Surfacing Material.

a. Homogenous solid sheets of filled plastic resin complying with ISSFA-2.

b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) E.I. du Pont de Nemours and Company.

2) LG Hausys

3) Meganite Inc.; a division of Pyrochem Group

c. Type: Standard type, unless Special Purpose type is indicated.

d. Colors and Patterns: As specified in SECTION 090600 SCHEDULE FOR FINISHES.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

A. Maintain work areas and storage areas to a minimum temperature of 21° C (70° F) for not less than 10 days before and during installation of interior millwork.

B. Do not install finish lumber or millwork in any room or space where wet process systems such as concrete, masonry, or plaster work is not complete and dry.

3.2 INSTALLATION

A. General:

1. Millwork receiving transparent finish shall be primed and back-painted on concealed surfaces. Set no millwork until primed and back-painted.

2. Secure trim with fine finishing nails, screws, or glue as required.

3. Set nails for putty stopping. Use washers under bolt heads where no other bearing plate occurs.

4. Seal cut edges of preservative and fire retardant treated wood materials with a certified acceptable sealer.

5. Coordinate with plumbing and electrical work for installation of fixtures and service connections in millwork items.

6. Plumb and level items unless shown otherwise.

7. Nail finish at each blocking, lookout, or other nailer and intermediate points; toggle or expansion bolt in place where nails are not suitable.

B. Cafe Counters:

1. Secure framing to floor with expansion bolts.
2. Secure counter top to support with wood cleats or metal angles screwed on 150 mm (6 inch) centers.
3. Conceal fasteners on public side. Exposed fasteners permitted under countertop on staff side.

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SECTION 06 61 00

Architectural Fiberglass Reinforced Polymer (FRP)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes: Architectural Fiberglass Reinforced Polymer (FRP) fabrications.

1. Column Covers
2. Custom Architectural Cornice

1.2 RELATED SECTIONS

A. Section 05 12 00 - Structural Steel: Support framing for architectural fiberglass fabrications.

B. Section 06 10 00 - Rough Carpentry: Framing of Opening and Blocking.

C. Section 07 92 00 - Joint sealants and field applied sealants.

1.3 DESIGN REQUIREMENTS

A. Installed architectural fiberglass fabrications and fastening systems shall be designed, engineered, fabricated, and installed to conform to the state codes, local codes, and the Architect's design.

1.4 SUBMITTALS

A. Shop Drawings: Shall illustrate dimensions, adjacent construction, materials, thickness, fabrications details, required clearances, field jointing, tolerances, colors, finishes, methods of support, attachments, anchorage to substrates, integration of components, and list of part numbers that coordinate with labeled architectural fiberglass parts.

B. Submit current valid third party product Listing and Labeling from International Code Council (ICC)-sanctioned authority to be affixed to all products manufactured and delivered to the jobsite as required per the 2009 International Building Code (IBC). ICC-sanctioned Listing and Labeling Program shall be in place at bid time and state compliance with Flame Spread Index requirements stipulated in the 2009 IBC, section 2612. Manufactured products without Listing and Labeling Program at bid time will not be considered.

C. Submit manufacturer's current valid certification with The Certified Composites Technician (CCT) program created by the American Composites Manufacturers Association (ACMA).

D. Submit manufacturer's internal Quality Control & Assurance Procedures based upon provisions published in the “Guidelines and Recommended Practices for Fiberglass Reinforced Plastic Architectural Products” upon request.

E. Product Data: Submit manufacturer's product data and installation instructions.

F. Product Samples: Submit minimum 3-inch x 5-inch samples in specified color, texture and finish when applicable.

1.5 **QUALITY ASSURANCE**

A. Obtain architectural fiberglass fabrications from a single source manufacturer that has the ability and resources to comply with the requirements and schedule of the project.

B. Manufacturer's ICC-sanctioned Listing and Labeling Program shall include site visits to manufacturing facility by third party testing authority witnessing compliance with manufacturing procedures and Listing and Labeling Program.

C. Manufacturer to comply with Quality Control & Assurance Procedures, and fabricate architectural fiberglass based upon provisions published in the “Guidelines and Recommended Practices for Fiberglass Reinforced Plastic Architectural Products”.

D. Inspect each molded piece to ensure that it complies with specified requirements, including nominal dimensions.

1.6 **MANUFACTURER'S QUALIFICATIONS**

A. Manufacturer: Provide products manufactured by a firm specializing in the manufacture of fiberglass architectural ornamentation, in the United States with a minimum of ten (10) years experience.

B. All products manufactured shall carry ICC-sanctioned Listing and Labeling per 2009 IBC.

C. Manufacturer shall demonstrate current valid certification and participation in the CCT program and fabricate material based upon provisions published in the “Guidelines and Recommended Practices for Fiberglass Reinforced Plastic Architectural Products”.

D. Provide a list of projects comparable in size, scope, and complexity as indicated, upon request.

E. Provide verification that architectural fiberglass meets or exceeds products specified.

1.7 **DELIVERY, STORAGE AND HANDLING**

A. Handle, store and transport architectural fiberglass fabrications according to manufacturer's recommendations and in a manner that prevents damage.

B. Protect architectural fiberglass from damage by retaining shipping protection in place until installation.

C. Damage Responsibility: Except for damage caused by others, the installer is responsible for chipping, cracking, or other damage to fiberglass fabrications, after delivery to the jobsite and until installation is completed and inspected and approved by the Architect or owner's representative.

1.8 **WARRANTY**

A. Warrant architectural fiberglass fabrications to be free from defect due to materials and workmanship for one year.

PART 2 - PRODUCTS

2.1 **PRODUCT DESCRIPTION**

A. Architectural Fiberglass Columns:

1. Column shaft shall be consistent with the Order of Classical Architecture - Tuscan Straight shaft with smooth finish.

   a. Size: As indicated on the drawings.

2. Capital shall be consistent with the Tuscan Order of Classical Architecture.

3. Base shall be consistent with the Tuscan Order of Classical Architecture.

4. Capitals and bases shall be manufactured from the same manufacturer as the column shaft.

B. Custom Architectural Fiberglass Cornice:

1. Style: As indicated on the drawings.

2. Size: As indicated on the drawings.

2.2 **FABRICATION PATTERNS/MOLDS**

A. Custom Pattern/Mockups: Patterns and mockups shall be hand carved and/or CNC machined by skilled pattern makers with minimum of ten (10) years experience with architectural elements. Patterns & mockups shall be available at manufacturing facility for architect's inspection and approval before molds are produced.

B. Custom Molds: Molds shall be produced with ample layers of tooling resin, tooling gel-coat, glass fibers and/or flexible rubber by skilled mold makers with minimum of ten (10) years experience with architectural elements. Produced molds shall have rigidity and thickness to prevent distortion and deflection of molded architectural fiberglass.

2.3 **MATERIALS CHARACTERISTICS**

A. MOLDED EXTERIOR SURFACE: U-V inhibited, NPG-ISO polyester gel coat, 18 to 22 mils thick. Color to match in texture and finish of sample supplied by Architect.

B. BARRIER COAT: Specifically formulated backup polyester surface veil 18-20 mils thick to prevent glass print through and ultimate Class A finish.

C. BACK UP LAMINATE:

1. Resin: Polyester resin shall be fire retardant, and meet Class 1 flame spread rating of 25 or less and smoke density under 450 without the use of antimony trioxide as characterized by the ASTM E-84 tunnel test at typical 1/8” glass mat laminate. General Purpose resin <u>will not</u> be permitted.

2. Filler: Functional filler to be added to resin matrix to minimize shrinkage, add stiffness, control opacity, add fire retardance, improve surface finish, minimize crazing, and control dimensional stability from weather extremes.

3. Fiberglass Reinforcement: Type “E” fiberglass, glass cloth, matt and/or random chopped glass fibers. Glass content approximately 20% to 30%.

4. Laminate Thickness: Nominal laminate shall be minimum 3/16” thickness. Additional core reinforcements and/or sandwich structure added as required for rigidity and structural integrity. Fiberglass laminate thickness to meet the structural design as indicated on the drawings. Additional stiffeners and framing as required shall be embedded in the fiberglass composite to ensure straightness, strength, and profile dimensional stability. Additional skeleton framing will not be field provided. Flat surfaces equal to or greater than 12" by 12" or any running surface equal to or greater than 9" in width, shall be fabricated with a minimum 1/4" thick sandwich core structure.

2.4 **FABRICATION**

A. Architectural Fiberglass Columns:

1. Column cover halves shall be manufactured with sufficient butt joints to provide structural integrity and shall be manufactured to accommodate construction adhesive, and align with adjoining half section. Joint shall be custom engineered lap.
2. Column vertical joint shall be designed to accept polyester body filler for monolithic finish and field painting. Column vertical joint shall be caulked.
3. Column cover shaft half sections shall be manufactured as a single unit spanning entire height from base to top of capital.
4. Column base shall be manufactured as a separate unit for column shaft height adjustment.

B. Custom Architectural Fiberglass Cornice:

1. Cornice sections shall be manufactured with sealable lap and/or butt joints. Cornice joints shall be manufactured to accommodate adjoining sections and alignment of cornice surface sections.
2. Factory inside and outside corners, and unique transition sections shall be shop fabricated. Field corner fabrication will not be permitted.
3. Coordinate miscellaneous cutouts required for vents, drainage, and other cornice obstructions/penetrations.

2.5 **AVERAGE MECHANICAL PROPERTIES:**

Tensile strength	12,000 PSI	ASTM D638
Flexural strength	20,000 PSI	ASTM D790
Flexural modulus	0.9×10^{6} PSI	ASTM D790
Compressive	17,000 PSI	ASTM D695
strength	9,000 PSI	ASTM D638
Bearing strength	10×10^{-6} (°F)	
Thermal expansion	1.5	
Specific gravity		

2.6 FINISH

A. Color as selected by Architect or Owner's representative.

B. Surface Texture/Exposed side shall be smooth based upon approved sample.

2.7 **TOLERANCES**

A. Part Thickness: + or - 1/8 inch.

B. Gel Coat Thickness: + or - 2.5 mils.

C. Length: + or - 1/8 inch

D. Variation from Square: 1/8 inch.

E. Hardware Location Variation: + or - ¼ inch.

2.8 **IDENTIFICATION**

A. Identify each architectural fiberglass unit with a permanent serial number.

B. Number parts to coordinate with shop drawings.

2.9 **CURING AND CLEANING**

A. Cure and clean components prior to shipment and remove material which may be:

1. Toxic to plant or animal life.

2. Incompatible with adjacent building material.

2.10 **ANCHORS AND FASTENERS**

A. Contractor to provide anchors and fasteners and other accessories for proper installation of architectural fiberglass fabrications as recommended and approved by fiberglass fabrication manufacturer.

PART 3 - EXECUTION

3.1 **PRE-INSTALLATION EXAMINATION**

A. Carefully observe and verify field conditions that substrates are ready for installation of architectural fiberglass fabrications. Contractor shall verify on site dimensions with shop drawings and assume full responsibility for fitting the components to the structure.

B. Verify that bearing surfaces are true and level.

C. Verify that support framing has been constructed to allow accurate placement, alignment and connection of architectural fiberglass fabrications to structure.

D. Report discrepancies between design dimensions and field dimensions, which could adversely affect installation, to the Architect and Resident Engineer.

E. Do not proceed with installation until discrepancies are corrected, or until installation requirements are modified and approved by the Architect and Owner's Representative.

F. Beginning of installation means acceptance of existing conditions and fiberglass materials.

3.2 INSTALLATION

A. Install architectural fiberglass fabrications in accordance with manufacturer's instructions and approved shop drawings.

B. The position of the plinth must be determined by dropping a plumb line from the center of the soffit beam to floor. This point should be marked well on the floor.

C. Measure the overall height. Raise the soffit or porch slightly and brace safely for later column placement.

D. Measure length and if necessary, trim the shaft on the bottom only. Trim with an abrasive saw blade. Finish the top and bottom ends of the shaft with a rasp or sander to ensure an even load distribution around the shaft.

E. Slide the capital over the neck and rest temporarily on the astragal until the shaft is in the proper position.

F. Slide the base/plinth onto the shaft from the bottom.

G. Stand column in a vertical position and slide into place where mark was made on the floor.

H. Use small L brackets to hold the shaft to the floor and do not let the bracket interfere with the position of the base/plinth. (Note: use through bolts on the shaft, do not use screws.)

I. Remove brace and allow load to rest on the column evenly. Secure top of shaft with L brackets similar to the bottom of the shaft.

J. Slide capital up to soffit and attach using corrosion resistant screws. Attach the base to the flooring using masonry or appropriate fasteners. Fill holes with polyester body filler.

K. Apply sealant between the capital and the shaft, and the base and the shaft for a completed appearance. (Note: a gap around the base and shaft is normal and standard in the industry.)

L. Fiberglass column cover vertical joint shall be field finished and painted per manufacturer's instructions for monolithic appearance. Vertical joint shall be field caulked.

M. Erect required connection blocking, framing, and cornice, plumb, square, and true to line and level to substrate. Recess blocking or notch continuous blocking behind each panel joint per manufacturer's instructions. The installer shall supply connectors, blocking and framing approved by cornice manufacturer.

N. Space joints according to shop drawings, not less than 1/8″ and not greater than 3/8″. Prepare joints by lightly sanding and filling joints with a continuous bead of specified sealant as work progresses to make a weather tight joint. Carefully monitor ambient temperatures at time of installation to prevent excessive expansion and contraction of panels during sealant application.

O. Do not field cut cornice where the finish cannot be field restored. Installer may repair small unnoticeable finish repairs with manufacturer's supplied colored gel-coat patching material.

P. Space joints between rail sections and newel post according to shop drawings, not less than 1/8″ and not greater than 3/8″. Prepare joints by lightly sanding and filling joints with a continuous bead of specified sealant as work progresses to make a weather tight joint. Carefully monitor ambient temperatures at time of installation to prevent excessive expansion and contraction of balustrade system during sealant application.

Q. Do not field cut baluster rails or newel post where the finish cannot be field restored. Installer may repair small unnoticeable finish repairs with manufacturer's supplied colored gel-coat patching material.

R. Countersink all exposed fasteners and repair with manufacturer's supplied colored gel-coat patching material. Repairs shall be made with care to be undetectable.

3.3 **ALLOWABLE TOLERANCES FOR INSTALLED UNITS**

A. Maximum offset from True Alignment: 1/4 inch in 20 feet.

B. Maximum Variation from True Position: 1/2 inch in 20 feet.

3.4 **PAINTING AND FINISHING**

A. Make sure all surfaces are clean prior to painting. Lightly sand and remove all dust and dirt before applying primer or paint. Fill any visible surface scratches.

B. Fiberglass column joints on split columns shall be finished with fiberglass repair kit and painted with high quality primer & paint.

C. Use a good quality exterior paint at least one coat of primer and two coats of paint. Oiled based primer is recommended.

3.5 **CLEANING**

A. Clean installed architectural fiberglass fabrications using cleaning methods and material approved by manufacturer.

3.6 **PROTECTION OF INSTALLED FABRICATIONS**

A. Comply with manufacturer's recommendations and instructions for protecting installed fabrications during construction activities.

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Section 06 62 00

CAST PLASTIC FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Section includes the furnishing and installation of High Density Urethane Balustrade Systems, including but not limited to:

1. Balusters
2. Railings
3. Newel Posts
4. Newel Post Accessories
5. Installation Kits

1.2 RELATED WORK:

A. 06 10 00 – Rough Carpentry
B. 06 20 00 – Finish Carpentry
C. 07 90 00 – Joint Protection
D. 09 06 00 – Schedule for Finishes
E. 09 90 00 – Painting and Coating

1.3 REFERENCED STANDARDS:

A. ASTM E84 (UL723) – Surface Burning Characteristics of Building Materials

1.4 DESIGN / PERFORMANCE REQUIREMENTS:

A. Installed balustrade and fastening systems shall be designed, engineered, fabricated and installed to conform to all state and local codes and the project drawings and specifications.

1.5 SUBMITTALS:

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s)

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment

2. Letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the amount of recycled content.
3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

C. Product Data: Provide Manufacturer's Data Sheets for each product to be used, including: storage and handling requirements and recommendations; preparation instructions and recommendations and installation instructions.

D. Shop drawings: Submit detailed drawings showing location, profiles and product components, including but not limited to anchorage requirements, accessories and provisions for achieving desired finishes.

E. Product Samples: Submit duplicate samples for each product component specified, representing all available styles and finishes. One approved sample will be returned to contractor.

F. Manufacturer's Certificates: Provide Manufacturer's documentation certifying that products meet or exceed specified requirements.

G. Test Reports: Submit manufacturer's test reports for urethane balustrade systems from an approved independent testing agency.

1.6 QUALITY ASSURANCE:

A. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. Manufacturer Qualifications: Manufacturer shall have not less than 10 years successful experience in manufacturing the type of products specified and required for the project applications of this project.

C. Installer Qualifications: Installer shall have a minimum of five (5) years experience installing products of similar type and scope as those specified in this section and approved by the manufacturer.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish areas as designated by Architect.
2. Include mock-up for each profile combination indicated on the drawings.
3. Do not proceed with remaining work until workmanship, color and sheen are approved by Architect.
4. Rework mock-up areas as required to produce acceptable work.
5. Mock-up may remain as finished work if approved by Architect.

E. Pre-installation Meeting: Conduct a pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

1.7 DELIVERY, STORAGE AND HANDLING:

A. Deliver all materials in original packaging, unopened with no visible damage.

B. Label each package with product contents and stock number of contents, with warranty, installation, handling and storage recommendations enclosed or on packaging.

C. Allow for receiving, unloading, handling and movement to approved storage areas within project, and final movement to point of installation.

D. Store and protect all materials in accordance with manufacturer's requirements for environmental and physical protection. Keep temporary protective coverings in place.

E. Store products on flat level surface to prevent warping.

F. Protect materials and finish from damage during handling and installation.

1.8 PROJECT CONDITIONS:

A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommendations.

B. Field Measurements: Verify actual measurements and openings by field measurements before fabrication. Show recorded measurements on shop drawings

C. Allow at least 24 hours for materials to adapt to conditions at project site prior to installation.

1.9 WARRANTY:

A. Upon completion of work, provide a written Manufacturer's Lifetime Limited Warranty for products installed as part of this project to the Original Owner.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Product Description: molded, high-density rigid polyurethane.

B. Balustrade System Components:

1. Balusters: As shown on the Drawings.
2. Railings: As shown on the Drawings.
3. Newel Posts: As shown on the Drawings.
4. Newel Post Accessories: As recommended by manufacturer's specifications.
5. Hardware: As recommended by manufacturer's specifications.

2.2 ACCESSORIES:

A. Sealant: Use a manufacturer's approved urethane-based adhesive.

B. Fasteners: Use corrosive-resistant fasteners.

2.3 FINISHES:

A. Urethane Balustrade Components are supplied with a manufacturer supplied protective barrier coat primer, resistant to UV degradation, providing interim UV protection which is suitable for field application of a good quality latex or oil base paint.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Site Verification of Conditions:

1. Prior to the start of installation, inspect all preceding work to ensure that there are no conditions which will cause an unsatisfactory installation of work involving balustrade systems.
2. Notify Architect in writing of any unacceptable conditions that would adversely affect installation or subsequent performance of this product.
3. Do not install any work involving balustrade products until unsatisfactory conditions are corrected and acceptable for proper installation of work.
4. Contractor shall be responsible for correcting or replacing all unacceptable work involving balustrade products, which were installed over unsatisfactory conditions at no cost to Owner.

3.2 PREPARATION:

A. Provide protection for surrounding and adjacent work as required preventing damage to preceding work during execution of this work.

B. Perform all preparation necessary for a successful installation of products as specified in manufacturer's installation instructions.

3.3 INSTALLATION:

A. Obtain Manufacturer's instructions for successful installation of work to

be performed and become knowledgeable with all material handling and installation recommendations.

B. Ensure full compliance with Manufacturer's instructions in all aspects of tasks required by this work. Install products in accordance with manufacturer's instructions at locations indicated on the drawings.

C. Coordinate all work with other project trades to assure proper installation and provide proper accommodations for following work by other trades.

3.4 FIELD QUALITY CONTROL:

A. After installation, check all work for flaws and defects.

B. Repair all defective work.

C. Remove and replace all damaged components that cannot be successfully repaired as determined by Project Architect.

3.5 PROTECTION:

A. Install temporary protective materials necessary to prevent damage to materials installed in this work until final acceptance of the project.

3.6 CLEANING:

A. Remove all protection materials.

B. Clean all surfaces following manufacturer's recommendations prior to final project completion. Do not use harsh cleaning materials or methods that would damage finish.

C. Dispose properly of all debris generated by this work, protection materials and cleaning materials.

- - - END - - -

SECTION 07 13 26

SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Modified bituminous sheet waterproofing.
2. Bonded HDPE or polyethylene sheet waterproofing.
3. Molded-sheet drainage panels.

1.2 RELATED WORK

A. Related Sections include the following:

1. Joint-sealant materials and installation: Section 07 92 00, Joint Sealants.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

C. Samples: For the following products:

1. 12-by-12-inch square of waterproofing and flashing sheet.
2. 4-by-4-inch square of drainage panel.

D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for waterproofing.

G. Warranties: Special warranties specified in this Section.

H. VOC content for Adhesives, Paints and Coatings: Manufacturers' product data for installation adhesives, paints and coatings applied onsite and inside the weatherproofing system, including printed statement of VOC content (in g/L).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm that is approved or licensed by and acceptable to waterproofing manufacturer for installation of waterproofing required for this Project.

B. Source Limitations: Obtain waterproofing materials and molded-sheet drainage panels through one source from a single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Store rolls according to manufacturer's written instructions.

E. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace waterproofing material that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch in width.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Not less than 60-mil- thick, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated to a 4-mil-thick, polyethylene film with release liner on adhesive side and formulated for application with primer or surface conditioner that complies with VOC

limits of authorities having jurisdiction.

a. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.

b. CETCO Building Materials Group; Envirosheet.

c. Grace, W. R. & Co.; Bituthene 4000.

d. Henry Company; Blueskin WP 200.

e. Meadows, W. R., Inc.; SealTight Mel-Rol.

f. Pecora Corporation; Duramem 700-SM.

2. Physical Properties:

a. Tensile Strength: 250 psi minimum; ASTM D 412, Die C, modified.

b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.

c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.

d. Crack Cycling: Unaffected after 100 cycles of 1/8-inchmovement; ASTM C 836.

e. Puncture Resistance: 40 lbf minimum; ASTM E 154.

f. Hydrostatic-Head Resistance: 150 feet minimum; ASTM D 5385.

g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.

h. Vapor Permeance: 0.05 perms; ASTM E 96, Water Method.

2.2 BONDED HDPE OR POLYETHYLENE SHEET WATERPROOFING

A. Bonded HDPE Sheet for Vertical Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of either a HDPE film coated with a pressure-sensitive adhesive and protective release liner, total 32-mil thickness, or an HDPE film coated with a modified asphalt layer and a nonwoven geotextile-fabric final layer, total 73-mil thickness; with the following physical properties:

Property	Test Method	Typical Value
Thickness	ASTM D 3767 Method A	1.0 mm (0.032 in.) nominal
Lateral Water Migration Resistance	ASTM D5385, Modified1	Pass at 71 m (231 ft) of hydrostatic head pressure
Low Temperature Flexibility	ASTM D 1970	Unaffected at -29°C (-20°F)
Elongation	ASTM D 412 Modified2	580%
Crack Cycling at -23°C (-9.4°F), 100 Cycles	ASTM C 836	Unaffected, Pass
Tensile Strength	ASTM D 412	27.6 MPa (4,000 lbs/in.2)
Peel Adhesion to Concrete	ASTM D 903 Modified3	880 N/m (5.0 lbs/in.)
Lap Adhesion	ASTM D 1876	880 N/m (5.0 lbs/in.)

	Modified4	
Resistance to Hydrostatic Head	ASTM D 5385 Modified5	Pass at 71 m (231 ft)
Puncture Resistance	ASTM E 154	445 N (100 lbs)
Permeance	ASTM E 96 Method B	0.6 ng/Pa x s x m2 (0.01 perms)
Water Absorption	ASTM D 570	0.5%

B. Bonded HDPE or Polyethylene Sheet for Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of either an HDPE film coated with pressure-sensitive adhesive and protective release liner, total 46-mil thickness, or a cross-laminated film of low- and medium-density polyethylene, coated with a modified asphalt layer and a nonwoven geotextile-fabric final layer, total 95-mil thickness; with the following physical properties:

Property	Test Method	Typical Value
Thickness	ASTM D 3767 Method A	1.0 mm (0.032 in.) nominal
Lateral Water Migration Resistance	ASTM D5385, Modified1	Pass at 71 m (231 ft) of hydrostatic head pressure
Low Temperature Flexibility	ASTM D 1970	Unaffected at -29°C (-20°F)
Elongation	ASTM D 412 Modified2	580%
Crack Cycling at -23°C (-9.4°F), 100 Cycles	ASTM C 836	Unaffected, Pass
Tensile Strength	ASTM D 412	27.6 MPa (4,000 lbs/in.2)
Peel Adhesion to Concrete	ASTM D 903 Modified3	880 N/m (5.0 lbs/in.)
Lap Adhesion	ASTM D 1876 Modified4	880 N/m (5.0 lbs/in.)
Resistance to Hydrostatic Head	ASTM D 5385 Modified5	Pass at 71 m (231 ft)
Puncture Resistance	ASTM E 154	445 N (100 lbs)
Permeance	ASTM E 96 Method B	0.6 ng/Pa x s x m2 (0.01 perms)
Water Absorption	ASTM D 570	0.5%

C. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of

authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of sheet waterproofing material.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.

F. Sheet Strips: Self-adhering, rubberized-asphalt sheet strips of same material and thickness as sheet waterproofing.

G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

1. Detail Tape: Two-sided, pressure-sensitive, self-adhering reinforced tape, 4-1/2 inches wide, with a tack-free protective adhesive coating on one side and release film on self-adhering side.

2. Detail Strips: 62.5-mil- thick, felt-reinforced self-adhesive strip, 9 inches wide, with release film on adhesive side.

H. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.

I. Protection Course: Extruded-polystyrene board insulation, unfaced, ASTM C 578, Type X, 1/2 inch 13 mm thick.

J. Protection Course: Molded-polystyrene board insulation, ASTM C 578, Type I, 0.90-lb/cu. ft. 15-kg/cu. m minimum density, 1-inch 25-mm minimum thickness

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm)sieve laminated to one side with or without a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per ft. (112 to 188 L/min. per m).

B. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.425-mm) (0.425-mm) sieve laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a horizontal flow rate not less than 2.8 gpm per ft. (35 L/min. per m) (35 L/min. per m).

2.5 INSULATION

A. Insulation, General: Comply with Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.

2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

3. Verify that compacted subgrade is dry, smooth, and sound; and ready to receive adhesive-coated HDPE sheet.

4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

F. Bridge and cover isolation joints, expansion joints and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:

a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing

manufacturer's written instructions and according to recommendations in ASTM D 6135.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths to provide a minimum of 2 thicknesses of sheet membrane over areas to receive waterproofing.

E. Horizontal Application: Apply sheets from low point to high point of decks to ensure that side laps shed water.

F. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.

G. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic.

H. Install sheet waterproofing and auxiliary materials to tie into adjacent waterproofing.

I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

J. Immediately install protection course with butted joints over waterproofing membrane.

1. Molded-sheet drainage panels and Board insulation may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

K. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

3.4 BONDED HDPE OR POLYETHYLENE SHEET-WATERPROOFING APPLICATION

A. Install bonded HDPE or polyethylene sheets according to manufacturer's written instructions.

B. Place and secure molded-sheet drainage panels over substrate. Lap edges and ends of geotextile to maintain continuity.

C. Vertical Applications: Install sheet with HDPE face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation. Mechanically fasten to substrate.

1. Securely fasten top termination of membrane with continuous metal termination bar anchored into substrate and cover with detailing tape.

D. Horizontal Applications: Install sheet with HDPE or polyethylene face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.

E. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.

F. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.

G. Install sheet-waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches (150 mm) beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

3.5 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or mechanical fasteners that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation protection course before installing drainage panels.

3.6 INSULATION INSTALLATION

A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch of projections and penetrations.

B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.

C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.7 FIELD QUALITY CONTROL

A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; membrane application, flashings, protection, and drainage components; and to furnish daily reports to Resident Engineer and Architect.

3.8 PROTECTION AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed board insulation panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation where required by waterproofing manufacturer.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

- - - END - - -

SECTION 07 14 16

COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-component polyurethane waterproofing.
2. Latex-rubber waterproofing.

B. Related Section:

1. Division 07 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Product Data: For each type of product indicated. Include manufacturer's

written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

C. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

D. Samples: For the following products:

1. Flashing sheet, 10 by 8 inches.

2. Membrane-reinforcing fabric, 10 by 8 inches.

E. Qualification Data: For Installer.

F. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.

G. Field quality-control reports.

H. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.7 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which waterproofing manufacturer[and Installer] agree to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/16 inch in width.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Installer's Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Carlisle Coatings & Waterproofing Inc.; CCW-525.

b. Neogard, Div. of Jones-Blair; Neogard 7401.

c. Tremco Incorporated; [Tremproof 60] [Vulkem 250 GC] [Vulkem 201].

2.2 ts in LATEX-RUBBER WATERPROOFING

A. Two-Component, Unreinforced, Latex-Rubber Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

a. Grace, W. R. & Co.; Procor.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.

B. Primer: Manufacturer's standard, factory-formulated polyurethane or epoxy primer.

C. Sheet Flashing: 50-mil- minimum, non-staining, uncured sheet neoprene.

1. Adhesive: Manufacturer's recommended contact adhesive.

D. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing, complying with ASTM C 920 Type M, Class 25; Grade NS for sloping and vertical applications or Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.

2.4 PROTECTION COURSE

A. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.

2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

1. Abrasive blast clean concrete surfaces uniformly to expose top surface

of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.

E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.3 PREPARATION AT TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C 1471 and manufacturer's written instructions.

B. Prime substrate unless otherwise instructed by waterproofing manufacturer.

C. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1471 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.

1. Comply with ASTM C 1193 for joint-sealant installation.

2. Apply bond breaker between sealant and preparation strip.

3. Prime substrate and apply a single thickness of preparation strip extending a minimum of 3 inches along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

3.5 WATERPROOFING APPLICATION

A. Apply waterproofing according to ASTM C 1471 and manufacturer's written instructions.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils and a minimum dry film thickness of 50 mils at any point.

2. Apply waterproofing to prepared wall terminations and vertical surfaces.

3. Verify wet film thickness of waterproofing every 100 sq. ft..

E. Install protection course with butted joints over nominally cured membrane

before starting subsequent construction operations.

3.6 FIELD QUALITY CONTROL

A. Engage a full time site representative qualified by the waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, and application of the membrane, flashings, protection, and drainage components; and to furnish daily reports to Architect.

B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of sheet flashings.

2. Flood each area for 48 hours.

3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

C. Owner will engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

3.7 CURING, PROTECTION, AND CLEANING

A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.

1. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

- - - END - - -

SECTION 07 21 13

THERMAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies thermal and acoustical insulation for buildings.

B. Acoustical insulation is identified by thickness and words "Acoustical Insulation".

1.2 RELATED WORK

A. Insulation in connection with roofing and waterproofing: Section 07 22 00, ROOF AND DECK INSULATION.

B. Safing insulation: Section 07 84 00, FIRESTOPPING.

1.3 SUBMITTALS:

A. LEED BUILDING Submittal Requirements: The contractor or subcontractor shall submit the following LEED BUILDING certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's Literature and Data:

1. Insulation, each type used

2. Adhesive, each type used.

3. Tape

D. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.4 STORAGE AND HANDLING:

A. Store insulation materials in weathertight enclosure.

B. Protect insulation from damage from handling, weather and construction operations before, during, and after installation.

1.5 QUALITY ASSURANCE REQUIREMENTS:

A. LEED Building Performance Requirements:

1. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

2. Fiberglass insulation shall contain a minimum of 20% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Mineral-wool insulation shall contain a minimum of 50% (combined) pre-consumer/post-consumer recycled content. Certification of recycled content shall be in accordance with the Submittal Requirements above.

3. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.6 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. American Society for Testing and Materials (ASTM):

1. C270-08 Mortar for Unit Masonry
2. C552-07 Cellular Glass Thermal Insulation.
3. C553-08 Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
4. C578-08 Rigid, Cellular Polystyrene Thermal Insulation
5. C591-08 Unfaced Preformed Rigid Cellular Polyisocynurate Thermal Insulation
6. C612-04 Mineral Fiber Block and Board Thermal Insulation
7. C665-06 Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
8. C954-07 Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Base to Steel Studs From 0.033 (0.84 mm) inch 0.112 inch (2.84 mm) in thickness

9. C1002-07 Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
10. D312-00(R2006) Asphalt Used in Roofing
11. E84-08 Surface Burning Characteristics of Building Materials
12. F1667-05 Driven Fasteners: Nails, Spikes and Staples.

PART 2 - PRODUCTS

2.1 INSULATION – GENERAL:

A. Where thermal resistance ("R" value) is specified or shown for insulation, the thickness shown on the drawings is nominal. Use only insulation with actual thickness that is not less than that required to provide the thermal resistance specified.

B. Where "R" value is not specified for insulation, use the thickness shown on the drawings.

C. Where more than one type of insulation is specified, the type of insulation for each use is optional, except use only one type of insulation in any particular area.

D. Insulation Products shall comply with following minimum content standards for recovered materials:

Material Type	Percent by Weight
Perlite composite board	23 percent post consumer recovered paper
Polyisocyanurate/polyurethane	
Rigid foam	9 percent recovered material
Foam-in-place	5 percent recovered material
Glass fiber reinforced	6 percent recovered material
Phenolic rigid foam	5 percent recovered material
Rock wool material	75 percent recovered material

The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

2.2 PERIMETER INSULATION IN CONTACT WITH SOIL:

A. Polystyrene Board: ASTM C578, Type IV, V, VI, VII, or IX where covered by soil or concrete.

2.3 EXTERIOR FRAMING OR FURRING INSULATION:

A. Spray Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450,

respectively, per ASTM E 84.

1. Minimum density of 1.5 lb/cu. ft., thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F.
2. Compressive Strength minimum (ASTM D1621, 10% parallel to rise): 25 psi 182 kPa.
3. Thermal Resistance (ASTM C518): (Aged R-value: 5.4 at 180 days; 50% R.H. per FTC requirements(180 days ambient temperature conditioning).
4. Closed Cell Content (ASTM D2856): minimum 90 percent.
5. Water Absorption by Volume maximum. (ASTM D2842): 1.7 percent.
6. Water Vapour Permeability maximum. (ASTM E96): 2.3 perm-inches 3.36 ng/(Pa.s.m).

B. Mineral Fiber: ASTM C665, Type II, Class C, Category I where framing is faced with gypsum board. At box beam headers or where shown on the drawings.

2.4 ACOUSTICAL INSULATION:

A. Mineral Fiber Batt or Blankets: ASTM C665. Maximum flame spread of 25 and smoke development of 450 when tested in accordance with ASTM E84.

B. Thickness as shown; of widths and lengths to fit tight against framing.

2.5 SOUND DEADENING BOARD:

A. Mineral Fiber Board: ASTM C612, Type IB, 13 mm (1/2 inch thick).

2.6 RIGID INSULATION:

A. On the inside face of exterior walls, spandrel beams, floors, bottom of slabs, and where shown.

B. Mineral Fiber Board: ASTM C612, Type IB or 2.

2.7 FASTENERS:

A. Impaling Pins: Steel pins with head not less than 50 mm (2 inches) in diameter with adhesive for anchorage to substrate. Provide impaling pins of length to extend beyond insulation and retain cap washer when washer is placed on the pin.

2.8 ADHESIVE:

A. As recommended by the manufacturer of the insulation.

2.9 TAPE:

A. Pressure sensitive adhesive on one face.

B. Perm rating of not more than 0.50.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install insulation with the vapor barrier facing the heated side, unless specified otherwise.

B. Install rigid insulating units with joints close and flush, in regular courses and with cross joints broken.

C. Install batt or blanket insulation with tight joints and filling framing void completely. Seal cuts, tears, and unlapped joints with tape.

D. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.

E. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

F. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

G. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 PERIMETER INSULATION:

A. Vertical insulation:

1. Fill joints of insulation with same material used for bonding.

2. Bond polystyrene board to surfaces with adhesive or Portland cement mortar mixed and applied in accordance with recommendations of insulation manufacturer.

3. Bond cellular glass insulation to surfaces with hot asphalt or adhesive cement.

4. If not otherwise indicated, extend insulation a minimum of 600 mm (24 inches) 610 mmbelow exterior grade line.

B. Horizontal insulation under concrete floor slab:

1. Lay insulation boards and blocks horizontally on level, compacted and drained fill.

2. Extend insulation from foundation walls towards center of building not less than 600 mm (24 inches) or as shown.

3.3 EXTERIOR FRAMING OR FURRING BLANKET INSULATION:

A. Pack insulation around door frames and windows and in building expansion joints, door soffits and other voids. Pack behind outlets around pipes, ducts, and services encased in walls. Open voids are not permitted. Hold insulation in place with pressure sensitive tape.

B. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

1. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

a. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions

C. Lap vapor retarder flanges together over face of framing for continuous surface. Seal all penetrations through the insulation.

D. Fasten blanket insulation between metal studs or framing and exterior wall furring by continuous pressure sensitive tape along flanged edges.

E. Roof Rafter Insulation or Floor Joist Insulation: Place mineral fiber blankets between framing to provide not less than a 50 mm (2 inch) air space between insulation and roof sheathing or subfloor.

F. Ceiling Insulation and Soffit Insulation:

1. At metal framing or ceilings suspension systems, install blanket insulation above suspended ceilings or metal framing at right angles to the main runners or framing. Tape insulation tightly together so no gaps occur and metal framing members are covered by insulation.

2. In areas where suspended ceilings adjoin areas without suspended ceilings, install either blanket, batt, or mineral fiberboard extending from the suspended ceiling to underside of deck or slab above. Secure in place to prevent collapse or separation of hung blanket, batt, or board insulation and maintain in vertical position. Secure blanket or batt with continuous cleats to structure above.

1.1 RIGID INSULATION ON SURFACE OF EXTERIOR FOUNDATION WALLS, FLOORS, AND UNDERSIDE OF FLOORS:

G. On the interior face of solid masonry and concrete walls, beams, beam soffits, underside of floors, and to the face of studs for interior wall finish where shown.

A. Bond to solid vertical surfaces with adhesive as recommended by insulation manufacturer. Fill joints with adhesive cement.

B. Use impaling pins for attachment to underside of horizontal surfaces. Space fastenings as required to hold insulation in place and prevent sagging.

C. Fasten board insulation to face of studs with screws, nails or staples. Space fastenings not more than 300 mm (12 inches) apart. Stagger fasteners at joints of boards. Install at each corner.

D. Floor insulation:

1. Bond insulation to concrete floors in attic by coating surfaces with hot steep asphalt applied at rate of not less than 11.5 Kg per m² (25 lbs/100 sq. ft.), and firmly bed insulation therein.

1. When applied in more than one layer, bed succeeding layers in hot steep asphalt applied at the rate of not less than 11.5 Kg per m² (25 lbs/100 sq. ft.).

2. Contractors option: Insulation may be installed with nonflammable adhesive in accordance with the manufacturer's printed instructions when a separate vapor retarder is used.

3.4 ACOUSTICAL INSULATION:

A. Fasten blanket insulation between metal studs and wall furring with continuous pressure sensitive tape along edges or adhesive.

B. Pack insulation around door frames and windows and in cracks, expansion joints, control joints, door soffits and other voids. Pack behind outlets, around pipes, ducts, and services encased in wall or partition. Hold insulation in place with pressure sensitive tape or adhesive.

C. Do not compress insulation below required thickness except where embedded items prevent required thickness.

D. Where acoustical insulation is installed above suspended ceilings install blanket at right angles to the main runners or framing. Extend insulation over wall insulation systems not extending to structure above.

- - - E N D - - -

SECTION 07 22 00

ROOF AND DECK INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Roof and deck insulation, substrate board vapor retarder and cover board, Ventilated Roof Insulation on new construction ready to receive roofing or waterproof membrane.

1.2 RELATED WORK

A. General sustainable design documentation requirements: Section 01 81 13 SUSTAINABLE DESIGN REQIREMENTS.

B. Perimeter, rigid, and batt or blanket insulation: Section 07 21 13, THERMAL INSULATION.

C. Sheet metal components and wind uplift requirements for roof-edge design: Section 07 60 00, FLASHING AND SHEET METAL.

1.3 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.

B. American Society of Heating, Refrigeration and Air Conditioning(ASHRAE):

1. 90.1 - 07 Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. American International ASTM):

1. C208-08 Cellulosic Fiber Insulating Board
2. C552-07 Cellular Glass Thermal Insulation
3. C726-05 Mineral Fiber Roof Insulation Board
4. C1177/C1177M-08 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
5. C1278/C1278M-07 Standard Specification for Fiber-Reinforced Gypsum Panel
6. C1289-10 Faced Rigid Cellular Polyisocynurate Thermal Insulation Board
7. C1396/C1396M-09 Standard Specification for Gypsum Board
8. D41-05 Asphalt Primer Used in Roofing, Damp proofing, and Waterproofing
9. D312-06 Asphalt Used in Roofing

10. D1970-09 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dan Protection.
11. D2178-04 Asphalt Glass Felt Used in Roofing and Waterproofing
12. D2822-05 Asphalt Roof Cement
13. D4586-07 Standard Specification for Asphalt Roof Cement, Asbestos-Free
14. E84-09 Standard Test Method for Surface Burning Characteristics of Building Material
15. F1667-05 Driven Fasteners: Nails, Spikes, and Staples

D. FM Approvals: RoofNav Approved Roofing Assemblies and Products.

1. 4450-89 Approved Standard for Class 1 Insulated Steel Deck Roofs
2. 4470-10 Approved Standard for Class 1 Roof Coverings
3. 1-28-09 Loss Prevention Data Sheet: Design Wind Loads.
4. 1-29-09 Loss Prevention Data Sheet: Above-Deck Roof Components
5. 1-49-09 Loss Prevention Data Sheet: Perimter Flashing

E. National Roofing Contractors Association: Roofing and Waterproofing Manual

F. U.S. Department of Agriculture (USDA): USDA Biopreferred Catalog.

G. Underwriters Laboratories, Inc. (UL): Fire Resistance Directory (2009)

H. U.S. Department of Commerce National Institute of Standards and Technology (NIST):

1. DOC PS 1-09 U.S. Product Standard for Construction and Industrial Plywood.
2. DOC PS @-04 Performance Standard for Wood Based Structural Use Panels.

1.4 PERFORMANCE REQUIREMENTS

A. LEED BUILDING Submittal Requirements: The contractor or subcontractor shall submit the following LEED BUILDING certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the amount of recycled content.
3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Thermal Performance: Provide roof insulation meeting minimum overall average R-value of 33, with minimum R-value at any location of 10.

C. FM Approvals: Provide roof insulation complying with requirements in FM Approvals 4450 and 4470 as part of specified roofing system, listed in FM Approvals "RoofNav" as part of roofing system meeting Fire/Windstorm Classification in Division 07 roofing section.

1.5 QUALITY CONTROL

A. LEED Building Performance Requirements:

1. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
2. Fiberglass insulation shall contain a minimum of 20% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Mineral-wool insulation shall contain a minimum of 50% (combined) pre-consumer/post-consumer recycled content. Certification of recycled content shall be in accordance with the Submittal Requirements above.
3. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. Requirements of Division 07 roofing section for qualifications of roofing system insulation Installer; Work of this Section shall be performed by same Installer.

C. Requirements of Division 07 roofing section for inspection of Work of this Section and qualifications of Inspector.

D. Unless specified otherwise, comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to insulation for storage, handling, and application.

E. Requirements of roofing system uplift pressure design for specified roofing system.

F. Requirements of applicable FM Approval for specified roofing system insulation attachment.

G. Bio-Based Materials: Where applicable, provide products designated by USDA and meeting or exceeding USDA recommendations for bio-based content, and products meeting Rapidly Renewable Materials and certified sustainable wood content definitions; refer to www.biopreferred.gov.

1.6 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Product Data:

1. Asphalt and adhesive materials, each type
2. Roofing cement, each type
3. Roof insulation, each type
4. Substrate board, each type.
5. Cover board, eack type.
6. Fastening requirements.
7. Insulation span data for flutes of metal decks.
8. Ventilated Roof Insulation System.

C. LEED and Federal Sustainable Design Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
3. Product Data for Federally-Mandated Bio-Based Materials: For roof materials, indicating USDA designation and compliance with definitions for bio-based products, Rapidly Renewable Materials, and certified sustainable wood content

D. Shop Drawings: Include plans, sections, details, and attachments:

1. Nailers, and terminations.
2. Layout of insulation showing slopes, tapers, penetration, and edge conditions.
3. Ventilated Roof Insulation System - Drawing showing how the 50% lateral ventilation is achieved. Calculations of spacer block percentage of panel area and the Net Free Area per Lin. Ft. of insulation after deducting for spacers.

E. Samples:

1. Roof insulation, each type
2. Nails and fasteners, each type
3. Ventilated Roof Insulation System - with the edge profile specified and

large enough to show the actual lateral spacing of the vent space supports.

F. Certificates:

1. Indicating type, thermal conductance and minimum and average thickness of insulation.

2. Indicating materials and method of application of insulation system meet the Requirements of FM Approvals for insulation products..

G. Laboratory Test Reports: Thermal values of insulation products.

H. Documentation of supervisors and inspectors qualifications.

1.7 DELIVERY, STORAGE AND MARKING

A. Comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to built-up roofing for storage, handling and installation requirements.

1.8 QUALITY ASSURANCE:

A. Roof insulation on combustible or steel decks shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E84, or shall have successfully passed FM Approvals 4450.

1. Insulation bearing the UL label and listed in the UL Building Materials Directory as meeting the flame spread and smoke developed ratings will be accepted in-lieu-of copies of test reports.

2. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the particular type used for this project and the construction is listed as fire-classified in the UL Building Materials Directory or listed as Class I roof deck construction in the FM Approvals "RoofNav".

3. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

PART 2 - PRODUCTS

2.1 Basis of Design:

A. Thermocal 2, Manufacturer: Cornell Corporation, or approved equal.

2.2 ADHESIVE MATERIALS

A. Adhesive Materials, General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use, identical to materials utilized in approved listed roofing system, and compatible with roofing membrane.

1. Liquid-type adhesive materials shall comply with VOC limits of authorities having jurisdiction.

2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Plastic Foam Adhesives: 50 g/L.

b. Multipurpose Construction Adhesives: 70 g/L.

c. Fiberglass Adhesives: 80 g/L.

d. Contact Adhesives: 80 g/L.

e. Other Adhesives: 250 g/L.

f. Nonmembrane Roof Sealants: 300 g/L.

g. Sealant Primers for Nonporous Substrates: 250 g/L.

h. Sealant Primers for Porous Substrates: 775 g/L

B. Primer: ASTM D41.

C. Asphalt: ASTM D312, Type III or IV for vapor retarders and insulation.

D. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphaltic, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.

E. Roof Cement: ASTM D2822, Type I or Type II, asbestos free; or, D4586, Type I or Type II.

2.3 ROOF AND DECK INSULATION

A. Roof and Deck Insulation, General: Preformed roof insulation boards approved by roofing manufacturer and listed as component of FM Approvals-approved roofing system.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

C. Composite Nail Base Insulated Roof Sheathing:

1. Oriented-Strand-Board-Surfaced, or Plywood, Polyisocyanurate-Foam Sheathing: polyisocyanurate thermal insulation ASTM C1289, Type V, insulation thickness as indicated, with oriented strand board laminated to top surface.

a. Ventilated roof insulation shall be a preassembled panel, with built-in ventilation space maintained by 1″ wood spacers blocks.

2. Oriented Strand Board: NBS DOC PS 1, Exposure 1, 15.9 mm (5/8 inch) thick.

3. Bottom surface faced with felt facers.

4. Performance Requirements:

a. Composite Nail Base Insulated Roof Sheathing overall thickness 3.5".

b. The Long Term Thermal Resistance (LTTR) R-Value of the ventilated roof insulation shall be no less than 12.0 for foam only.

c. Wood spacer blocks shall not exceed 8% of the panel area and shall leave 50% open for lateral (across the slope) ventilation. Spacer blocks shall not be over 12″ apart in either direction.

d. The vent space shall provide a minimum of 10 sq. in. of Net Free Area

per lineal foot of insulation along the 8’ edge after deducting for the spacer blocks.

e. The foam insulation shall have a Flame Spread Rating of 40-60.

f. Minimum thickness: 2 ½″ insulation.

g. Minimum R-Value Performance combined with composite board: 10.2 .

2.4 INSULATION ACCESSORIES

A. Glass (Felt): ASTM D2178, Type VI, heavy duty ply sheet.

B. Vapor Retarder:

1. Glass-Fiber Felts: ASTM D2178, Type IV, asphalt impregnated.

2. Self-Adhering Sheet Vapor Retarder: ASTM D1970, minimum of 1.0-mm- (40-mil-) thick, polyethylene film laminated to layer of rubberized asphalt adhesive, or 0.76- to 1.0-mm- (30- to 40-mil-) thick, polyethylene film laminated to layer of butyl rubber adhesive; maximum permeance rating of 6 ng/Pa x s x sq. m (0.1 perm).

C. Substrate Board:

1. Glass-mat, water-resistant gypsum substrate, ASTM C1177/C1177M, Type X, 16 mm (5/8 inch) thick, factory primed.

D. Cover Board:

1. Oriented Strand Board, DOC PS 2, Exposure 1, 11 mm (7/16 inch) thick.

2.5 FASTENERS

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with FM Approvals 4470, designed for fastening substrate board to roof deck.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Comply with requirements of Division 07 roofing section.

3.2 PREPARATION

A. Comply with requirements of Division 07 roofing section.

3.3 SUBSTRATE BOARD INSULATION

A.

B. Fasten substrate board to top flanges of steel deck to resist uplift pressures according to roofing system manufacturers instructions and requirements of FM Approvals listing for specified roofing system.

3.4 VAPOR RETARDER INSTALLATION

A. General:

1. Install continuous vapor retarder on roof decks where indicated.

2. At vertical surfaces, turn up vapor retarder to top of insulation or base flashing.

3. At all pipes, walls, and similar penetrations through vapor retarder, seal openings with roof cement to prevent moisture entry from below.
4. Seal penetrations with roof cement.

B. Steel Deck:

1. Material and method of application of roofing systems used on metal decks shall meet the requirements of FM Approvals for Class I-A Insulated Steel Roof Deck.
2. Attach substrate board and subsequent components to meet the requirements of FM Approval's "RoofNav" listing for specified system meeting Fire/Windstorm Classification indicated in Division 07 roofing section.
3. Locate the long dimension edge joints to have solid bearing on top of decking ribs; do not cantilever over rib openings or flutes.

3.5 RIGID INSULATION INSTALLATION

A. Insulation Installation, General:

1. Install roof insulation in accordance with roofing system manufacturer's written instructions.
2. Install roof insulation in accordance with requirements of FM Approval's Listing for specified roofing system.
3. Base Sheet: Where required by roofing system, install one lapped base sheet specified in Division 07 roofing section by mechanically fastening to roofing substrate prior to installation of insulation.

B. Insulation Thickness:

1. Thickness of roof insulation shown on drawings is nominal. Actual thickness shall provide the average thermal resistance "R" value of not less than that specified in Performance Requirements Article.
2. Insulation on Metal Decks: Provide minimum thickness of insulation for metal decks recommended by the insulation manufacturer to span rib opening (flute size) of metal deck used. Support edges of insulation on metal deck ribs.

C. Lay insulating units with close joints, in regular courses and with cross joints broken. When laid in more than one layer, break joints of succeeding layers of roof insulation with those in preceding layer.

D. Lay units with long dimension perpendicular to the rolled (longitudinal) direction of the roofing felt.

E. Seal all cut edges at penetrations and at edges against blocking with bitumen or roof cement.

F. Cut to fit tight against blocking or penetrations.

G. Cover all insulation installed on the same day; comply with temporary protection requirements of Division 07 roofing section.

H. Installation Method:

1. Mechanically Fastened Insulation:
   a. Fasten insulation in accordance with FM Approval's "RoofNav" requirement in Division 07 roofing section.

b. Fasten insulation to resist uplift pressures specified in Division 07 roofing section

2. Cover Board: Install cover boards over insulation with long joints in continuous straight lines with staggered end joints. Offset cover board joints from insulation joints minimum 150 mm (6 inches). Fasten cover boards according to "Mechanically Fastened Insulation" requirements.

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SECTION 07 31 13

ASPHALT SHINGLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies fiberglass asphalt shingles.

1.2 RELATED WORK

A. Color of shingles: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Counter flashing and flashing of roof projections: Section 07 60 00, FLASHING AND SHEET METAL.

C. Skylights, roof scuttles, ridge and roof vents, Section 07 71 00, ROOF SPECIALTIES.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:
   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s)..
   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.
2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.
3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Samples: Shingles, each type, color and texture.

D. Manufacturer's Literature and Data:

1. Shingles, each type

2. Installation instructions

1.4 DELIVERY AND STORAGE

A. Deliver materials in manufacturer's unopened bundles or containers with the manufacturer's brand and name clearly marked thereon.

B. Shingle bundle wrapping shall bear the label of Underwriters Laboratories, Inc.

C. Store shingles in accordance with manufacturer's printed instructions. Store roll goods on end in an upright position.

D. Keep materials dry, covered completely and protected from the weather.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below form a part o this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

1. D226-06 Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

2. D1970-08 Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

3. D2178-04 Asphalt Glass Felt used in Roofing and Waterproofing

4. D3018-03 Class A Asphalt Shingles Surfaced with Mineral Granules

5. D3462-07 Asphalt, Shingles Made from Glass Felt and Surfaced with Mineral Granules

6. F1667-05 Driven Fasteners: Nails, Spikes, and Staples

C. Underwriter’s Laboratories Inc. (UL):

1. UL790-04 Fire Tests of Roof Covering

1.6 QUALITY ASSURANCE REQUIREMENTS

D. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

PART 2 - PRODUCTS

2.6 SHINGLES

A. Basis-Of-Design Product: Subject to compliance with requirements provide Certainteed Corporation; Landmark Solaris Gold or a comparable product from one of the following:

1. ELK Premium Building Products, Inc.; an Elk Corp. Company.
2. GAF Materials Corporation.

B. Product: Asphalt Fiberglass Shingles

1. UL Certification of ASTM D3462; Conforms to ASTM D3018 Type I – Self-Sealing; and UL 790 Class A Fire Resistance; Solar Reflectance (SR)25 or greater comply with Energy Star® requirements; SRI of 29 qualify for a USGBC LEED®-NC urban heat island (roofs) point; glass fiber mat base, ceramically colored/UV resistant mineral surface granules across entire face of shingle; two-piece laminated shingle.
2. Weight: 250 pounds per square (100 square feet) (14.6 kg/sq m).
3. Dimensions (overall): 13 1/4" x 38 3/4".
4. Weather Exposure: 5 5/8".
5. Color: As selected by Architect from manufacturer’s standards.

2.7 ROOFING NAILS

A. ASTM F1667; Type I, Style 20, galvanized steel, deformed shanks, with heads 9.5 mm to 11 mm (3/8 inch to 7/16 inch) diameter.

B. Use nails 32 mm (1-1/4 inches) long for shingles and 19 mm (3/4-inch long) for felt.

2.8 ROOFING FELT

A. Eaves Protection: ASTM D 1970 sheet barrier of self-adhering rubberized asphalt membrane shingle underlayment having internal reinforcement, and "split" back plastic release film; provide material with warranty equal in duration to that of shingles being applied.

B. Underlayment: ASTM D 6757; asphalt impregnated fiberglass-reinforced organic felt designed for use on roof decks as a water-resistant layer beneath roofing shingles.

C. Waterproofing Underlayment: ASTM D 1970 sheet barrier of self-adhering rubberized asphalt membrane shingle underlayment having internal reinforcement, and “split” back plastic release film; Use in ‘low-slope’ areas (below 4:12, but no less than 2:12); provide material with warranty equal in duration to that of shingles being applied.

PART 3 - EXECUTION

3.6 PREPARATION

A. Roof surfaces shall be sound, reasonably smooth and free from defects which would interfere with roofing installation.

B. Roof accessories, vent pipes and other projections through the roof must be in place and roof flashing installed or ready for installation before laying shingles.

3.7 INSTALLATION – EAVE ICE DAM PROTECTION

A. Place eave edge and gable edge metal flashing tight with fascia boards. Weather-lap joints 2 inches (50 mm). Secure flange with nails spaced 8 inches (200 mm) on center.

B. Extend eave protection membrane minimum 24 inches (640 mm) up slope beyond interior face of exterior wall and over all exterior roof areas and overhangs.

3.8 INSTALLATION – PROTECTION UNDERLAYMENT

A. Roof Slope Between 2:12 and 4:12: Apply one layer of underlayment over all areas not protected at eaves, with ends and edges weather-lapped per application instructions. Stagger end-laps each consecutive layer. Nail in place.

B. Roof Slope Between 2:12 and 4:12: Apply two layers of asphalt impregnated fiberglass-reinforced organic felt or D4869 underlayment over areas not protected by eave ice dam protection at eaves with ends and edges weather-lapped minimum 19 inches (480 mm). Stagger end laps each consecutive layer. Nail in place.

C. Roof Slope 4:12 or Greater: Install one layer asphalt felt shingle underlayment perpendicular to slope of roof and lap minimum 4 inches (100 mm) over each eave protection.

D. Weather-lap and seal watertight with asphalt roofing cement items projecting through or mounted on roof. Avoid contact of solvent-based cements with protection underlayment.

3.9 LAYING

A. Lay felt under shingles over entire roof.

B. Install asphalt felt underlayment, lapping a minimum of 100 mm (4 inches) at ends, 50 mm (2 inches) at head and 300 mm (12 inches) over ridge. Extend felt 13 mm (1/2 inch) beyond edges of roof. Nail felt 125 mm (5 inches) on centers along laps.

C. At eaves, install strip of 41 Kg (90 pound) mineral surface roll roofing not less than 460 mm (18 inches) wide and starter course of roof shingles with tabs reversed. Both shall overhang lower edge of roof 13 mm (1/2 inch).

D. Lay shingles with maximum exposure of 125 mm (5 inches). Nail shingles in accordance with manufacturer's published directions.

3.10 METAL DRIP EDGES

A. At rakes, install metal drip edges made of painted aluminum specified under Section 0760 00, FLASHING AND SHEET METAL. Apply the metal drip edge directly over the underlayment along the rakes.

B. Secure metal drip edges with compatible nails spaced not more than 250 mm (10 inches) on center along the inner edges.

3.11 FLASHINGS

A. Provide metal flashings specified under Section 07 60 00, FLASHING AND SHEET METAL at the intersections of roofs, adjoining walls, or projections through the deck such as chimneys and vent stacks. Give careful attention to the installation of all flashings.

3.12 RIDGE

A. Bend each shingle lengthwise down center to provide equal exposure on each side of ridge. Beginning at one end of ridge, apply shingles with maximum

125 mm (5 inches) exposure.

B. Secure each shingle with one nail on each side, 210 mm (8 1/2 inches) back from exposed end and one inch up from edge.

3.13 VALLEY FLASHING

A. Install metal valley flashing shown and as specified under Section 07 60 00, FLASHING AND SHEET METAL.

B. Secure valley flashing in accordance with shingle manufacturer's printed instructions.

C. Expose flashing in open portion of valley a minimum of 125 mm (5 inches) and lap the shingles over the flashing a minimum of 125 mm (5 inches).

3.14 ROOF ACCESSORIES

A. Install ridge and roof vents, as specified under Section 07 71 00, ROOF ACCESSORIES prior to placing shingles.

B. Lap shingles over the accessories flashing a minimum of 125 mm (5 inches).

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SECTION 07 46 00

FIBER-CEMENT SIDING, TRIM AND SOFFIT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes:

1. Fiber-cement siding.
2. Fiber-cement soffit.
3. Fiber-cement door and window trim, fascia and battens.

1.2 RELATED SECTIONS

A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for additional LEED requirements.

B. Section 01 81 19, INDOOR AIR QUALITY REQUIREMENTS for VOC limit.
C. Section 04 43 13, MASONRY VENEER SYSTEM.
D. Section 07 60 00, FLASHING AND SHEET METAL.
E. Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

1. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

2. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

3. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the

MSDS to indicate the VOC content).

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Samples: For siding and soffit including related accessories.

D. Samples: For each type, color, texture, and pattern required.

1. 12-inch-(300-mm-)long-by-actual-width Sample of siding.

2. 12-inch-(300-mm-)long-by-actual-width Sample of soffit.

3. 12-inch-(300-mm-)long-by-actual-width Samples of trim and accessories.

E. Qualification Data: For qualified siding Installer.

F. Product Certificates: For each type of siding and soffit, from manufacturer.

G. Warranty: Sample of special warranty.

H. Maintenance Data: For each type of siding and soffit and related accessories to include in maintenance manuals.

I. LEED Submittals:

1. Credits MR 4.1 & 4.2: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content.
   a. Include statement indicating costs for each product containing recycled content.

2. Credits MR 5.1 & 5.2: For products manufactured within 500 miles of project site *and* whose raw materials are extracted, harvested or recovered, within 500 miles of the project site, documentation indicating the location and distance of material manufacturer and point of extraction, harvest, or recovery for each raw material from the Project site.
   a. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.4 QUALITY ASSURANCE

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Source Limitations: Obtain each type, color, texture, and pattern of

D. Siding and soffit, including related accessories, from single source from single manufacture Sustainability Requirements:
   1. Recycled Content: Siding products to contain a minimum of 30% fly ash, a post-industrial (pre-consumer) recycled material.
   2. Sustainably Harvested Wood: Sustainably managed forests ensure that wood is grown, harvested, and processed in accordance with the principles of sustainability.
   3. Raw materials used to manufacture Fiber Cement siding products are to be sourced from within 500 miles of our plants to reduce transportation impacts.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a dry, well-ventilated, weathertight place.

1.6 COORDINATION

A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.7 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace siding and soffit that fail(s) in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including cracking, deforming, and fading.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Fading is defined as loss of color, after cleaning with product recommended by manufacturer.
   3. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie; HardiePlank, Smooth Lap Siding; ColorPlus - HZ5 or comparable product by one of the following:
   1. Cemplank.
   2. GAF Materials Corporation.
   3. CertainTeed
   4. Nichiha Fiber Cement.

2.2 FIBER-CEMENT SIDING AND SOFFIT

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
B. Horizontal Lap Siding:
   1. Size: 7-1/2 inches high by 12 feet long by 5/16 inch thick.
   2. Style: Smooth Lap Siding. 3. Factory Priming: Manufacturer's standard acrylic primer.
   4. Factory Finish: Factory applied ColorPlus Technology

a. Color: As selected by Architect from Manufacturer's standard colors.

E. Soffit: Combination of ventilated and non-vented. 1. Size: 12 inches wide by 12 feet long by 1/4 inch thick.
2. Style: Vented Smooth and Non-Vented Smooth.
3. Factory Priming: Manufacturer's standard acrylic primer.
4. Factory Finish: Factory applied ColorPlus Technology
a. Color: As selected by Architect from Manufacturer's standard colors.

2.3 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories made from same material as and matching color and texture of adjacent siding unless otherwise indicated.
2. Trim/Fascia: 3-1/2 to 11-1/4 inches wide by 12 feet long by 7/16 inch thick.
3. Trim: 4/4, 1-3/4 to 11-1/4 inches wide by 12 feet long by 3/4 inch thick.

B. Flashing: Provide flashing complying with Section 07 60 00, FLASHING AND SHEET METAL at window and door heads and where indicated.

C. Sealant: Paintable, 100 percent acrylic latex caulk complying with ASTM C 920.

D. Fasteners:

1. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.
2. For fastening fiber cement, use hot-dip galvanized fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding and soffit and related accessories.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.
B. Do not begin installation until unacceptable conditions have been corrected.

3.3 INSTALLATION

A. General: Comply with siding and soffit manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Do not install damaged components.
2. Center nails in elongated nailing slots without binding siding to allow

for thermal movement.

B. Install fiber-cement siding and soffit and related accessories.
   1. Install fasteners no more than 24 inches (600 mm) o.c.

C. Install joint sealants as specified in Section 07 92 00, JOINT SEALANTS and to produce a weathertight installation.

D. Joints in Horizontal Siding: Avoid joints in lap siding except at corners; where joints are inevitable stagger joints between successive courses.

E. Do not install siding less than 6 inches (150 mm) from surface of ground nor closer than 1 inch (25 mm) to roofs, patios, porches, and other surfaces where water may collect.

F. After installation, seal all joints except lap joints of lap siding. Seal around all penetrations. Paint all exposed cut edges.

3.4 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

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SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Formed sheet metal work for wall and roof flashing, copings, roof edge metal, fasciae, drainage specialties, and formed expansion joint covers are specified in this section.

1.2 RELATED WORK

A. Membrane base flashings and stripping: .

B. Flashing components of factory finished roofing and wall systems: Division 07 roofing and wall system sections.

C. Joint Sealant: Section 07 92 00, JOINT SEALANTS.

D. Color of factory coated exterior architectural metal and anodized aluminum items: Section 09 06 00, SCHEDULE FOR FINISHES.

E. Integral flashing component of manufactured roof specialties and accessories or equipment: Section 07 71 00, ROOF SPECIALTIES, Division 22, PLUMBING sections and Division 23 HVAC sections.

F. Paint materials and application: Section 09 91 00, PAINTING.

G. Flashing of Roof Drains: Section 22 14 00, FACILITY STORM DRAINAGE.

1.3 APPLICABLE PUBLICATIONS

A. Publications listed below for a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.

B. Aluminum Association (AA):

1. AA-C22A41 Aluminum Chemically etched medium matte, with clear anodic coating, Class I Architectural, 0.7-mil thick.

2. AA-C22A42 Chemically etched medium matte, with integrally colored anodic coating, Class I Architectural, 0.7 mils thick.

3. AA-C22A44 Chemically etched medium matte with electrolytically deposited metallic compound, integrally colored coating Class I Architectural, 0.7-mil thick finish.

C. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):

1. ANSI/SPRI ES-1-03 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

D. American Architectural Manufacturers Association (AAMA):

1. AAMA 620 Voluntary Specification for High Performance Organic Coatings

on Coil Coated Architectural Aluminum.

2. AAMA 621 Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.

E. ASTM International (ASTM):

1. A167-99(R 2009) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
2. A653/A653M-09 Steel Sheet Zinc-Coated (Galvanized) or Zinc Alloy Coated (Galvanized) by the Hot- Dip Process
3. B32-04 Solder Metal
4. B209-07 Aluminum and Aluminum-Alloy Sheet and Plate
5. B370-03 Copper Sheet and Strip for Building Construction
6. D173-03 Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing
7. D412-06 Vulcanized Rubber and Thermoplastic Elastomers-Tension
8. D1187-97 (R2002) Asphalt Base Emulsions for Use as Protective Coatings for Metal
9. D1784-08 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
10. D3656-07 Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
11. D4586-07 Asphalt Roof Cement, Asbestos Free

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual.

G. National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 500-06 Metal Finishes Manual

H. Federal Specification (Fed. Spec):

1. A-A-1925A Shield, Expansion; (Nail Anchors)
2. UU-B-790A Building Paper, Vegetable Fiber

I. International Code Commission (ICC): International Building Code, Current Edition

1.4 PERFORMANCE REQUIREMENTS

A. Wind Uplift Forces: Resist the following forces per FM Approvals 1-49:

1. Wind Zone 3: 2.20 to 4.98 kPa (46 to 104 lbf/sq. ft.): 9.96-kPa (208-lbf/sq. ft.) perimeter uplift force, 14.94-kPa (312-lbf/sq. ft.) corner uplift force, and 4.98-kPa (104-lbf/sq. ft.) outward force.

B. Wind Design Standard: Fabricate and install roof-edge flashings tested per ANSI/SPRI ES-1 to resist design pressure indicated on Drawings.

1.5 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Shop Drawings: For all specified items, including:

1. Flashings

2. Gutter and Conductors

D. Manufacturer's Literature and Data: For all specified items, including:

1. Two-piece counterflashing

2. Thru wall flashing

3. Nonreinforced, elastomeric sheeting

E. Certificates: Indicating compliance with specified finishing requirements, from applicator and contractor.

1.6 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic

Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

PART 2 - PRODUCTS

2.1 FLASHING AND SHEET METAL MATERIALS

A. Stainless Steel: ASTM A167, Type 302B, dead soft temper.

B. Aluminum Sheet: ASTM B209, alloy 3003-H14. Except alloy used for color anodized aluminum shall be as required to produce specified color. Alloy required to produce specified color shall have the same structural properties as alloy 3003-H14.

C. Nonreinforced, Elastomeric Sheeting: Elastomeric substances reduced to thermoplastic state and extruded into continuous homogenous sheet (0.056 inch) thick. Sheeting shall have not less than 7 MPa (1,000 psi) tensile strength and not more than 7 percent tension-set at 50 percent elongation when tested in accordance with ASTM D412. Sheeting shall show no cracking or flaking when bent through 180 degrees over a 1 mm (1/32 inch) diameter mandrel and then bent at same point over same size mandrel in opposite direction through 360 degrees at temperature of -30° C (-20° F).

2.2 FLASHING ACCESSORIES

A. Solder: ASTM B32; flux type and alloy composition as required for use with metals to be soldered.

B. Rosin Paper: Fed-Spec. UU-B-790, Type I, Grade D, Style 1b, Rosin-sized sheathing paper, weighing approximately 3 Kg/10 m^2(6 lbs/100 sf).

C. Bituminous Paint: ASTM D1187, Type I.

D. Fasteners:

1. Use copper, copper alloy, bronze, brass, or stainless steel for copper and copper clad stainless steel, and stainless steel for stainless steel and aluminum alloy. Use galvanized steel or stainless steel for galvanized steel.

2. Nails:

a. Minimum diameter for aluminum nails 3 mm (0.105 inch).

b. Minimum diameter for stainless steel nails: 2 mm (0.095 inch) and annular threaded.

c. Length to provide not less than 22 mm (7/8 inch) penetration into anchorage.

3. Rivets: Not less than 3 mm (1/8 inch) diameter.

4. Expansion Shields: Fed Spec A-A-1925A.

E. Sealant: As specified in Section 07 92 00, JOINT SEALANTS for exterior locations.

F. Insect Screening: ASTM D3656, 18 by 18 regular mesh.

G. Roof Cement: ASTM D4586.

2.3 SHEET METAL THICKNESS

A. Except as otherwise shown or specified use thickness or weight of sheet metal as follows:

B. Concealed Locations (Built into Construction):

1. Stainless steel: 0.25 mm (0.010 inch) thick.

C. Exposed Locations:

1. Stainless steel: 0.4 mm (0.015 inch).

D. Thickness of aluminum or galvanized steel is specified with each item.

2.4 FABRICATION, GENERAL

A. Jointing:

1. In general, copper, stainless steel and copper clad stainless steel joints, except expansion and contraction joints, shall be locked and soldered.

2. Jointing of copper over 0.5 Kg (20 oz) weight or stainless steel over 0.45 mm (0.018 inch) thick shall be done by lapping, riveting and soldering.

3. Joints shall conform to following requirements:

a. Flat-lock joints shall finish not less than 19 mm (3/4 inch) wide.

b. Lap joints subject to stress shall finish not less than 25 mm (1 inch) wide and shall be soldered and riveted.

c. Unsoldered lap joints shall finish not less than 100 mm (4 inches) wide.

4. Flat and lap joints shall be made in direction of flow.

5. Edges of nonreinforced elastomeric sheeting and polyethylene coated copper shall be jointed by lapping not less than 100 mm (4 inches) in the direction of flow and cementing with asphalt roof cement or sealant as required by the manufacturer's printed instructions.

6. Soldering:

a. Pre tin both mating surfaces with solder for a width not less than 38 mm (1-1/2 inches) of uncoated copper, stainless steel, and copper clad stainless steel.

b. Wire brush to produce a bright surface before soldering lead coated copper.

c. Treat in accordance with metal producers recommendations other sheet metal required to be soldered.

d. Completely remove acid and flux after soldering is completed.

B. Expansion and Contraction Joints:

1. Fabricate in accordance with the Architectural Sheet Metal Manual recommendations for expansion and contraction of sheet metal work in continuous runs.

2. Space joints as shown or as specified.

3. Space expansion and contraction joints for copper, stainless steel, and copper clad stainless steel at intervals not exceeding 7200 mm (24 feet).
4. Space expansion and contraction joints for aluminum at intervals not exceeding 5400 mm (18 feet), except do not exceed 3000 mm (10 feet) for gravel stops and fascia-cant systems.
5. Fabricate slip-type or loose locked joints and fill with sealant unless otherwise specified.
6. Fabricate joint covers of same thickness material as sheet metal served.

C. Cleats:

1. Fabricate cleats to secure flashings and sheet metal work over 300 mm (12 inches) wide and where specified.
2. Provide cleats for maximum spacing of 300 mm (12 inch) centers unless specified otherwise.
3. Form cleats of same metal and weights or thickness as the sheet metal being installed unless specified otherwise.
4. Fabricate cleats from 50 mm (2 inch) wide strip. Form end with not less than 19 mm (3/4 inch) wide loose lock to item for anchorage. Form other end of length to receive nails free of item to be anchored and end edge to be folded over and cover nail heads.

D. Edge Strips or Continuous Cleats:

1. Fabricate continuous edge strips where shown and specified to secure loose edges of the sheet metal work.
2. Except as otherwise specified, fabricate edge strips or minimum 0.6 mm (0.024 inch) thick stainless steel. 1.25 mm (0.050 inch) thick aluminum.
3. Use material compatible with sheet metal to be secured by the edge strip.
4. Fabricate in 3000 mm (10 feet) maximum lengths with not less than 19 mm (3/4 inch) loose lock into metal secured by edge strip.
5. Fabricate Strips for fascia anchorage to extend below the supporting wood construction to form a drip and to allow the flashing to be hooked over the lower edge at least 19 mm (3/4 inch).
6. Fabricate anchor edge maximum width of 75 mm (3 inches) or of sufficient width to provide adequate bearing area to insure a rigid installation using 1 Kg (32 oz) copper 0.8 mm (0.031 inch) thick stainless steel.

E. Drips:

1. Form drips at lower edge of sheet metal counter-flashings (cap flashings), fascias, gravel stops, wall copings, by folding edge back 13 mm (1/2 inch) and bending out 45 degrees from vertical to carry water away from the wall.
2. Form drip to provide hook to engage cleat or edge strip for fastening for not less than 19 mm (3/4 inch) loose lock where shown.

F. Edges:

1. Edges of flashings concealed in masonry joints opposite drain side shall be turned up 6 mm (1/4 inch) to form dam, unless otherwise specified or shown otherwise.

2. Finish exposed edges of flashing with a 6 mm (1/4 inch) hem formed by folding edge of flashing back on itself when not hooked to edge strip or cleat. Use 6 mm (1/4 inch) minimum penetration beyond wall face with drip for through-wall flashing exposed edge.
3. All metal roof edges shall meet requirements of IBC, current edition.

G. Metal Options:

1. Where options are permitted for different metals use only one metal throughout.
2. Stainless steel may be used in concealed locations for fasteners of other metals exposed to view.

2.5 FINISH

A. Use same finish on adjacent metal or components and exposed metal surfaces unless specified or shown otherwise.

B. In accordance with NAAMM Metal Finishes Manual, unless otherwise specified.

C. Finish exposed metal surfaces as follows, unless specified otherwise:

1. Stainless Steel: Finish No. 2B or 2D.
2. Aluminum:
   a. Fluorocarbon Finish: AAMA 605, high performance organic coating.
3. Steel and Galvanized Steel:
   a. Manufacturer's finish:
      1) Fluorocarbon Finish: AAMA 605, high performance organic coating.

2.6 THROUGH-WALL FLASHINGS

A. Form through-wall flashing to provide a mechanical bond or key against lateral movement in all directions. Install a sheet having 2 mm (1/16 inch) deep transverse channels spaced four to every 25 mm (1 inch), or ribbed diagonal pattern, or having other deformation unless specified otherwise.

1. Fabricate in not less than 2400 mm (8 feet) lengths; 3000 mm (10 feet) maximum lengths.
2. Fabricate so keying nests at overlaps.

B. For Masonry Work When Concealed Except for Drip:

1. Either copper, stainless steel, or copper clad stainless steel.
2. Form an integral dam at least 5 mm (3/16 inch) high at back edge.
3. Form exposed portions of flashing with drip, approximately 6 mm (1/4 inch) projection beyond wall face.

C. For Masonry Work When Exposed Edge Forms a Receiver for Counter Flashing:

1. Use same metal and thickness as counter flashing.
2. Form an integral dam at least 5 mm (3/16 inch) high at back edge.
3. Form exposed portion as snap lock receiver for counter flashing upper edge.

D. Window Sill Flashing and Lintel Flashing:

1. Use either copper, stainless steel, copper clad stainless steel plane flat sheet, or nonreinforced elastomeric sheeting, bituminous coated copper, copper covered paper, or polyethylene coated copper.
2. Fabricate flashing at ends with folded corners to turn up 5 mm (3/16 inch) in first vertical masonry joint beyond masonry opening.
3. Turn up back edge as shown.
4. Form exposed portion with drip as specified or receiver.

E. Door Sill Flashing:

1. Where concealed, use either 0.5 Kg (20 oz) copper, 0.5 mm (0.018 inch) thick stainless steel, 0.5 mm (0.018 inch) thick copper clad stainless steel.
2. Where shown on drawings as combined counter flashing under threshold, sill plate, door sill, or where subject to foot traffic, use either 0.6 Kg (24 ounce) copper, 0.6 mm (0.024 inch) stainless steel, or 0.6 mm (0.024 inch) thick stainless steel.
3. Fabricate flashing at ends to turn up 5 mm (3/16 inch) in first vertical masonry joint beyond masonry opening with folded corners.

2.7 BASE FLASHING

A. Use metal base flashing at vertical surfaces intersecting built-up roofing without cant strips or where shown.

1. Use either copper, or stainless steel, thickness specified unless specified otherwise.
2. When flashing is over 250 mm (10 inches) in vertical height or horizontal width use either Kg (20 oz) copper or 0.5 mm (0.018 inch) stainless steel.
3. Use either copper, or stainless steel at pipe flashings.

B. Fabricate metal base flashing up vertical surfaces not less than 200 mm (8 inch) nor more than 400 mm (16 inch).

C. Fabricate roof flange not less than 100 mm (4 inches) wide unless shown otherwise. When base flashing length exceeds 2400 mm (8 feet) form flange edge with 13 mm (1/2 inch) hem to receive cleats.

D. Form base flashing bent from strip except pipe flashing. Fabricate ends for riveted soldered lap seam joints. Fabricate expansion joint ends as specified.

E. Pipe Flashing: (Other than engine exhaust or flue stack)

1. Fabricate roof flange not less than 100 mm (4 inches) beyond sleeve on all sides.
2. Extend sleeve up and around pipe and flange out at bottom not less than 13 mm (1/2 inch) and solder to flange and sleeve seam to make watertight.
3. At low pipes 200 mm (8 inch) to 450 mm (18 inch) above roof:

   a. Form top of sleeve to turn down into the pipe at least 25 mm (1 inch).

   b. Allow for loose fit around and into the pipe.

4. At high pipes and pipes with goosenecks or other obstructions which would prevent turning the flashing down into the pipe:

a. Extend sleeve up not less than 300 mm (12 inch) above roofing.

b. Allow for loose fit around pipe.

2.8 HANGING GUTTERS

A. Fabricate gutters of not less than 0.03225 mm (0.051 inch) thick Prefinished Aluminum.

1. Gutter Profile: Half round according to SMACNA's "Architectural Sheet Metal Manual."

B. Fabricate hanging gutters in sections not less than 2400 mm (8 feet) long, except at ends of runs where shorter lengths are required.

C. Building side of gutter shall be not less than 38 mm (1-1/2 inches) higher than exterior side.

D. Gutter Bead: Stiffen outer edge of gutter by folding edge over approximately 19 mm (3/4 inch) toward roof and down approximately19 mm (3/4 inch) unless shown otherwise.

E. Gutter Spacers:

1. Fabricate of same material and thickness as gutter.

2. Fabricate 25 mm (1 inch) wide strap and fasten to gutters not over 900 mm (36 inches) on center.

3. Turn back edge up 25 mm (1 inch) and lap front edge over gutter bead.

4. Rivet and solder to gutter except rivet and seal to aluminum.

F. Outlet Tubes:

1. Form outlet tubes to connect gutters to conductors of same metal and thickness as gutters extend into the conductor 75 mm (3 inch). Flange upper end of outlet tube 13 mm (1/2 inch).

2. Lock and solder longitudinal seam except use sealant in lieu of solder with aluminum.

3. Solder tube to gutter.Seal aluminum tube to gutter and rivet to gutter.

G. Gutter Brackets:

1. Fabricate of same metal as gutter. Use [[**5 mm x 25 mm][(3/16 by 1 inch)][(1/4 by 1 inch) aluminum**].

2. Fabricate to gutter profile.

3. Drill two 5 mm (3/16 inch) diameter holes in anchor leg for countersunk flat head screws.

2.9 CONDUCTORS (DOWNSPOUTS)

A. Fabricate conductors of same metal and thickness as gutters in sections approximately 3000 mm (10 feet) long with 19 mm (3/4 inch) wide flat locked seams.

1. Fabricate open face channel shape with hemmed longitudinal edges.

B. Fabricate elbows by mitering, riveting, and soldering except seal aluminum in lieu of solder. Lap upper section to the inside of the lower piece.

C. Fabricate conductor brackets or hangers of same material as conductor, 2

mm (1/16 inch) thick by 25 mm (1 inch) minimum width. Form to support conductors 25 mm (1 inch) from wall surface in accordance with Architectural Sheet Metal Manual Plate 34, Design C for rectangular shapes and E for round shapes.

D. Conductor Heads:

1. Fabricate of same material as conductor.
2. Fabricate conductor heads to not less than 250 mm (10 inch) wide by 200 mm (8 inch) deep by 200 mm (8 inches) from front to back.
3. Form front and side edges channel shape not less than 13 mm (1/2 inch) wide flanges with edge hemmed.
4. Slope bottom to sleeve to conductor or downspout at not less than 60 degree angle.
5. Extend wall edge not less than 25 mm (1 inch) above front edge.
6. Solder joints for water tight assembly.
7. Fabricate outlet tube or sleeve at bottom not less than 50 mm (2 inches) long to insert into conductor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install flashing and sheet metal items as shown in Sheet Metal and Air Conditioning Contractors National Association, Inc., publication, ARCHITECTURAL SHEET METAL MANUAL, except as otherwise shown or specified.
2. Apply Sealant as specified in Section 07 92 00, JOINT SEALANTS.
3. Apply sheet metal and other flashing material to surfaces which are smooth, sound, clean, dry and free from defects that might affect the application.
4. Remove projections which would puncture the materials and fill holes and depressions with material compatible with the substrate. Cover holes or cracks in wood wider than 6 mm (1/4 inch) with sheet metal compatible with the roofing and flashing material used.
5. Coordinate with masonry work for the application of a skim coat of mortar to surfaces of unit masonry to receive flashing material before the application of flashing.
6. Apply a layer of 7 Kg (15 pound) saturated felt followed by a layer of rosin paper to wood surfaces to be covered with copper. Lap each ply 50 mm (2 inch) with the slope and nail with large headed copper nails.
7. Confine direct nailing of sheet metal to strips 300 mm (12 inch) or less wide. Nail flashing along one edge only. Space nail not over 100 mm (4 inches) on center unless specified otherwise.
8. Install bolts, rivets, and screws where indicated, specified, or required in accordance with the SMACNA Sheet Metal Manual. Space rivets at 75 mm (3 inch) on centers in two rows in a staggered position. Use neoprene washers under fastener heads when fastener head is exposed.

9. Coordinate with roofing work for the installation of metal base flashings and other metal items having roof flanges for anchorage and watertight installation.

10. Nail continuous cleats on 75 mm (3 inch) on centers in two rows in a staggered position.

11. Nail individual cleats with two nails and bend end tab over nail heads. Lock other end of cleat into hemmed edge.

12. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a water tight installation.

13. Where required to prevent galvanic action between dissimilar metal isolate the contact areas of dissimilar metal with sheet lead, waterproof building paper, or a coat of bituminous paint.

14. Isolate aluminum in contact with dissimilar metals others than stainless steel, white bronze or other metal compatible with aluminum by:

    a. Paint dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.

    b. Paint dissimilar metal with a coat of bituminous paint.

    c. Apply an approved caulking material between aluminum and dissimilar metal.

15. Paint aluminum in contact with or built into mortar, concrete, plaster, or other masonry materials with a coat of bituminous paint.

3.2 THROUGH-WALL FLASHING

A. General:

1. Install continuous through-wall flashing between top of concrete foundation walls and bottom of masonry building walls; at top of concrete floors; under masonry, concrete, or stone copings and elsewhere as shown.

2. Where exposed portions are used as a counterflashings, lap base flashings at least 100 mm (4 inches)and use thickness of metal as specified for exposed locations.

3. Exposed edge of flashing may be formed as a receiver for two piece counter flashing as specified.

4. Terminate exterior edge beyond face of wall approximately 6 mm (1/4 inch) with drip edge where not part of counter flashing.

5. Turn back edge up 6 mm (1/4 inch) unless noted otherwise where flashing terminates in mortar joint or hollow masonry unit joint.

6. Terminate interior raised edge in masonry backup unit approximately 38 mm (1-1/2 inch) into unit unless shown otherwise.

7. Under copings terminate both edges beyond face of wall approximately 6 mm (1/4 inch) with drip edge.

8. Lap end joints at least two corrugations, but not less than 100 mm (4 inches). Seal laps with sealant.

9. Where dowels, reinforcing bars and fastening devices penetrate flashing,

seal penetration with sealing compound. Sealing compound is specified in Section 07 92 00, JOINT SEALANTS.

10. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.

11. Where ends of flashing terminate turn ends up 25 mm (1 inch) and fold corners to form dam extending to wall face in vertical mortar or veneer joint.

12. Turn flashing up not less than 200 mm (8 inch) between masonry or behind exterior veneer.

13. When flashing terminates in reglet extend flashing full depth into reglet and secure with lead or plastic wedges spaced 150 mm (6 inch) on center.

14. Continue flashing around columns:

    a. Where flashing cannot be inserted in column reglet hold flashing vertical leg against column.

    b. Counterflash top edge with 75 mm (3 inch) wide strip of saturated cotton unless shown otherwise. Secure cotton strip with roof cement to column. Lap base flashing with cotton strip 38 mm (1 1/2 inch).

B. Flashing at Top of Concrete Foundation Walls Where concrete is exposed. Turn up not less than 200 mm (8 inch) high and into masonry backup mortar joint or reglet in concrete backup as specified.

C. Flashing at Top of Concrete Floors (except where shelf angles occur): Place flashing in horizontal masonry joint not less than 200 mm (8 inch) below floor slab and extend into backup masonry joint at floor slab 38 mm (1-1/2 inch).

D. Flashing at Veneer Walls:

1. Install near line of finish floors over shelf angles or where shown.

2. Turn up against sheathing.

3. At stud framing, hem top edge 19 mm (3/4 inch) and secure to each stud with stainless steel fasteners through sheathing.

4. At concrete backing, extend flashing into reglet as specified.

5. Coordinate with installation of waterproofing or asphalt felt for lap over top of flashing.

E. Lintel Flashing when not part of shelf angle flashing:

1. Install flashing full length of lintel to nearest vertical joint in masonry over veneer.

2. Turn ends up 25 mm (1 inch) and fold corners to form dam and extend end to face of wall.

3. Turn back edge up to top of lintel; terminate back edge as specified for back-up wall.

F. Window Sill Flashing:

1. Install flashing to extend not less than 100 mm (4 inch) beyond ends of sill into vertical joint of masonry or veneer.

2. Turn back edge up to terminate under window frame.
3. Turn ends up 25 mm (1 inch) and fold corners to form dam and extend to face of wall.

G. Door Sill Flashing:

1. Install flashing under bottom of plate sills of doors over curbs opening onto roofs. Extend flashing out to form counter flashing or receiver for counter flashing over base flashing. Set in sealant.
2. Extend sill flashing 200 mm (8 inch) beyond jamb opening. Turn ends up one inch in vertical masonry joint, extend end to face of wall. Join to counter flashing for water tight joint.
3. Where doors thresholds cover over waterproof membranes install sill flashing over waterproof membrane under thresholds. Extend beyond opening to cover exposed portion of waterproof membrane and not less than 150 mm (6 inch) beyond door jamb opening at ends. Turn up approximately 6 mm (1/4 inch) under threshold.

H. Flashing at Masonry, Stone, or Precast Concrete Copings:

1. Install flashing with drips on both wall faces unless shown otherwise.
2. Form penetration openings to fit tight against dowel or other item with edge turned up. Seal penetrations with sealant.

3.3 BASE FLASHING

A. Install where roof membrane type base flashing is not used and where shown.

1. Install flashing at intersections of roofs with vertical surfaces or at penetrations through roofs, to provide watertight construction.
2. Install metal flashings and accessories having flanges extending out on top of the built-up roofing before final bituminous coat and roof aggregate is applied.
3. Set flanges in heavy trowel coat of roof cement and nail through flanges into wood nailers over bituminous roofing.
4. Secure flange by nailing through roofing into wood blocking with nails spaced 75 mm (3 inch) on centers or, when flange over 100 mm (4 inch) wide terminate in a 13 mm (1/2 inch) folded edge anchored with cleats spaced 200 mm (8 inch) on center. Secure one end of cleat over nail heads. Lock other end into the seam.

B. For long runs of base flashings install in lengths of not less than 2400 mm (8 feet) nor more than 3000 mm (10 feet). Install a 75 mm (3 inch) wide slip type, loose lock expansion joint filled with sealant in joints of base flashing sections over 2400 mm (8 feet) in length. Lock and solder corner joints at corners.

C. Extend base flashing up under counter flashing of roof specialties and accessories or equipment not less than 75 mm (3 inch).

3.4 ENGINE EXHAUST PIPE OR STACK FLASHING

A. Set collar where shown and secure roof tabs or flange of collar to structural deck with 13 mm (1/2 inch) diameter bolts.

B. Set flange of sleeve base flashing not less than 100 mm (4 inch) beyond collar

on all sides as specified for base flashing.

C. Install hood to above the top of the sleeve 50 mm (2 inch) and to extend from sleeve same distance as space between collar and sleeve beyond edge not sleeve:

1. Install insect screen to fit between bottom edge of hood and side of sleeve.

2. Set collar of hood in high temperature sealant and secure with one by 3 mm (1/8 inch) bolt on stainless steel draw band type, or stainless steel worm gear type clamp. Install sealant at top of head.

3.5 HANGING GUTTERS

A. Hang gutters with high points equidistant from downspouts. Slope at not less than 1:200 (1/16 inch per foot).

B. Lap joints, except for expansion joints, at least 25 mm (1 inch) in the direction of flow. Rivet and seal or solder lapped joints.

C. Support gutters in brackets spaced not more than 600 mm (24 inch) on centers, brackets attached to facial or wood nailer by at least two screws or nails.

1. For copper or copper clad stainless steel gutters use brass or bronze brackets.

2. For stainless steel gutters use stainless steel brackets.

3. For aluminum gutters use aluminum brackets or stainless steel brackets.

4. Use brass or stainless steel screws.

D. Secure brackets to gutters in such a manner as to allow free movement of gutter due to expansion and contraction.

E. Gutter Expansion Joint:

1. Locate expansion joints midway between outlet tubes.

2. Provide at least a 25 mm (1 inch) expansion joint space between end baffles of gutters.

3. Install a cover plate over the space at expansion joint.

4. Fasten cover plates to gutter section on one side of expansion joint only.

5. Secure loose end of cover plate to gutter section on other side of expansion joint by a loose-locked slip joint.

F. Outlet Tubes: Set bracket strainers loosely into gutter outlet tubes.

3.6 CONDUCTORS (DOWNSPOUTS)

A. Where scuppers discharge into downspouts install conductor head to receive discharge with back edge up behind drip edge of scupper. Fasten and seal joint. Sleeve conductors to gutter outlet tubes and fasten joint and joints between sections.

B. Set conductors plumb and clear of wall, and anchor to wall with two anchor straps, located near top and bottom of each section of conductor. Strap at top shall be fixed to downspout, intermediate straps and strap at bottom shall be slotted to allow not less than 13 mm (1/2 inch) movement for each 3000 mm (10 feet) of downspout.

C. Install elbows, offsets and shoes where shown and required. Slope not less than 45 degrees.

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SECTION 07 71 00

ROOF SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies gravity ventilators.

1.2 RELATED WORK

A. Color and texture of finish: Section 09 06 00, SCHEDULE FOR FINISHES. Sealant material and installation: Section 07 92 00, JOINT SEALANTS.

B. General insulation: Section 07 21 13, THERMAL INSULATION. Rigid insulations for roofing: Section 07 22 00, ROOF AND DECK INSULATION

1.3 QUALITY CONTROL

A. All roof accessories shall be the products of manufacturers regularly engaged in producing the kinds of products specified.

B. Each accessory type shall be the same and be made by the same manufacturer.

C. Each accessory shall be completely assembled to the greatest extent possible before delivery to the site.

1.4 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the

MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Samples: Representative sample panel of color anodized aluminum not less than 100 mm X 100 mm (four by four inches), except extrusions shall be a width not less than section to be used. Sample shall show coating with integral color and texture and shall include manufacturer's identifying label.

D. Shop Drawings: Each item specified showing design, details of construction, installation and fastenings.

E. Manufacturer's Literature and Data: Each item specified.

F. Certificates: Stating that aluminum has been given specified thickness of anodizing.

1.5 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):

1. RR-G-1602D Grating, Metal, Other Than Bar Type (Floor, Except for Naval Vessels)

C. American Society for Testing and Material (ASTM):

1. A653/A653M-10	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) By the Hot-Dip Process
2. B209/209M-07	Aluminum and Aluminum Alloy-Sheet and Plate
3. B221/221M-08	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
4. C612-10	Mineral Fiber Block and Board Thermal Insulation
5. D1187-97 (R2002)	Asphalt-Base Emulsions for Use as Protective Coatings for Metal

D. National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 500 Series Metal Finishes Manual

E. American Architectural Manufacturers Association (AAMA):

1. 2605-11 High Performance Organic Coatings on Architectural Extrusions and Panels.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum, Extruded: ASTM B221/B221M.

B. Galvanized Sheet Steel: ASTM A526/A526M; G-90 coating.

2.2 LOW SILHOUETTE GRAVITY VENTILATORS

A. Fabricate base of 1 mm (0.04 inch) thick aluminum, and vent of 0.8 mm (0.032 inch) thick aluminum. Height not to exceed 300 mm (12 inches) above top of roof curb. Design ventilators to withstand 137 Km (85 miles) per hour wind velocity. Provide ventilators with a removable 18 by 18 mesh aluminum wire cloth insect screen.

B. Construct damper of the same material as the ventilator and design to completely close opening or remain wide open. Hold damper in closed position by a brass chain and catch. Extend chains 300 mm (12 inches) below and engage catch when damper is closed.

2.3 FINISH

A. In accordance with NAAMM Amp 500 Series.

B. Fluorocarbon Finish: AAMA 2605.2 high performance organic coating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof specialties where shown.

B. Secure with fasteners in accordance with manufacture's printed installation instructions and approved shop drawings unless shown otherwise.

C. Coordinate to install insulation where shown; see Section 07 21 13, THERMAL INSULATION and Section 07 22 00, ROOF AND DECK INSULATION.

D. Comply with section 07 92 00, JOINT SEALANTS to install sealants where manufactures installation instructions require sealant.

E. Coordinate with roofing work for installation of items in sequence to prevent water infiltration.

1. After completion of base flashing bend down cap flashing flange and secure to blocking with screws.

2. Install cover plates with formed aluminum flashing concealed and centered on joint. Flashing to lap cover not less than 100 mm (4 inches).

3.2 PROTECTION OF ALUMINUM

A. Provide protection for aluminum against galvanic action wherever dissimilar materials are in contact, by painting the contact surfaces of the dissimilar

material with two coats of asphalt coating (complete coverage), or by separating the contact surfaces with a preformed neoprene tape having pressure sensitive adhesive coating on side.

B. Paint aluminum in contact with wood, concrete and masonry, or other absorptive materials, that may become repeatedly wet, with two coats of asphalt coating.

3.3 PROTECTION

A. Protect roof accessories from damage during installation and after completion of the work from subsequent construction.

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SECTION 07 81 00

APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies mineral fiber and cementitious coverings to provide fire resistance to interior structural steel members shown.

1.2 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Certification Form, per Section 013323 – Submittals under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED BUILDING Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's Literature and Data:

1. Manufacturer's complete and detailed application instructions and specifications.

2. Manufacturer's repair and patching instructions.

D. Certificates:

1. Certificate from testing laboratory attesting fireproofing material and application method meet the specified fire ratings.

   a. List thickness and density of material required to meet fire ratings.

b. Accompanied by complete test report and test record.

2. Manufacturer's certificate indicating sprayed-on fireproofing material supplied under the Contract is same within manufacturing tolerance as fireproofing material tested.

E. Miscellaneous:

1. Manufacturer's written approval of surfaces to receive sprayed-on fireproofing.

2. Manufacturer's written approval of completed installation.

3. Manufacturer's written approval of the applicators of fireproofing material.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver to job-site in sealed containers marked and labeled to show manufacturer's name and brand and certification of compliance with the specified requirements.

B. Remove damaged containers from the site.

C. Store the materials off the ground, under cover, away from damp surfaces.

D. Keep dry until ready for use.

E. Remove materials that have been exposed to water before installation from the site.

1.4 QUALITY ASSURANCE AND QUALITY CONTROL

A. LEED Building Performance Requirements:

1. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable. Some applicable VOC limits are:

a. Firestop Sealants: 250 g/l less water.

b. All Architectural Sealants: 250 g/l less water.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. Test for fire endurance in accordance with ASTM E119, for fire rating specified, in a nationally recognized laboratory.

C. Manufacturer's inspection and approval of surfaces to receive fireproofing as specified under paragraph Examination.

D. Manufacturer's approval of fireproofing applications.

E. Manufacturer's approval of completed installation.

F. Manufacturer's representative shall observe and advise at the commencement of application, and shall visit the site as required thereafter for the

purpose of ascertaining proper application.

G. Pre-Application Test Area.

1. Apply a test area consisting of a typical overhead fireproofing installation, including not less than 4.5 m (15 feet) of beam and deck.

   a. Apply to one column.

   b. Apply for the hourly ratings used.

2. Install in location selected by the Resident Engineer, for approval by the representative of the fireproofing material manufacturer and by the Government.

3. Perform Bond test on painted steel in accordance with ASTM E736.

4. Do not proceed in other areas until installation of test area has been completed and approved.

5. Keep approved installation area open for observation as criteria for sprayed-on fireproofing.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

1. C841-03 (R2008 Installation of Interior Lathing and Furring

2. C847-10 Metal Lath

3. E84-10 Surface Burning Characteristics of Building Materials

4. E119-10 Fire Tests of Building Construction and Materials

5. E605-93(R2006) Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members

6. E736-00(R2006) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

7. E759-92(R2005) The Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members

8. E760-92(R2005) Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members

9. E761-92(R2005) Compressive Strength of Fire-Resistive Material Applied to Structural Members

10. E859-93(R2006) Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members

11. E937-93(R2005) Corrosion of Steel by Sprayed Fire-Resistive Material Applied to Structural Members

12. E1042-02(R2008) Acoustically, Absorptive Materials Applied by Trowel or Spray.

13. G21-09 Determining Resistance of Synthetic Polymeric Materials to Fungi

C. Underwriters Laboratories, Inc. (UL):

1. Fire Resistance Directory Latest Edition including Supplements

D. Warnock Hersey (WH):

1. Certification Listings Latest Edition

E. Factory Mutual System (FM):

1. Approval Guide Latest Edition including Supplements

PART 2 - PRODUCTS

2.1 SPRAYED-ON FIREPROOFING

A. ASTM E1042, Class (a), Category A.

1. Type I, factory mixed cementitious materials with approved aggregate.
2. Type II, factory mixed mineral fiber with integral inorganic binders minimum 240 kg/m^3 (15 1b/ft^3) density per ASTM E605 test unless specified otherwise. Use in areas that are completely encased.

B. Materials containing asbestos are not permitted.

C. Fireproofing characteristics when applied in the thickness and density required to achieve the fire-rating specified.

	Characteristic	Test	Results
1.	Deflection	ASTM E759	No cracking, spalling, or delamination when backing to which it is applied has a deflection up to 1/120 in 3m (10 ft.)
2.	Corrosion-Resistance	ASTM E937	No promotion of corrosion of steel.
3.	Bond Impact	ASTM E760	No cracking, spalling, or delamination.
4.	Cohesion/Adhesion (Bond Strength)	ASTM E736	Minimum cohesive/adhesive strength of 9.57 kPa (200 lbf/ft^2) for protected areas. 19.15 kPa (400 lbf/ft^2) for exposed areas.
5.	Air Erosion	ASTM E859	Maximum gain weight of the collecting filter 0.27gm/m^2 (0.025 gm/ft^2).
6.	Compressive Strength	ASTM E761	Minimum compressive strength 48 kPa (1000psf).
7.	Surface Burning Characteristics with adhesive and sealer to be used	ASTM E84	Flame spread 25 or less smoke developed 50 or less
8.	Fungi Resistance	ASTM G21	Resistance to mold growth when inoculated with aspergillus niger (28 days for general application)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces to receive fireproofing are clean and free of dust, soot, oil, grease, water soluble materials or any foreign substance which would prevent adhesion of the fireproofing material.

B. Verify hangers, inserts and clips are installed before the application of fireproofing material.

C. Verify ductwork, piping, and other obstructing material and equipment is not installed that will interfere with fireproofing installation.

D. Verify concrete work on steel decking and concrete encased steel is completed.

E. Verify temperature and enclosure conditions are required by fire-proofing material manufacturer.

3.2 APPLICATION

A. Do not start application until written approval has been obtained from manufacturer of fireproofing materials that surfaces have been inspected by the manufacturer or his representative, and are suitable to receive sprayed-on fireproofing.

B. Coordinate application of fireproofing material with other trades.

C. Application of Metal Lath:

1. Apply to beam and columns having painted surfaces which fail ASTM E736 Bond Test requirements in pre-application test area.

2. Apply to beam flanges 300 mm (12 inches) or more in width.

3. Apply to column flanges 400 mm (16 inches) or more in width.

4. Apply to beam or column web 400 mm (16 inches) or more in depth.

5. Tack weld or mechanically fasten on maximum of 300 mm (12 inch) center.

6. Lap and tie lath member in accordance with ASTM C841.

D. Mix and apply in accordance with manufacturer's instructions.

1. Mechanically control material and water ratios.

2. Apply adhesive and sealer, when not an integral part of the materials, in accordance with the manufacturer's instructions.

3. Apply to density and thickness indicated in UL Fire Resistance Directory, FM Approval Guide, or WH Certification Listings unless specified otherwise. Test in accordance with ASTM E119.

4. Minimum applied dry density per cubic meter (cubic foot) for the underside of the walk on deck (interstitial) hung purl in or beam and steel deck, columns in interstitial spaces and mechanical equipment rooms shall be as follows:

a. Type I - 240 kg/m^3 (15 lb/ft^3).

b. Type II - 350 kg/m^3 (22 lb/ft^3).

c. [Materials with higher density of 640kg/m^2 (40pcf) may be used in some

mechanical rooms or parking garages.]

E. Application shall be completed in one area, inspected and approved by Resident Engineer before removal of application equipment and proceeding with further work.

3.3 FIELD TESTS

A. Tests of applied material will be performed by VA retained Testing Laboratory. See Section 01 45 29, TESTING LABORATORY SERVICES.

B. Resident Engineer will select area to be tested in specific bays on each floor using a geometric grid pattern.

C. Test for thickness and density in accordance with ASTM E605. Areas showing thickness less than that required as a result of fire endurance test will be rejected.

D. Areas showing less than required fireproofing characteristics will be rejected on the following field tests.

1. Test for cohesion/adhesion: ASTM E736.

2. Test for bond impact strength: ASTM E760.

3.4 PATCHING AND REPAIRING

A. Inspect after mechanical, electrical and other trades have completed work in contact with fireproofing material, but before sprayed material is covered by subsequent construction.

B. Perform corrective measures in accordance with fireproofing material Manufacturer's recommendations.

1. Respray areas requiring additional fireproofing material to provide the required thickness, and replace dislodged or removed material.

2. Spray material for patching by machine directly on point to be patched, or into a container and then hand apply.

3. Hand mixing of material is not permitted.

C. Repair:

1. Respray all test and rejected areas.

2. Patch fireproofing material which is removed or disturbed after approval.

D. Perform final inspection of sprayed areas after patching and repair.

3.5 SCHEDULE

A. Apply fireproofing material in interior structural steel membersexcept on following surfaces:

1. Structural steel and underside of steel decks in elevator or dumbwaiter machine rooms.

2. Steel members in elevator hoist ways.

3. Areas used as air handling plenums.

4. Steel to be encased in concrete or designated to receive other type of fireproofing.

B. Type I:

1. One hour fire rating.

C. Type II:

1. One hour fire rating.

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SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.

B. Closure of openings in walls against penetration of gases or smoke in smoke partitions.

1.2 RELATED WORK

A. Expansion and seismic joint firestopping: Section 07 95 13, EXPANSION JOINT COVER ASSEMBLIES.

B. Spray applied fireproofing: Section 07 81 00, APPLIED FIREPROOFING

C. Sealants and application: Section 07 92 00, JOINT SEALANTS.

D. Fire and smoke damper assemblies in ductwork: Section 23 31 00, HVAC DUCTS AND CASINGS Section 23 37 00, AIR OUTLETS AND INLETS

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Certification Form, per Section 013323 – Submittals under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED BUILDING Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.

D. List of FM, UL, or WH classification number of systems installed.

E. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

1.4 DELIVERY AND STORAGE

A. Deliver materials in their original unopened containers with manufacturer’s name and product identification.

B. Store in a location providing protection from damage and exposure to the elements.

1.5 WARRANTY

A. Firestopping work subject to the terms of the Article "Warranty of Construction", FAR clause 52.246-21, except extend the warranty period to five years.

1.6 QUALITY ASSURANCE

A. LEED Building Performance Requirements:

1. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable. Some applicable VOC limits are:

a. Firestop Sealants: 250 g/l less water

b. All Architectural Sealants: 250 g/l less water

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. FM, UL, or WH or other approved laboratory tested products will be acceptable.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

1. E84-10 Surface Burning Characteristics of Building Materials

2. E814-11 Fire Tests of Through-Penetration Fire Stops

C. Factory Mutual Engineering and Research Corporation (FM):

1. Annual Issue Approval Guide Building Materials

D. Underwriters Laboratories, Inc. (UL):

1. Annual Issue Building Materials Directory
2. Annual Issue Fire Resistance Directory
3. 1479-10 Fire Tests of Through-Penetration Firestops

E. Warnock Hersey (WH):

1. Annual Issue Certification Listings

PART 2 - PRODUCTS

2.1 FIRESTOP SYSTEMS

A. Use either factory built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases or smoke.

B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 100 mm (4 in) nominal pipe or 0.01 m2 (16 sq. in.) in overall cross sectional area.

C. Products requiring heat activation to seal an opening by its intumescence shall exhibit a demonstrated ability to function as designed to maintain the fire barrier.

D. Firestop sealants used for firestopping or smoke sealing shall have following properties:

1. Contain no flammable or toxic solvents.
2. Have no dangerous or flammable out gassing during the drying or curing of products.
3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
4. When used in exposed areas, shall be capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

E. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials shall have following properties:

1. Classified for use with the particular type of penetrating material used.
2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.
3. Intumescent products which would expand to seal the opening and act as fire, smoke, toxic fumes, and, water sealant.

F. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84.

G. FM, UL, or WH rated or tested by an approved laboratory in accordance with

ASTM E814.

H. Materials to be asbestos free.

2.2 SMOKE STOPPING IN SMOKE PARTITIONS

A. Use silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.

B. Use mineral fiber filler and bond breaker behind sealant.

C. Sealants shall have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with E84.

D. When used in exposed areas capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Submit product data and installation instructions, as required by article, submittals, after an on site examination of areas to receive firestopping.

3.2 PREPARATION

A. Remove dirt, grease, oil, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.

B. Remove insulation on insulated pipe for a distance of 150 mm (six inches) on either side of the fire rated assembly prior to applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.

3.3 INSTALLATION

A. Do not begin work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.

B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.

C. Install smoke stopping seals in smoke partitions.

3.4 CLEAN-UP AND ACCEPTANCE OF WORK

A. As work on each floor is completed, remove materials, litter, and debris.

B. Do not move materials and equipment to the next-scheduled work area until completed work is inspected and accepted by the Resident Engineer.

C. Clean up spills of liquid type materials.

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SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK:

A. [Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.]

B. Firestopping penetrations: Section 07 84 00, FIRESTOPPING.

C. Glazing: Section 08 80 00, GLAZING.

D. Sound rated gypsum partitions/sound sealants: Section 09 29 00, GYPSUM BOARD.

E. Mechanical Work: Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION .

1.3 QUALITY ASSURANCE AND QUALITY CONTROL:

A. LEED Building Performance Requirements:

1. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable. Some applicable VOC limits are:

   a. Firestop Sealants: 250 g/l less water

   b. All Architectural Sealants: 250 g/l less water.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

C. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

D. VOC: Acrylic latex and Silicon sealants shall have less than 50g/l VOC content.

E. Mockups: Before installing joint sealants, apply elastomeric sealants as

follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:

1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this section.

1.4 SUBMITTALS:

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Certification Form, per Section 013323 – Submittals under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED BUILDING Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's installation instructions for each product used.

D. Cured samples of exposed sealants for each color where required to match adjacent material.

E. Manufacturer's Literature and Data:

1. Caulking compound

2. Primers

3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.5 PROJECT CONDITIONS:

A. Environmental Limitations:

1. Do not proceed with installation of joint sealants under following

conditions:

a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4° C (40° F).

b. When joint substrates are wet.

B. Joint-Width Conditions:

1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions:

1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.6 DELIVERY, HANDLING, AND STORAGE:

A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.

B. Carefully handle and store to prevent inclusion of foreign materials.

C. Do not subject to sustained temperatures exceeding 32° C (90° F) or less than 5° C (40° F).

1.7 DEFINITIONS:

A. Definitions of terms in accordance with ASTM C717 and as specified.

B. Back-up Rod: A type of sealant backing.

C. Bond Breakers: A type of sealant backing.

D. Filler: A sealant backing used behind a back-up rod.

1.8 WARRANTY:

A. Warranty exterior sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be extended to two years.

B. General Warranty: Special warranty specified in this Article shall not deprive Government of other rights Government may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

1.9 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Society for Testing and Materials (ASTM):

1. C509-06 Elastomeric Cellular Preformed Gasket and Sealing Material.

2. C612-10 Mineral Fiber Block and Board Thermal Insulation.

3. C717-10 Standard Terminology of Building Seals and Sealants.

4. C834-10 Latex Sealants.
5. C919-08. Use of Sealants in Acoustical Applications.
6. C920-10 Elastomeric Joint Sealants.
7. C1021-08 Laboratories Engaged in Testing of Building Sealants.
8. C1193-09 Standard Guide for Use of Joint Sealants.
9. C1330-02 (R2007) Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
10. D1056-07 Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
11. E84-09 Surface Burning Characteristics of Building Materials.

C. Sealant, Waterproofing and Restoration Institute (SWRI). The Professionals' Guide

PART 2 - PRODUCTS

2.1 SEALANTS:

A. S-1:
1. ASTM C920, polyurethane or polysulfide.
2. Type M.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 20-40

B. S-2:
1. ASTM C920, polyurethane or polysulfide.
2. Type M.
3. Class 25.
4. Grade P.
5. Shore A hardness of 25-40.

C. S-4:
1. ASTM C920 polyurethane or polysulfide.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-40.

D. S-6:
1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.
4. Grade NS.

5. Shore A hardness of 15-20.
6. Minimum elongation of 1200 percent.

E. S-7:
1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

F. S-9:
1. ASTM C920 silicone.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Non-yellowing, mildew resistant.

2.2 CAULKING COMPOUND:

A. C-1: ASTM C834, acrylic latex.

B. C-2: One component acoustical caulking, non drying, non hardening, synthetic rubber.

2.3 COLOR:

A. Sealants used with exposed masonry shall match color of mortar joints.

B. Sealants used with unpainted concrete shall match color of adjacent concrete.

C. Color of sealants for other locations shall be light gray or aluminum, unless specified otherwise.

D. Caulking shall be light gray or white, unless specified otherwise.

2.4 JOINT SEALANT BACKING:

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Type C: Closed-cell material with a surface skin.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F).

Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self- adhesive tape where applicable.

2.5 FILLER:

A. Mineral fiber board: ASTM C612, Class 1.

B. Thickness same as joint width.

C. Depth to fill void completely behind back-up rod.

2.6 PRIMER:

A. As recommended by manufacturer of caulking or sealant material.

B. Stain free type.

2.7 CLEANERS-NON POUROUS SURFACES:

A. Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.

B. Coordinate for repair and resolution of unsound substrate materials.

C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATIONS:

A. Prepare joints in accordance with manufacturer's instructions and SWRI.

B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.

1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.

2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:

a. Concrete.

b. Masonry.

c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

a. Metal.

b. Glass.

c. Porcelain enamel.

d. Glazed surfaces of ceramic tile.

C. Do not cut or damage joint edges.

D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.

1. Apply primer prior to installation of back-up rod or bond breaker tape.

2. Use brush or other approved means that will reach all parts of joints.

F. Take all necessary steps to prevent three sided adhesion of sealants.

3.3 BACKING INSTALLATION:

A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.

B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.

C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.

D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.

E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.

F. Take all necessary steps to prevent three sided adhesion of sealants.

3.4 SEALANT DEPTHS AND GEOMETRY:

A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.

B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION:

A. General:

1. Apply sealants and caulking only when ambient temperature is between 5° C and 38° C (40° F and 100° F).
2. Do not use polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
3. Do not use sealant type listed by manufacture as not suitable for use in locations specified.
4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
5. Avoid dropping or smearing compound on adjacent surfaces.
6. Fill joints solidly with compound and finish compound smooth.
7. Tool joints to concave surface unless shown or specified otherwise.
8. Finish paving or floor joints flush unless joint is otherwise detailed.
9. Apply compounds with nozzle size to fit joint width.
10. Test sealants for compatibility with each other and substrate. Use only compatible sealant.

B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.

C. Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.

1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.6 FIELD QUALITY CONTROL:

A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as recommended by sealant manufacturer:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:

a. Perform 10 tests for first 300 m (1000 feet) of joint length for each

type of elastomeric sealant and joint substrate.

b. Perform one test for each 300 m (1000 feet) of joint length thereafter or one test per each floor per elevation.

B. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.

C. Inspect tested joints and report on following:

1. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.

2. Compare these results to determine if adhesion passes sealant manufacturer’s field-adhesion hand-pull test criteria.

3. Whether sealants filled joint cavities and are free from voids.

4. Whether sealant dimensions and configurations comply with specified requirements.

D. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

E. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

F. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.7 CLEANING:

A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.

B. After filling and finishing joints, remove masking tape.

C. Leave adjacent surfaces in a clean and unstained condition.

3.8 LOCATIONS:

A. Exterior Building Joints, Horizontal and Vertical:

1. Metal to Metal: Type S-1, S-2

2. Metal to Masonry or Stone: Type S-1

3. Masonry to Masonry or Stone: Type S-1

4. Stone to Stone: Type S-1

5. Cast Stone to Cast Stone: Type S-1

6. Threshold Setting Bed: Type S-1, S-4

7. Masonry Expansion and Control Joints: Type S-6

B. Metal Reglets and Flashings:

1. Flashings to Wall: Type S-6
2. Metal to Metal: Type S-6

C. Sanitary Joints:

1. Walls to Plumbing Fixtures: Type S-9
2. Counter Tops to Walls: Type S-9
3. Pipe Penetrations: Type S-9

D. High Temperature Joints over 204 degrees C (400 degrees F):

1. Exhaust Pipes, Flues, Breech Stacks: Type S-7

E. Interior Caulking:

1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1 and C-2.
2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1, C-2.
3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Types C-1 and C-2.
4. Exposed Isolation Joints at Top of Full Height Walls: Types C-1 and C-2.
5. Exposed Acoustical Joint at Sound Rated Partitions Type C-2.
6. Concealed Acoustic Sealant Types S-4, C-1 and C-2.

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SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies steel doors, steel frames and related components.

B. Terms relating to steel doors and frames as defined in ANSI A123.1 and as specified.

1.2 RELATED WORK

A. Aluminum frames entrance work: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.

B. Door Hardware: Section 08 71 00, DOOR HARDWARE.

C. Glazing and ballistic rated glazing: Section 08 80 00, GLAZING.

1.3 TESTING

A. An independent testing laboratory shall perform testing.

1.4 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the

MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturers Literature and Data:

1. Fire rated doors and frames, showing conformance with NFPA 80 and Underwriters Laboratory, Inc., or Intertek Testing Services or Factory Mutual fire rating requirements and temperature rise rating for stairwell doors. Submit proof of temperature rating.

2. Sound rated doors, including test report from Testing Laboratory.

1.5 SHIPMENT

A. Prior to shipment label each door and frame to show location, size, door swing and other pertinent information.

B. Fasten temporary steel spreaders across the bottom of each door frame.

1.6 STORAGE AND HANDLING

A. Store doors and frames at the site under cover.

B. Protect from rust and damage during storage and erection until completion.

1.7 QUALITY ASSURANCE

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

4. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.8 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. Door and Hardware Institute (DHI):

1. A115 Series Steel Door and Frame Preparation for Hardware, Series A115.1 through A115.17 (Dates Vary)

C. Steel Door Institute (SDI):

1. 113-01 Thermal Transmittance of Steel Door and Frame Assemblies
2. 128-1997 Acoustical Performance for Steel Door and Frame Assemblies
3. A250.8-03 Standard Steel Doors and Frames

D. American Society for Testing and Materials (ASTM):

1. A167-99(R2004) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
2. A568/568-M-07 Steel, Sheet, Carbon, and High- Strength, Low-alloy, Hot-Rolled and Cold-Rolled
3. A1008-08 Steel, sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability
4. B209/209M-07 Aluminum and Aluminum-Alloy Sheet and Plate
5. B221/221M-08 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
6. D1621-04 Compressive Properties of Rigid Cellular Plastics
7. D3656-07 Insect Screening and Louver Cloth Woven from Vinyl Coated Glass Yarns
8. E90-04 Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

E. The National Association Architectural Metal Manufactures (NAAMM):

1. Metal Finishes Manual (1988 Edition)

F. National Fire Protection Association (NFPA):

1. 80-09 Fire Doors and Fire Windows

G. Underwriters Laboratories, Inc. (UL):

1. Fire Resistance Directory

H. Intertek Testing Services (ITS):

1. Certifications Listings…Latest Edition

I. Factory Mutual System (FM):

1. Approval Guide

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Steel: ASTM A1008, cold-rolled for panels (face sheets) of doors.

B. Anchors, Fastenings and Accessories: Fastenings anchors, clips connecting members and sleeves from zinc coated steel.

C. Prime Paint: Paint that meets or exceeds the requirements of A250.8.

2.2 FABRICATION, GENERAL

A. GENERAL:

1. Follow SDI A250.8 for fabrication of standard steel doors, except as specified otherwise. Doors to receive hardware specified in Section 08

71 00, DOOR HARDWARE. Tolerances as per SDI A250.8. Thickness, 44 mm (1-3/4 inches), unless otherwise shown.

2. Close top edge of exterior doors flush and seal to prevent water intrusion.

3. When vertical steel stiffeners are used for core construction, fill spaces between stiffeners with mineral fiber insulation.

B. Heavy Duty Doors: SDI A250.8, Level 2, Model 2 of size and design shown. Core construction types a, d, or f, for interior doors, and, types b, c, e, or f, for exterior doors.

C. Fire Rated Doors (Labeled):

1. Conform to NFPA 80 when tested by Underwriters Laboratories, Inc., Inchcape Testing Services, or Factory Mutual for the class of door or door opening shown.

2. Fire rated labels of metal, with raised or incised markings of approving laboratory shall be permanently attached to doors.

3. Close top and vertical edges of doors flush. Vertical edges shall be seamless. Apply steel astragal to the meeting stile of the active leaf of pairs of fire rated doors, except where vertical rod exit devices are specified for both leaves swinging in the same direction.

4. Construct fire rated doors in stairwell enclosures for maximum transmitted temperature rise of 230° C (450° F) above ambient temperature at end of 30 minutes of fire exposure when tested in accordance with ASTM E152.

2.3 METAL FRAMES

A. General:

1. SDI A250.8, 1.3 mm (0.053 inch) thick sheet steel, types and styles as shown or scheduled.

2. Frames for exterior doors: Fabricate from 1.7 mm (0.067 inch) thick galvanized steel conforming to ASTM A525.

3. Frames for labeled fire rated doors and windows.

a. Comply with NFPA 80. Test by Underwriters Laboratories, Inc., Inchcape Testing Services, or Factory Mutual.

b. Fire rated labels of approving laboratory permanently attached to frames as evidence of conformance with these requirements. Provide labels of metal or engraved stamp, with raised or incised markings.

4. Frames for doors specified to have automatic door operators; Security doors (Type 36); service window: minimum 1.7 mm (0.067 inch) thick.

5. Knocked-down frames are not acceptable.

B. Reinforcement and Covers:

1. SDI A250.8 for, minimum thickness of steel reinforcement welded to back of frames.

2. Provide mortar guards securely fastened to back of hardware reinforcements except on lead-lined frames.

C. Glazed Openings:

1. Integral stop on exterior, corridor, or secure side of door.

2. Design rabbet width and depth to receive glazing material or panel shown or specified.

D. Frame Anchors:

1. Floor anchors:

a. At bottom of jamb use 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive two 6 mm (1/4 inch) floor bolts. Use 50 mm x 50 mm (2 inch by 2 inch) 9 mm (3/8 inch) clip angle for lead lined frames, drilled for 9 mm (3/8 inch) floor bolts.

b. Where mullions occur, provide 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two 6 mm (1/4 inch) floor bolts and frame anchor screws.

c. Where sill sections occur, provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for 6 mm (1/4 inch) floor bolts and frame anchor screws. Space floor bolts at 50 mm (24 inches) on center.

2. Jamb anchors:

a. Locate anchors on jambs near top and bottom of each frame, and at intermediate points not over 600 mm (24 inches) apart, except for fire rated frames space anchors as required by labeling authority.

b. Form jamb anchors of not less than 1 mm (0.042 inch) thick steel unless otherwise specified.

c. Anchors set in masonry: Use adjustable anchors designed for friction fit against the frame and for extension into the masonry not less than 250 mm (10 inches). Use one of following type:

1) Wire loop type of 5 mm (3/16 inch) diameter wire.

2) T-shape or strap and stirrup type of corrugated or perforated sheet steel.

d. Anchors for stud partitions: Either weld to frame or use lock-in snap-in type. Provide tabs for securing anchor to the sides of the studs.

e. Anchors for frames set in prepared openings:

1) Steel pipe spacers with 6 mm (1/4 inch) inside diameter welded to plate reinforcing at jamb stops or hat shaped formed strap spacers, 50 mm (2 inches) wide, welded to jamb near stop.

2) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass thru frame and spacers.

f. Anchors for observation windows and other continuous frames set in stud partitions.

1) In addition to jamb anchors, weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.

2) Anchors spaced 600 mm (24 inches) on centers maximum.

g. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

2.4 SHOP PAINTING

A. SDI A250.8.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Plumb, align and brace frames securely until permanent anchors are set.

1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
2. Use wood spreaders at bottom of frame if the shipping spreader is removed.
3. Protect frame from accidental abuse.
4. Where construction will permit concealment, leave the shipping spreaders in place after installation, otherwise remove the spreaders after the frames are set and anchored.
5. Remove wood spreaders and braces only after the walls are built and jamb anchors are secured.

B. Floor Anchors:

1. Anchor the bottom of door frames to floor with two 6 mm (1/4 inch) diameter expansion bolts. Use 9 mm (3/8 inch) bolts on lead lined frames.
2. Power actuated drive pins may be used to secure frame anchors to concrete floors.

C. Jamb Anchors:

1. Anchors in masonry walls: Embed anchors in mortar. Fill space between frame and masonry wall with grout or mortar as walls are built.
2. Coat frame back with a bituminous coating prior to lining of grout filling in masonry walls.
3. Secure anchors to sides of studs with two fasteners through anchor tabs. Use steel drill screws to steel studs.
4. Frames set in prepared openings of masonry or concrete: Expansion bolt to wall with 6 mm (1/4 inch) expansion bolts through spacers. Where subframes or rough bucks are used, 6 mm (1/4 inch) expansion bolts on 600 mm (24 inch) centers or power activated drive pins 600 mm (24 inches) on centers. Secure two piece frames to subframe or rough buck with machine screws on both faces.

D. Install anchors for labeled fire rated doors to provide rating as required.

E. Frames for Sound Rated Doors: Coordinate to line frames for sound rated doors with insulation.

3.2 INSTALLATION OF DOORS AND APPLICATION OF HARDWARE

A. Install doors and hardware as specified in Sections Section 08 11 13, HOLLOW METAL DOORS AND FRAMES Section 08 14 00, WOOD DOORS Section 08 71 00, DOOR HARDWARE .

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SECTION 08 14 00

INTERIOR WOOD DOORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies interior flush doors with prefinish, prefit option.

B. Section includes sound retardant doors,.

1.2 RELATED WORK

A. Metal door frames: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.

B. Door hardware including hardware location (height): Section 08 71 00, DOOR HARDWARE.

C. Installation of doors and hardware: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, Section **08 14 00**, WOOD DOORS, or Section 08 71 00, DOOR HARDWARE.

D. Glazing : Section 08 80 00, GLAZING.

E. Finish: Section 09 06 00, SCHEDULE FOR FINISHES.

F. Metal louvers: Section 08 90 00, LOUVERS AND VENTS.

G. Card readers and biometric devices: Section 28 13 00, ACCESS CONTROL

1.3 SUBMITTALS

A. LEED Building Submittal Requirements

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify that no added urea formaldehyde is present in any composite wood materials, agrifiber material or adhesive.

4. Documentation for all new wood products, including FSC Certified. Provide vendor invoices for all permanently installed wood products, FSC Certified or not. Each wood product must be identified on a line-item basis, FSC products must be identified as such on a line item basis, the dollar value of each line item must be shown, the vendors Chain-of-Custody

certificate number must be shown on any invoice that includes FSC products.

5. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

6. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Samples:

1. Corner section of flush veneered door 300 mm (12 inches) square, showing details of construction, labeled to show grade and type number and conformance to specified standard.

2. Veneer sample 200 mm (8 inch) by 275 mm (11 inch) by 6 mm (1/4 inch) showing specified wood species sanded to receive a transparent finish. Factory finish veneer sample where the prefinished option is accepted.

D. Shop Drawings:

1. Show every door in project and schedule location in building.

2. Indicate type, grade, finish and size; include detail of glazing louvers sound gasketing and pertinent details.

3. Provide information concerning specific requirements not included in the manufacturer's literature and data submittal.

E. Manufacturer's Literature and Data:

1. Sound rated doors, including test report indicating STC rating per ASTM E90 from test laboratory.

2. Labeled fire rated doors showing conformance with NFPA 80.

F. Laboratory Test Results:

1. Screw holding capacity test report in accordance with WDMA T.M.10.

2. Split resistance test report in accordance with WDMA T.M.5.

3. Cycle/Slam test report in accordance with WDMA T.M.7.

4. Hinge-Loading test report in accordance with WDMA T.M.8.

1.4 WARRANTY

A. Doors are subject to terms of Article titled "Warranty of Construction", FAR clause 52.246-21, except that warranty shall be as follows:

1. For interior doors, manufacturer’s warranty for lifetime of original installation.

2. Specified STC RATING for sound retardant rated door assembly in place.

1.5 DELIVERY AND STORAGE

A. Factory seal doors and accessories in minimum of 6 mill polyethylene bags or cardboard packages which shall remain unbroken during delivery and storage.

B. Store in accordance with WDMA I.S.1-A, J-1 Job Site Information.

C. Label package for door opening where used.

1.6 QUALITY ASSURANCE

A. LEED Building Performance Requirements:

1. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

2. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

3. Engineered wood, not including salvaged wood, shall contain a minimum of 10% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

4. All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) to be permanently installed on the interior of project shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI). Certification of these products shall be in accordance with the LEED Building Submittal Requirements of this Section.

5. Adhesives used for work in this section including plastic laminating adhesives shall contain no added Urea Formaldehyde.

6. Wood Materials manufactured, fabricated, and or harvested within 500 miles (by air) of the project site shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

7. Solid wood materials shall be FSC Certified as sustainably harvested by the Forest Stewardship Council Documentation of FSC Certification shall be in accordance with the LEED Building Submittal requirements of this Section.

8. Adhesives, sealants, paints and coatings used for work in this section shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable. VOC Limits include, but are not limited to the following:

Wood Flooring Adhesive	100 g/l
Clear Wood Varnish	350 g/l
Clear Wood Lacquer	550 g/

Wood Stains	250 g/l
Sanding Sealers	275 g/l
Clear Shellac	730 g/l
Pigmented Shellac	550 g/l

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. Window and Door Manufacturers Association (WDMA):

1. I.S.1-A-04 Architectural Wood Flush Doors
2. I.S.4-07A Water-Repellent Preservative Non-Pressure Treatment for Millwork
3. I.S.6A-01 Architectural Wood Stile and Rail Doors
4. T.M.5-90 Split Resistance Test Method
5. T.M.6-08 Adhesive (Glue Bond) Durability Test Method
6. T.M.7-08 Cycle-Slam Test Method
7. T.M.8-08 Hinge Loading Test Method
8. T.M.10-08 Screwholding Test Method

C. National Fire Protection Association (NFPA):

1. 80-07 Protection of Buildings from Exterior Fire
2. 252-08 Fire Tests of Door Assemblies

D. ASTM International (ASTM):

1. E90-04 Laboratory Measurements of Airborne Sound Transmission Loss

PART 2 - PRODUCTS

2.1 FLUSH DOORS

A. General:

1. Meet requirements of WDMA I.S.1-A, Extra Heavy Duty.
2. Adhesive: Type II
3. Thickness: 45 mm (1-3/4 inches) unless otherwise shown or specified.
4. Give exposed wood parts of exterior doors a water-repellent preservative treatment in accordance with WDMA I.S.4.

B. Face Veneer:

1. In accordance with WDMA I.S.1-A.
2. One species throughout the project unless scheduled or otherwise shown.
3. For transparent finishes: Premium Grade. plain sliced cut, white maple.
   a. AA grade face veneer
   b. Match face veneers for doors for uniform effect of color and grain at joints.

c. Door edges shall be same species as door face veneer except maple may be used for stile face veneer on birch doors.

4. Factory sand doors for finishing.

C. Wood for stops, louvers, muntins and moldings of flush doors required to have transparent finish:

1. Solid Wood of same species as face veneer, except maple may be used on birch doors.

2. Glazing:

a. On non-labeled doors use applied wood stops nailed tight on room side and attached on opposite side with flathead, countersunk wood screws, spaced approximately 125 mm (5 inches) on centers.

b. Use stainless steel or dull chrome plated brass screws for exterior doors.

D. Stiles and Rails:

1. Option for wood stiles and rails:

a. Composite material having screw withdrawal force greater than minimum performance level value when tested in accordance with WDMA T.M.10.

2. Provide adequate blocking for bottom of doors having mechanically operated door bottom seal meeting or exceeding the performance duty level per T.M.10 for horizontal door edge screw holding.

3. Rabbeted transom meeting rail edges match face veneers of doors. Bottom rail of transom panel match face veneer on non rabbeted meeting rail edge.

E. Fire rated wood doors:

1. Fire Performance Rating:

a. "B" label, 1-1/2 hours.

b. "C" label, 3/4 hour.

2. Labels:

a. Doors shall conform to the requirements of ASTM E2074, or NFPA 252, and, carry an identifying label from a qualified testing and inspection agency for class of door or opening shown designating fire performance rating.

b. Metal labels with raised or incised markings.

3. Performance Criteria for Stiles of doors utilizing standard mortise leaf hinges:

a. Hinge Loading: WDMA T.M.8. Average of 10 test samples for Extra Heavy Duty doors.

b. Direct screw withdrawal: WDMA T.M.10 for Extra Heavy Duty doors. Average of 10 test samples using a steel, fully threaded #12 wood screw.

c. Cycle Slam: 1,000,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with WDMA T.M.7.

4. Additional Hardware Reinforcement:

a. Provide fire rated doors with hardware reinforcement blocking.

b. Size of lock blocks as required to secure hardware specified.

c. Top, bottom and intermediate rail blocks shall measure not less than 125 mm (five inches) minimum by full core width.

d. Reinforcement blocking in compliance with manufacturer's labeling requirements.

e. Mineral material similar to core is not acceptable.

5. Other Core Components: Manufacturer's standard as allowed by the labeling requirements.

6. Provide steel frame approved for use in labeled doors for vision panels.

7. Provide steel astragal on pair of doors.

F. Sound Rated Doors:

1. Fabricated as specified for flush wood doors with additional construction requirements to meet specified sound transmission class (STC).

2. STC Rating of the door assembly in place when tested in accordance with ASTM E90 by an independent nationally recognized acoustical testing laboratory not less than 36 .

3. Accessories:

a. Frame Gaskets: Continuous closed cell sponge neoprene with stop adjusters.

b. Automatic Door Bottom Seal:

1) Concealed or Surface Mounted.

2.2 PREFINISH, PREFIT OPTION

A. Flush doors may be factory machined to receive hardware, bevels, undercuts, cutouts, accessories and fitting for frame.

B. Factory fitting to conform to specification for shop and field fitting, including factory application of sealer to edge and routings.

C. Flush doors to receive transparent finish (in addition to being prefit)shall be factory finished as follows:

1. WDMA I.S.1-A Section F-3 specification for System TR-4, Conversion Varnish or System TR-5, Catalyzed Vinyl.

2. Use stain when required to produce the finish specified in Section 09 06 00 SCHEDULE FOR FINISHES.

2.3 IDENTIFICATION MARK:

A. On top edge of door.

B. Either a stamp, brand or other indelible mark, giving manufacturer’s name, door’s trade name, construction of door, code date of manufacture and quality.

C. Accompanied by either of the following additional requirements:

1. An identification mark or a separate certification including name of inspection organization.

2. Identification of standards for door, including glue type.
3. Identification of veneer and quality certification.
4. Identification of preservative treatment for stile and rail doors.

2.4 SEALING:

A. Give top and bottom edge of doors two coats of catalyzed polyurethane or water resistant sealer before sealing in shipping containers.

PART 3 - EXECUTION

3.1 DOOR PREPARATION

A. Field, shop or factory preparation: Do not violate the qualified testing and inspection agency label requirements for fire rated doors.

B. Clearances between Doors and Frames and Floors:

1. Maximum 3 mm (1/8 inch) clearance at the jambs, heads, and meeting stiles, and a 19 mm (3/4 inch) clearance at bottom, except as otherwise specified.
2. Maximum clearance at bottom of sound rated doors, light-proofed doors, doors to operating rooms, and doors designated to be fitted with mechanical seal: 10 mm (3/8 inch).

C. Provide cutouts for special details required and specified.

D. Rout doors for hardware using templates and location heights specified in Section, 08 71 00 DOOR HARDWARE.

E. Fit doors to frame, bevel lock edge of doors 3 mm (1/8 inch) for each 50 mm (2 inches) of door thickness.

F. Immediately after fitting and cutting of doors for hardware, seal cut edges of doors with two coats of water resistant sealer.

G. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch.

H. Apply a steel astragal on the opposite side of active door on pairs of fire rated doors.

I. Apply a steel astragal to meeting style of active leaf of pair of doors or double egress smoke doors.

3.2 INSTALLATION OF DOORS APPLICATION OF HARDWARE

A. Install doors and hardware as specified in Section, INSTALLATION OF DOORS AND HARDWARE.

3.3 DOOR PROTECTION

A. As door installation is completed, place polyethylene bag or cardboard shipping container over door and tape in place.

B. Provide protective covering over knobs and handles in addition to covering door.

C. Maintain covering in good condition until removal is approved by Resident Engineer.

- - - E N D - - -

SECTION 08 14 23

ALUMINUM-CLAD WOOD DOORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes aluminum-clad wood doors.

1.2 RELATED SECTIONS

A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for additional LEED requirements.

B. Section 01 81 19, INDOOR AIR QUALITY REQUIREMENTS for VOC limit.

C. Section 07 92 00, JOINT SEALANTS.

D. Section 08 52 53, ALUMINUM-CLAD WOOD WINDOWS.

E. Section 08 71 00, DOOR HARDWARE.

F. Section 08 80 00, GLAZING.

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of wood doors with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for wood doors.

B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.

D. Samples: For units with factory-applied color finishes.

1. Include similar Samples of hardware and accessories involving color selection.

E. Samples: For wood doors and components required, prepared on Samples of

size indicated below:
1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
2. Exposed Hardware: Full-size units.

F. Product Schedule: For wood doors. Use same designations indicated on Drawings.

G. Qualification Data: For manufacturer and Installer.

H. Product Test Reports: For each type of wood door, for tests performed by a qualified testing agency.

I. Sample Warranties: For manufacturer's warranties.

J. LEED Building Submittal Requirements:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:
2. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content
3. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).
4. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.
5. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.
6. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify that no added urea formaldehyde is present in any composite wood materials, agrifiber material or adhesive.
7. Documentation for all new wood products, including FSC Certified. Provide vendor invoices for all permanently installed wood products, FSC Certified or not. Each wood product must be identified on a line-item basis, FSC products must be identified as such on a line item basis, the dollar value of each line item must be shown, the vendors Chain-of-Custody certificate number must be shown on any invoice that includes FSC products.
8. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.
9. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).
10. Indicate the total system % Visible Light Transmittance (Tvis).
11. Pre-requisite EA 2: Indicate the total system U-factor
12. (in BTU/HR/SQ.FT/F) and Solar Heat Gain Coefficient (SHGC).

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating wood doors that meet or exceed performance requirements indicated and of

documenting this performance by test reports, and calculations.

B. Installer Qualifications: An installer acceptable to wood door manufacturer for installation of units required for this Project.

C. LEED Building Performance Requirements:
1. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
2. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.
3. Engineered wood, not including salvaged wood, shall contain a minimum of 10% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section
4. All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) to be permanently installed on the interior of project shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI). Certification of these products shall be in accordance with the LEED Building Submittal Requirements of this Section.
5. Adhesives used for work in this section including plastic laminating adhesives shall contain no added Urea Formaldehyde.
6. Wood Materials manufactured, fabricated, and or harvested within 500 miles (by air) of the project site shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
7. Solid wood materials shall be FSC Certified as sustainably harvested by the Forest Stewardship Council Documentation of FSC Certification shall be in accordance with the LEED Building Submittal requirements of this Section.
8. Adhesives, sealants, paints and coatings used for work in this section shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable. VOC Limits include, but are not limited to the following.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection, water leakage, and air infiltration.
   c. Faulty operation of hardware.
   d. Deterioration of materials and finishes beyond normal weathering.
   e. Failure of insulating glass.

2. Warranty Period:
   a. Door: 10 years from date of Substantial Completion.
   b. Glazing Units: 20 years from date of Substantial Completion.
   c. Aluminum-Cladding Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Pella Corporation; Commercial Out-Swing French Hinged Doors - Architect Series or comparable product by one of the following:

1. Marvin Windows and Doors.
2. Weather Shield Mfg., Inc.

B. Source Limitations: Obtain wood doors from single source from single manufacturer.

C. LEED Requirements:

1. Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC- Accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
2. Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.
3. Provide glazing with a minimum Visible Light Transmittance (Tvis) of 90%.
4. Provide window assemblies/curtainwall/etc. with a minimum U-value of 1.4.

2.2 DOOR PERFORMANCE REQUIREMENTS

A. Air Infiltration: Provide doors with maximum air leakage through framing area of 0.15 cfm/sq. ft. (0.05 L/s per sq. m) when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).

2.3 WOOD DOORS

A. Frame and Door Panels: Fine-grained wood lumber complying with WDMA I.S.4; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

1. Metal Sill: Solid aluminum, ADA approved, low profile.
2. Panels: Three-ply construction. Randomly finger-jointed blocks laminated with water-resistant glue.
3. Exterior Finish: Aluminum-clad wood.
   a. Aluminum Finish: Manufacturer's standard baked-on enamel finish.
   b. Color: As indicated on Drawings.
4. Interior Finish: Manufacturer's standard factory-prime coat.
   a. Exposed Unfinished Wood Surfaces: Manufacturer's standard species of Pine or Douglas Fir.
   b. Color: As indicated on Drawings.

B. Wood: Clear ponderosa pine or another suitable fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

C. Aluminum Extrusions and Rolled Aluminum for Cladding: Manufacturer's standard formed sheet or extruded-aluminum cladding, mechanically bonded to

exterior exposed wood members. Provide aluminum alloy and temper recommended by wood door manufacturer for strength corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength, and not less than 16,000-psi (110-MPa) minimum yield strength.

1. Baked-Enamel Finish for Extrusions and Sheet: Manufacturer's standard baked enamel complying with AAMA 2603 and paint manufacturer's written specifications for cleaning, conversion coating, and painting.
2. Baked-Enamel Finish for Coil: Manufacturer's standard baked enamel complying with AAMA 620 and paint manufacturer's written specifications for cleaning, conversion coating, and painting.

D. Wood Trim: Material and finish to match frame members or as indicated in Schedule of finishes.

E. Clad Trim: Roll-formed sheet material and finish to match clad frame members or as indicated in Schedule of Finishes.

F. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with wood door members, cladding, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Unless avoidable for applying hardware, do notuse exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

G. Anchors, Nail Fins, Clips and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

H. Reinforcing Members: Aluminum, or nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

I. Compression-Type Weather Stripping: Provide panel-mounted, dual-durometer, extruded polymer compressible weather stripping designed for Permanently resilient sealing and for complete concealment when wood door is closed.

J. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.
1. Kind: Fully tempered per ASTM C1048 and where required by 2006 IBC Section 2406.

K. Insulating-Glass Units: ASTM E 2190, certified through IGCC as complying with requirements of IGCC.
1. Kind: Silicone-glazed 11/16-inch dual-seal, insulating glass, multi-layer Low-E coated with argon.
2. Color: Gray

L. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

M. Hinges: Provide manufacturer's standard corrosion-resistant leaves hardware fabricated from aluminum, stainless steel, carbon steel, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and sized to accommodate door weight and dimensions, with wear-resistant hinge bushings and stainless steel pin and decorative cap.
1. Provide minimum of 4 hinges per door leaf.
2. Exposed Hardware Color and Finish: As selected by Architect from

manufacturer's full range.

N. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
   1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.5 FABRICATION

A. Fabricate wood doors in sizes indicated. Include a complete system for installing and anchoring doors.
B. Glaze wood doors in the factory.
C. Weather strip each door to provide weathertight installation.
D. Mullions: Provide mullions and cover plates, matching door units, complete with anchors for support to structure and installation of door units. Allow for erection tolerances and provide for movement of door units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of door units.
E. Door Assemblies: Provide door units in configuration indicated. Provide door frame, hardware, and other trim and components necessary for a complete, secure, and weathertight installation.
F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing doors, hardware, accessories, and other components.
B. Install doors level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust doors and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing doors. Remove excess sealants, glazing materials, dirt, and other substances.
   1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace broken, chipped, cracked, abraded, or damaged glass during construction period.

D. Protect door surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact door surfaces, remove contaminants immediately according to manufacturer's written instructions.

- - - END - - -

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section specifies access doors or panels.

1.2 RELATED WORK

A. Lock Cylinders: Section 08 71 00, DOOR HARDWARE.

B. Access doors in acoustical ceilings: Section 09 51 00, ACOUSTICAL CEILINGS.

C. Locations of access doors for duct work cleanouts: Section 23 31 00, HVAC DUCTS AND CASINGS; Section 23 37 00, AIR OUTLETS AND INLETS.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Shop Drawings: Access doors, each type, showing construction, location and installation details.

D. Manufacturer's Literature and Data: Access doors, each type.

1.4 QUALITY ASSURANCE

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

4. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.

B. American Society for Testing and Materials (ASTM):

1. A167-99(R-2009) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

2. A1008-10 Steel Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy

C. American Welding Society (AWS):

1. D1.3-08 Structural Welding Code Sheet Steel

D. National Fire Protection Association (NFPA):

1. 80-10 Fire Doors and Windows

E. The National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 500 Series Metal Finishes Manual

F. Underwriters Laboratories, Inc. (UL):

1. Fire Resistance Directory

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

A. Fabricate components to be straight, square, flat and in same plane where required.

1. Slightly round exposed edges and without burrs, snags and sharp edges.

2. Exposed welds continuous and ground smooth.

3. Weld in accordance with AWS D1.3.

B. Number of locks and non-continuous hinges as required to maintain alignment of panel with frame. For fire rated doors, use hinges and locks as required by fire test.

C. Provide anchors or make provisions in frame for anchoring to adjacent construction. Provide size, number and location of anchors on four sides to secure access door in opening. Provide anchors as required by fire test.

2.2 ACCESS DOORS, FIRE RATED:

A. Shall meet requirements for "B" label 1-1/2 hours with maximum temperature rise of 120 degree C (250 degrees F).

B. Comply with NFPA 80 and have Underwriters Laboratories Inc., or other nationally recognized laboratory label for Class B opening.

C. Door Panel: Form of 0.9 mm (0.0359 inch) thick steel sheet, insulated sandwich type construction.

D. Frame: Form of 1.5 mm (0.0598 inch) thick steel sheet of depth and configuration to suit material and type of construction where installed. Provide frame flange at perimeter where installed in concrete masonry or gypsum board openings.

1. Weld exposed joints in flange and grind smooth.

2. Provide frame flange at perimeter where installed in concrete masonry or gypsum board.

3. Provide expanded galvanized metal lath perimeter wings when installed in plaster except veneer plaster.

E. Automatic Closing Device: Provide automatic closing device for door.

F. Hinge: Continuous steel hinge with stainless steel pin.

G. Lock:

1. Self-latching, with provision for fitting flush a standard screw-in type lock cylinder. Lock cylinder specified in Section 08 71 00, DOOR HARDWARE.

2. Provide latch release device operable from inside of door. Mortise case in door.

2.3 ACCESS DOORS, FLUSH PANEL:

A. Door Panel:

1. Form of 1.9 mm (0.0747 inch) thick steel sheet.

2. Reinforce to maintain flat surface.

B. Frame:

1. Form of 1.5 mm (0.0598 inch) thick steel sheet of depth and configuration to suit material and type of construction where installed.

2. Provide surface mounted units having frame flange at perimeter where installed in concrete, masonry, or gypsum board construction.

3. Weld exposed joints in flange and grind smooth.

4. Provide expanded galvanized metal lath perimeter wings when installed

in plaster except veneer plaster.

C. Hinge:

1. Concealed spring hinge to allow panel to open 175 degrees.

2. Provide removable hinge pin to allow removal of panel from frame.

D. Lock:

1. Flush, screwdriver operated cam lock.

2.4 FINISH:

A. Provide in accordance with NAAMM AMP 500 series on exposed surfaces.

B. Steel Surfaces: Baked-on prime coat over a protective phosphate coating.

2.5 SIZE:

A. Minimum 600 mm (24 inches) square door unless otherwise shown.

PART 3 - EXECUTION

3.1 LOCATION:

A. Provide access panels or doors wherever any valves, traps, dampers, cleanouts, and other control items of mechanical, electrical and conveyor work are concealed in wall or partition, or are above ceiling of gypsum board or plaster.

B. Use fire rated doors in fire rated partitions and ceilings.

C. Use flush panels in partitions and gypsum board or plaster ceilings, except lay-in acoustical panel ceilings or upward access acoustical tile ceilings.

3.2 INSTALLATION, GENERAL:

A. Install access doors in openings to have sides vertical in wall installations, and parallel to ceiling suspension grid or side walls when installed in ceiling.

B. Set frames so that edge of frames without flanges will finish flush with surrounding finish surfaces.

C. Set frames with flanges to overlap opening and so that face will be uniformly spaced from the finish surface.

3.3 ANCHORAGE:

A. Secure frames to adjacent construction using anchors attached to frames or by use of bolts or screws through the frame members.

B. Type, size and number of anchoring device suitable for the material surrounding the opening, maintain alignment, and resist displacement during normal use of access door.

C. Anchors for fire rated access doors shall meet requirements of applicable fire test.

3.4 ADJUSTMENT:

A. Adjust hardware so that door panel will open freely.

B. Adjust door when closed so door panel is centered in the frame.

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SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies aluminum entrance work including storefront construction, and other components to make a complete assembly.

1.2 RELATED WORK:

A. Glass and Glazing: Section 08 80 00, GLAZING.

B. Hardware: Section 08 71 00, DOOR HARDWARE.

C. Automatic Door Operators: Section 08 71 13, AUTOMATIC DOOR OPERATORS.

D. Texture and color of finish: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS:

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:
   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s)
   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment
2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.
3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Shop Drawings: (1/2 full scale) showing construction, anchorage, reinforcement, and installation details.

D. Manufacturer’s Literature and Data:

1. Entrance and Storefront construction.

E. Samples:

1. Two samples of organic finish of each color specified.

F. Manufacturer's Certificates:

1. Stating that aluminum has been given specified thickness of anodizing.
2. Indicating manufacturer's qualifications specified.

1.2 QUALITY ASSURANCE:

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. Approval by Contracting Officer is required of products of proposed manufacturer, or supplier, and will be based upon submission by Contractor certification.

C. Certify manufacturer regularly and presently manufactures aluminum entrances and storefronts as one of their principal products.

1.3 DELIVERY, STORAGE AND HANDLING:

A. Deliver aluminum entrance and storefront material to the site in packages or containers; labeled for identification with the manufacturer's name, brand and contents.

B. Store aluminum entrance and storefront material in weather-tight and dry storage facility.

C. Protect from damage from handling, weather and construction operations before, during and after installation.

1.4 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

1. B209-06 Aluminum and Aluminum-Alloy Sheet and Plate
2. B221-05 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
3. E283-04 Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

4. E331-00 Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

5. F468-06 Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

6. F593-04 Stainless Steel Bolts, Hex Cap Screws, and Studs

C. National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 500 Series Metal Finishes Manual

D. American Architectural Manufacturer's Association (AAMA):

1. 2604-05 High Performance Organic Coatings on Architectural Aluminum Extrusions and Panels

E. American Welding Society (AWS):

1. D1.2-03 Structural Welding Code Aluminum

1.5 PERFORMANCE REQUIREMENTS:

A. Shapes and thickness of framing members shall be sufficient to withstand a design wind load of not less than _as shown on the drawings of supported area with a deflection of not more than 1/175 times the length of the member and a safety factor of not less than 1.65 (applied to overall load failure of the unit). Provide glazing beads, moldings, and trim of not less than 1.25 mm (0.050 inch) nominal thickness.

B. Air Infiltration: When tested in accordance with ASTM E 283, air infiltration shall not exceed 2.63 x 10-50 cm per square meter (0.06 cubic feet per minute per square foot) of fixed area at a test pressure of 0.30 kPa (6.24 pounds per square foot) 80 kilometers (50 mile) per hour wind.

C. Water Penetration: When tested in accordance with ASTM E 331, there shall be no water penetration at a pressure of 0.38 kPa (8 pounds per square foot) of fixed area.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Aluminum, ASTM B209 and B221:

1. Alloy 6063 temper T5 for doors, door frames, storefronts.

2. For color anodized finish, use aluminum alloy as required to produce specified color.

B. Fasteners:

1. Aluminum: ASTM F468, Alloy 2024.

2. Stainless Steel: ASTM F593, Alloy Groups 1, 2 and 3.

2.2 FABRICATION:

A. Accurately form metal parts and accurately fit and rigidly assemble joints, except those joints designed to accommodate movement. Seal joints to prevent leakage of both air and water.

B. Make welds in aluminum in accordance with the recommended practice AWA D1.2. Use electrodes and methods recommended by the manufacturers of the metals

and alloys being welded. Make welds behind finished surfaces so as to cause no distortion or discoloration of the exposed side. Clean welded joints of welding flux and dress exposed and contact surfaces.

C. Fit and assemble the work at the manufacturer's plant. Mark work that cannot be permanently plant-assembled to assure proper assembly in the field.

2.3 PROTECTION OF ALUMINUM:

A. Isolate aluminum from contact with dissimilar metals other than stainless steel, white bronze, or zinc by any of the following:

1. Coat the dissimilar metal with two coats of heavy-bodied alkali resistant bituminous paint.
2. Place caulking compound, or non-absorptive tape, or gasket between the aluminum and the dissimilar metal.
3. Paint aluminum in contact with mortar, concrete and plaster, with a coat of aluminum paint primer.

2.4 FRAMES:

A. Fabricate frames for fixed glass and similar members from extruded aluminum not less than 3 mm (0.125 inch) thick.

B. Provide integral stops and glass rebates and applied snap-on type trim.

C. Use concealed screws, bolts and other fasteners. Secure cover boxes to frames in back of all lock strike cutouts.

D. Fabricate framework with thermal breaks in frames where insulating glass is scheduled and specified under Section 08 80 00, GLAZING.

2.5 FINISH

A. In accordance with NAAMM AMP 500 series.

B. Fluorocarbon Finish: AAMA 605.2, high performance coating.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Allowable Installation Tolerances: Install work plumb and true, in alignment and in relation to lines and grades shown. Variation of 3 mm (1/8 inch) in 2400 mm (8 feet), non-accumulative, is maximum permissible for plumb, level, warp, bow and alignment.

B. Anchor aluminum frames to adjoining construction at heads, jambs and bottom and to steel supports, and bracing. Anchor frames with stainless steel or aluminum countersunk flathead, expansion bolts or machine screws, as applicable. Use aluminum clips for internal connections of adjoining frame sections.

3.2 ADJUSTING:

A. After installation of entrance and storefront work is completed, adjust and lubricate operating mechanisms to insure proper performance.

3.3 PROTECTION, CLEANING AND REPAIRING:

A. Remove all mastic smears and other unsightly marks, and repair any damaged or disfiguration of the work. Protect the installed work against damage or abuse.

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SECTION 084229.23

SLIDING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes exterior, sliding, power-operated automatic entrances.

1.2 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For automatic entrances.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Include diagrams for power, signal, and control wiring.
3. Indicate locations of activation and safety devices.
4. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

C. Sample: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: For automatic entrances.

1.4 INFORMATIONAL SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:
   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
   b. The manufacturing location for the product(s); and the location(source) of the raw materials used to manufacture the product(s).
   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.
2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.
3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data

sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Product certificates.

C. Product test reports.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a Certified Inspector.

C. Certified Inspector Qualifications: Certified by AAADM.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCE ASSEMBLIES

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Power-Operated Door Standard: BHMA A156.10.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design automatic entrances.

B. Wind Loads: As indicated on Structural Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. of fixed entrance-system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..

2.3 SLIDING AUTOMATIC ENTRANCES

A. General: Provide manufacturer's standard automatic entrances including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, controls, and accessories required for a complete installation.

B. Telescoping Automatic Entrance :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Unislide Telescopic, concealed, full breakout, Bi-Part Telescopic Sliding Door Besam Entrance Solutions; Product US23-3300-04 or comparable product with equal performance criteria by one of the following:

a. Biparting-Telescoping Sliding Units:

1) Besam Entrance Solutions; Subsidiary of ASSA ABLOY Entrance Systems.

2) Horton Automatics; a division of Overhead Door Corporation.

3) Stanley Access Technologies, LLC; Division of Stanley Security Solutions.

2. Configuration: Biparting-telescoping-sliding door(s) with transom and sidelite(s).

a. Traffic Pattern: Two way.

b. Emergency Breakaway Capability: Sliding leaves and sidelite.

c. Mounting: Between jambs.

3. Operator Features:

a. Power opening and closing.

b. Drive System: belt.

c. Adjustable opening and closing speeds.

d. Adjustable hold-open time between zero and 30 seconds.

e. Obstruction recycle.

f. On-off/hold-open switch to control electric power to operator, key operated.

4. Sliding-Door Carrier Assemblies and Overhead Roller Tracks: Carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.

   a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

5. Sliding-Door Threshold: Threshold members and bottom-guide-track system with stainless-steel, ball-bearing-center roller wheels.

   a. Configuration: Saddle-type threshold across door opening and recessed guide-track system at sidelites.

6. Controls: Activation and safety devices as indicated on Drawings and according to BHMA standards.

   a. Activation Device: Motion sensor mounted on each side of door header to detect pedestrians in activating zone to activate door operator.

   b. Safety Device: Presence sensor mounted to underside of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.

7. Finish: Finish framing, door(s), and header with high-performance organic finish (two-coat fluoropolymer).

   a. Color: As selected by Architect from full range of industry colors and color densities.

2.4 ENTRANCE COMPONENTS

A. Framing Members: Extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.

   1. Nominal Size: 1-3/4 by 4-1/2 inches.

   2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.

B. Stile and Rail Doors: 1-3/4-inch- thick, glazed doors with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.

   1. Glazing Stops and Gaskets: Snap-on, extruded-aluminum stops and preformed gaskets.

   2. Stile Design: Medium stile, 3-1/2-inch nominal width.

3. Rail Design: 5-inch nominal height.
4. Muntin Bars: Horizontal tubular rail member for each door; match stile design and finish.

C. Sidelite(s) and Transom: 1-3/4-inch- deep sidelite(s) and transom with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members matching door design.

1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
2. Glazing Stops and Gaskets: Snap-on, extruded-aluminum stops and preformed gaskets.
3. Muntin Bars: Horizontal tubular rail members for each sidelite; match stile design.

D. Headers: Fabricated from minimum 0.125-inch- thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

1. Mounting: Concealed, with one side of header flush with framing.

E. Signage: As required by cited BHMA standard.

1. Application Process: Door manufacturer's standard process.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B 221.

B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

C. Glazing: As specified in Section 088000 "Glazing."

D. Sealants and Joint Fillers: As specified in Section 079200 "Joint Sealants."

E. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107/C 1107M; of consistency suitable for application.

F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type

of occupancy indicated.

B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.

1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.

2. Electromechanical Operators: Concealed, self-contained, overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation with power off.

C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by its plastic housing; adjustable to provide detection-field sizes and functions required by BHMA A156.10.

1. Provide capability for switching between bidirectional and unidirectional detection.

D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.

F. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.

B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Interrupt powered operation of door operator while in breakaway mode.

C. Deadlocks: Deadbolt operated by exterior cylinder and interior thumb turn, with minimum 1-inch- long throw bolt; BHMA A156.5, Grade 1.

1. Cylinders: BHMA A156.5, Grade 1, six-pin mortise type. As specified in Section 087100 "Door Hardware."

a. Keying: Integrate into building master key system.

2. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.

3. Two-Point Locking for Stile and Rail Sliding Doors: Mechanism in stile of active door leaf that automatically extends second lockbolt into overhead carrier assembly.

D. Weather Stripping: Replaceable components.

1. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.8 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

1. Provide components with concealed fasteners and anchor and connection devices.

2. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.

3. Fabricate exterior components to drain condensation and water passing joints within system to the exterior.

4. Provide anchorage and alignment brackets for concealed support of assembly from building structure.

5. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors and breakaway sidelites.

G. Controls:

1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.

2.9 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install automatic entrances according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power

supply.

1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Level recesses for recessed thresholds using nonshrink grout.

C. Door Operators: Connect door operators to electrical power distribution system.

D. Access-Control Devices: Connect access-control devices to access-control system as specified in Section 281300 "Access Control."

E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Glazing: Install glazing as specified in Section 088000 "Glazing."

G. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants" to provide weathertight installation.

1. Set thresholds, bottom-guide-track system, framing members and flashings in full sealant bed.
2. Seal perimeter of framing members with sealant.

H. Signage: Apply signage on both sides of each door and breakaway sidelite as required by cited BHMA standard for direction of pedestrian travel.

I. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 FIELD QUALITY CONTROL

A. Certified Inspector: Owner will engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic entrances will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 ADJUSTING

A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

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SECTION 08 52 23

ALUMINUM-CLAD WOOD WINDOWS

PART 1 - GENERAL

1.1 DESCRIPTIION

A. Section includes aluminum-clad wood windows.

1.2 RELATED SECTIONS

A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for additional LEED requirements.

B. Section 01 81 19, INDOOR AIR QUALITY REQUIREMENTS for VOC limit.

C. Section 07 92 00, JOINT SEALANTS.

D. Section 08 14 23, ALUMINUM-CLAD WOOD DOORS.

E. Section 08 71 00, DOOR HARDWARE.

F. Section 08 80 00, GLAZING.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. 2. Review, discuss, and coordinate the interrelationship of wood windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for wood windows.

B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.

D. Samples: For units with factory-applied color finishes.

1. Include similar Samples of hardware and accessories involving color selection.

E. Samples: For wood windows and components required, prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).

2. Exposed Hardware: Full-size units.

F. Product Schedule: For wood windows. Use same designations indicated on Drawings.

G. Qualification Data: For manufacturer and Installer.

H. Product Test Reports: For each type of wood window, for tests performed by a qualified testing agency.

I. Sample Warranties: For manufacturer's warranties.

J. LEED Building Submittal Requirements:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify that no added urea formaldehyde is present in any composite wood materials, agrifiber material or adhesive.

4. Documentation for all new wood products, including FSC Certified. Provide vendor invoices for all permanently installed wood products, FSC Certified or not. Each wood product must be identified on a line-item basis, FSC products must be identified as such on a line item basis, the dollar value of each line item must be shown, the vendors Chain-of-Custody certificate number must be shown on any invoice that includes FSC products.

5. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

6. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content,

then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

7. Credit EQ 8.1: Indicate the total system % Visible Light Transmittance (Tvis).

8. Pre-requisite EA 2: Indicate the total system U-factor (in BTU/HR/SQ.FT/F) and Solar Heat Gain Coefficient (SHGC).

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating wood windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

B. Installer Qualifications: An installer acceptable to wood window manufacturer for installation of units required for this Project.

C. LEED Building Performance Requirements:

1. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
2. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.
3. Aluminum Materials used for work in this section shall contain a minimum of 90% (combined) pre-consumer/ post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.
4. Engineered wood, not including salvaged wood, shall contain a minimum of 10% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.
5. All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) to be permanently installed on the interior of project shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI). Certification of these products shall be in accordance with the LEED Building Submittal Requirements of this Section.
6. Adhesives used for work in this section including plastic laminating adhesives shall contain no added Urea Formaldehyde.
7. Wood Materials manufactured, fabricated, and or harvested within 500 miles (by air) of the project site shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
8. Solid wood materials shall be FSC Certified as sustainably harvested by the Forest Stewardship Council Documentation of FSC Certification shall be in accordance with the LEED Building Submittal requirements of this Section.

9. Adhesives, sealants, paints and coatings used for work in this section shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable. VOC Limits include, but are not limited to the following:

Wood Flooring Adhesive	100 g/l
Clear Wood Varnish	350 g/l
Clear Wood Lacquer	550 g/
Wood Stains	250 g/l
Sanding Sealers	275 g/l
Clear Shellac	730 g/l
Pigmented Shellac	550 g/l

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Failure to meet performance requirements.

   b. Structural failures including excessive deflection, water leakage, and air infiltration.

   c. Faulty operation of movable sash and hardware.

   d. Deterioration of materials and finishes beyond normal weathering. e. Failure of insulating glass.

2. Warranty Period:

   a. Window: 10 years from date of Substantial Completion.

   b. Glazing Units: 20 years from date of Substantial Completion.

   c. Aluminum-Cladding Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Pella Corporation; Architect Series or comparable product by one of the following:

1. Marvin Windows and Doors.

2. Weather Shield Mfg., Inc.

B. Source Limitations: Obtain wood windows from single source from single manufacturer.

C. LEED Requirements:

1. Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship.”

2. Do not use composite wood or agrifiber products or adhesives that contain

urea-formaldehyde resin.

3. Provide glazing with a minimum Visible Light Transmittance (Tvis) of 90%.

4. Provide [window assemblies/curtainwall/etc.] with a minimum U-value of 1.2.

2.2 WINDOW PERFORMANCE REQUIREMENTS (FIXED WINDOW ONLY)

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: R.

2. Minimum Performance Grade: 30.

C. Structural Loads: Windows shall withstand the effects of wind loads, with no permanent deformation or breakage of components within window assembly when tested according to ASTM E 330.

1. Loads: 15 lbf/sq. ft. (720 Pa) minimum design pressure and 22.5 lbf/sq. (1080 Pa) minimum structural pressure.

D. Air Infiltration: Provide windows with maximum air leakage through fixed glazing and framing areas of 0.05 cfm/sq. ft. (0.01??? L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

E. Water penetration under Static Pressure: Provide windows that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E547 at a minimum static-air-pressure of 15 lbf/sq. ft. (720 Pa).

F. Energy Performance: Provide windows with performance properties specified, as indicated in manufacturer's published test data, based on argon-filled, Low-E IG with 3 mm glass and procedures indicated below at 77 mph (122 kmph) after 4 cycles of 5 minutes each with water being applied at a rate of 5 gph/sq. ft. (19 l/0.09sqM).

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.30 Btu/sq. ft. x h x deg F (1.47??? W/sq. m x K) as determined according to NFRC 100.

2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.26 as determined according to NFRC 200.

2.3 WOOD WINDOWS

A. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Casement: Project out.

2. Double hung.

3. Fixed.

B. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51

mm) wide; water-repellent preservative treated.
1. Exterior Finish: Aluminum-clad wood.

a. Aluminum Finish: Manufacturer's standard baked-on enamel finish. b. Color: As indicated on Drawings.
2. Interior Finish: Manufacturer's standard factory-prime coat.

a. Exposed Unfinished Wood Surfaces: Manufacturer's standard species of Pine or Douglas Fir.
b. Color: As indicated on Drawings.

C. Wood: Clear ponderosa pine or another suitable fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.
D. Aluminum Extrusions and Rolled Aluminum for Cladding: Manufacturer's standard formed sheet or extruded-aluminum cladding, mechanically bonded to exterior exposed wood members. Provide aluminum alloy and

temper recommended by wood window manufacturer for strength corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength, and not less than

16,000-psi (110-MPa) minimum yield strength.

1. Baked-Enamel Finish for Extrusions and Sheet: Manufacturer's standard baked enamel complying with AAMA 2603 and paint manufacturer's written specifications for cleaning, conversion coating, and painting.
2. Baked-Enamel Finish for Coil: Manufacturer's standard baked enamel complying with AAMA 620 and paint manufacturer's written specifications for cleaning, conversion coating, and painting.
E. Wood Trim: Material and finish to match frame members.

F. Clad Trim: Roll-formed sheet material and finish to match clad frame members.
G. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with wood window members, cladding, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Unless avoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
H. Anchors, Nail Fins, Clips and Accessories: Aluminum, nonmagnetic

stainless steel, or zinc-coated steel or iron complying with ASTM B

633for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
I. Reinforcing Members: Aluminum, or nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
J. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when wood window is closed.
K. Replaceable Weather Seals: Comply with AAMA 701/702.

L. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.

1. Kind: Fully tempered per ASTM C 1048 and where required by 2006 IBC Section

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M. Insulating-Glass Units: ASTM E 2190, certified through IGCC as complying with requirements of IGCC.
1. Kind: Silicone-glazed 11/16-inch dual-seal, insulating glass, multi-layer Low-E coated with argon.

N. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

O. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

P. Projected Window Hardware:
1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
a. Type and Style: Manufacturer's standard type for sash weight and size indicated.
2. Hinges: Manufacturer's standard type for sash weight and size indicated.
3. Single-Handle Locking System: Operates positive-acting arms that pull sash into locked position. Provide one lock on sashes up to 29 inches (735 mm) tall and two unison operating locks on taller sashes.
4. Limit Devices: Manufacturer's standard concealed friction adjustor, adjustable stay bar or concealed support arms with adjustable, limited, hold-open limit devices designed to restrict sash opening.
a. Limit clear opening to 4 inches (100 mm) for ventilation; with custodial key release.
5. Operator Stud Cover: Matching operator handle finish. Provide in locations where operator handle is removed for controlled access.
6. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 60 inches (1500 mm) above floor; one pole operator and pole hanger per room that has operable windows more than 72 inches (1800 mm) above floor.

Q. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
1. Dual type.
2. Continuous, flexible PVC material in dual-durometer design.
3. Welded corners, compressed between frame and sash for positive seal on 4 sides.
4. Secondary PVC leaf-type weather-strip between frame and sash for positive seal on 4 sides.

R. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.

1. Type:

   a. Interior: solid 7/8-inch wide clear pine, water-repellent and preservative treated.
   b. Exterior: 7/8 inch wide extruded aluminum.
   c. Insulating glass contains non-glare grid between 2 panes of glass.
   d. Bars shall be adhered to both sides of insulating glass with VHB acrylic adhesive tape and aligned with non-glare grid.

2. Material: Manufacturer's standard.

3. Pattern: As indicated on Drawings.

4. Profile: As indicated on Drawings.

5. Color: As indicated on Drawings.

2.5 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame.

Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Rolscreen.

   a. Compliance: ASTM D 3656 and SMA 1201.

   b. Screen Cloth: Self-storing, rolling, black, vinyl-coated fiberglass, 18/16 mesh.
   c. Mounted behind overhead cover.

   d. Cover: Unfinished clear pine veneer on extruded aluminum. e. Guides: Unfinished clear pine veneer on extruded aluminum.

2.6 FABRICATION

A. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.
B. Glaze wood windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
E. Window Assemblies: Provide operating and fixed units in configuration

1. Indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:

F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation

procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
B. Clean exposed surfaces immediately after installing windows. Remove

excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.
D. Protect window surfaces from contact with contaminating substances

resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

- - - END OF SECTION - - -

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Door hardware and related items necessary for complete installation and operation of doors.

1.2 RELATED WORK

A. Caulking: Section 07 92 00 JOINT SEALANTS.

B. Application of Hardware: Section 08 14 00, WOOD DOORS Section 08 11 13, HOLLOW METAL DOORS AND FRAMES Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS Section 08 42 29, AUTOMATIC DOOR OPERATORS Section 08 71 13.11, LOW ENERGY DOOR OPERATORS

C. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.

D. Painting: Section 09 91 00, PAINTING.

E. Card Readers: Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEMS.

F. Electrical: Division 26, ELECTRICAL.

G. Fire Detection: Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 GENERAL

A. All hardware shall comply with UFAS, (Uniform Federal Accessible Standards) unless specified otherwise.

B. Provide rated door hardware assemblies where required by most current version of the International Building Code (IBC).

C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Provide hardware listed by UL, except where heavier materials, large size, or better grades are specified herein under paragraph HARDWARE SETS. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.

D. Hardware for application on metal and wood doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.

E. The following items shall be of the same manufacturer, except as otherwise specified:

1. Mortise locksets.
2. Hinges for hollow metal and wood doors.
3. Surface applied overhead door closers.
4. Exit devices.

1.4 WARRANTY

A. Automatic door operators shall be subject to the terms of FAR Clause 52.246-21, except that the Warranty period shall be two years in lieu of one year for all items except as noted below:
   1. Locks, latchsets, and panic hardware: 5 years.
   2. Door closers and continuous hinges: 10 years.

1.5 MAINTENANCE MANUALS

A. In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS", furnish maintenance manuals and instructions on all door hardware. Provide installation instructions with the submittal documentation.

1.6 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23. Submit 2 final copies of the final approved schedules to VAMC Locksmith as record copies (VISN Locksmith if the VAMC does not have a locksmith).

B. Hardware Schedule: Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (if fire rated and listed)	ANSI/BHMA Finish Designation

C. Samples and Manufacturers' Literature:
   1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers Association shall be submitted for approval. Tag and mark all items with manufacturer's name, catalog number and project number.

2. Samples are not required for hardware listed in the specifications by manufacturer's catalog number, if the contractor proposes to use the manufacturer's product specified.

D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein. Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

E. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes.
   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).
   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.
   2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.
   3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.
   4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

1.7 DELIVERY AND MARKING

A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to Resident Engineer for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in Resident Engineer's office until all other similar items have been installed in project, at which time the Resident Engineer will deliver items on file to Contractor for installation in predetermined locations on the project.

1.8 PREINSTALLATION MEETING

A. Convene a preinstallation meeting not less than 30 days before start of installation of door hardware. Require attendance of parties directly affecting work of this section, including Contractor and Installer, Architect, Project Engineer and VA Locksmith, Hardware Consultant, and Hardware Manufacturer’s Representative. Review the following:

1. Inspection of door hardware.
2. Job and surface readiness.
3. Coordination with other work.
4. Protection of hardware surfaces.
5. Substrate surface protection.
6. Installation.
7. Adjusting.
8. Repair.
9. Field quality control.
10. Cleaning.

1.9 INSTRUCTIONS

A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mutes, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters (e.g., "HW") followed by a number. Each number designates a set of hardware items applicable to a door type.

B. Keying: All cylinders shall be keyed into existing Grand Master Key System. Provide removable core cylinders that are removable only with a

special key or tool without disassembly of knob or lockset. Cylinders shall be 7 pin type. Keying information shall be furnished at a later date by the Resident Engineer.

1.10 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.11 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.

B. American Society for Testing and Materials (ASTM):

F883-04.....Padlocks

E2180-07.....Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials

C. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):

A156.1-06.....Butts and Hinges

A156.2-03.....Bored and Pre-assembled Locks and Latches

A156.3-08.....Exit Devices, Coordinators, and Auto Flush Bolts

A156.4-08.....Door Controls (Closers)

A156.5-01.....Auxiliary Locks and Associated Products

A156.6-05.....Architectural Door Trim

A156.8-05.....Door Controls-Overhead Stops and Holders

A156.12-05 .....Interconnected Locks and Latches

A156.13-05.....Mortise Locks and Latches Series 1000

A156.14-07 .....Sliding and Folding Door Hardware

A156.15-06.....Release Devices-Closer Holder, Electromagnetic and Electromechanical

A156.16-08.....Auxiliary Hardware

A156.17-04 .....Self-Closing Hinges and Pivots

A156.18-06.....Materials and Finishes

A156.20-06 .....Strap and Tee Hinges, and Hasps

A156.21-09.....Thresholds

A156.22-05.....Door Gasketing and Edge Seal Systems

A156.23-04.....Electromagnetic Locks

A156.24-03.....Delayed Egress Locking Systems

A156.25-07 .....Electrified Locking Devices

A156.26-06.....Continuous Hinges

A156.28-07 .....Master Keying Systems

A156.29-07 .....Exit Locks and Alarms

A156.30-03 .....High Security Cylinders

A156.31-07 .....Electric Strikes and Frame Mounted Actuators

A250.8-03.....Standard Steel Doors and Frames

D. National Fire Protection Association (NFPA):

80-10.....Fire Doors and Fire Windows

101-09.....Life Safety Code

E. Underwriters Laboratories, Inc. (UL):

Building Materials Directory (2008)

PART 2 - PRODUCTS

2.1 BUTT HINGES

A. ANSI A156.1. Provide only three-knuckle hinges, except five-knuckle where the required hinge type is not available in a three-knuckle version (e.g., some types of swing-clear hinges). The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:

1. Exterior Doors: Type A2112/A5112 for doors 900 mm (3 feet) wide or less and Type A2111/A5111 for doors over 900 mm (3 feet) wide. Hinges for exterior outswing doors shall have non-removable pins. Hinges for exterior fire-rated doors shall be of stainless steel material.
2. Interior Doors: Type A8112/A5112 for doors 900 mm (3 feet) wide or less and Type A8111/A5111 for doors over 900 mm (3 feet) wide. Hinges for doors exposed to high humidity areas (shower rooms, toilet rooms, kitchens, janitor rooms, etc. shall be of stainless steel material.

B. Provide quantity and size of hinges per door leaf as follows:

1. Doors up to 1210 mm (4 feet) high: 2 hinges.
2. Doors 1210 mm (4 feet) to 2260 mm (7 feet 5 inches) high: 3 hinges minimum.
3. Doors greater than 2260 mm (7 feet 5 inches) high: 4 hinges.
4. Doors up to 900 mm (3 feet) wide, standard weight: 114 mm x 114 mm (4-1/2 inches x 4-1/2 inches) hinges.
5. Doors over 900 mm (3 feet) to 1065 mm (3 feet 6 inches) wide, standard weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
6. Doors over 1065 mm (3 feet 6 inches) to 1210 mm (4 feet), heavy weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
7. Provide heavy-weight hinges where specified.
8. At doors weighing 330 kg (150 lbs.) or more, furnish 127 mm (5 inch) high hinges.

C. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified above and continuous hinges specified below.

2.2 CONTINUOUS HINGES

A. ANSI/BHMA A156.26, Grade 1-600.

1. Listed under Category N in BHMA's "Certified Product Directory."

B. General: Minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete

C. Continuous, Barrel-Type Hinges: Hinge with knuckles formed around a Teflon-coated 6.35mm (0.25-inch) minimum diameter pin that extends entire length of hinge.

1. Base Metal for Exterior Hinges: Stainless steel.
2. Base Metal for Interior Hinges: Stainless steel.
3. Base Metal for Hinges for Fire-Rated Assemblies: Stainless steel.
4. Provide with non-removable pin (hospital tip option) at lockable outswing doors.
5. Where required to clear adjacent casing, trim, and wall conditions and allow full door swing, provide wide throw hinges of minimum width required.
6. Provide with manufacturer’s cut-outs for separate mortised power transfers and/or mortised automatic door bottoms where they occur.
7. Where thru-wire power transfers are integral to the hinge, provide hinge with easily removable portion to allow easy access to wiring connections.
8. Where models are specified that provide an integral wrap-around edge guard for the hinge edge of the door, provide manufacturer’s adjustable threaded stud and machine screw mechanism to allow the door to be adjusted within the wrap-around edge guard.

2.3 DOOR CLOSING DEVICES

A. Closing devices shall be products of one manufacturer for each type specified.

2.4 OVERHEAD CLOSERS

A. Conform to ANSI A156.4, Grade 1.

B. Closers shall conform to the following:

1. The closer shall have minimum 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
2. Where specified, closer shall have hold-open feature.

3. Size Requirements: Provide multi-size closers, sizes 1 through 6, except where multi-size closer is not available for the required application.
4. Material of closer body shall be forged or cast.
5. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.
6. Where closers are exposed to the exterior or are mounted in rooms that experience high humidity, provide closer body and arm assembly of stainless steel material.
7. Closers shall have full size metal cover; plastic covers will not be accepted.
8. Closers shall have adjustable hydraulic back-check, separate valves for closing and latching speed, adjustable back-check positioning valve, and adjustable delayed action valve.
9. Provide closers with any accessories required for the mounting application, including (but not limited to) drop plates, special soffit plates, spacers for heavy-duty parallel arm fifth screws, bull-nose or other regular arm brackets, longer or shorter arm assemblies, and special factory templating. Provide special arms, drop plates, and templating as needed to allow mounting at doors with overhead stops and/or holders.
10. Closer arms or backcheck valve shall not be used to stop the door from overswing, except in applications where a separate wall, floor, or overhead stop cannot be used.
11. Provide parallel arm closers with heavy duty rigid arm.
12. Where closers are to be installed on the push side of the door, provide parallel arm type except where conditions require use of top jamb arm.
13. Provide all surface closers with the same body attachment screw pattern for ease of replacement and maintenance.
14. All closers shall have a 1 ½″ (38mm) minimum piston diameter.

2.6 DOOR STOPS

A. Conform to ANSI A156.16.

B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of

building construction. For concrete, masonry or quarry tile construction, use lead expansion shields for mounting door stops.

C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.

D. Provide floor stops (Type L02141 or L02161 in office areas; Type L02121 x 3 screws into floor elsewhere. Wall bumpers, where used, must be installed to impact the trim or the door within the leading half of its width. Floor stops, where used, must be installed within 4-inches of the wall face and impact the door within the leading half of its width.

E. Where drywall partitions occur, use floor stops, Type L02141 or L02161 in office areas, Type L02121 elsewhere.

F. Provide stop Type L02011, as applicable for exterior doors. At outswing doors where stop can be installed in concrete, provide stop mated to concrete anchor set in 76mm (3-inch) core-drilled hole and filled with quick-setting cement.

G. Omit stops where floor mounted door holders are required and where automatic operated doors occur.

H. Provide appropriate roller bumper for each set of doors (except where closet doors occur) where two doors would interfere with each other in swinging.

I. Provide appropriate door mounted stop on doors in individual toilets where floor or wall mounted stops cannot be used.

J. Provide overhead surface applied stop Type C02541, ANSI A156.8 on patient toilet doors in bedrooms where toilet door could come in contact with the bedroom door.

K. Provide door stops on doors where combination closer magnetic holders are specified, except where wall stops cannot be used or where floor stops cannot be installed within 4-inches of the wall.

L. Where the specified wall or floor stop cannot be used, provide concealed overhead stops (surface-mounted where concealed cannot be used).

2.7 OVERHEAD DOOR STOPS AND HOLDERS

A. Conform to ANSI Standard A156.8. Overhead holders shall be of sizes recommended by holder manufacturer for each width of door. Set overhead holders for 110 degree opening, unless limited by building construction

or equipment. Provide Grade 1 overhead concealed slide type: stop-only at rated doors and security doors, hold-open type with exposed hold-open on/off control at all other doors requiring overhead door stops.

2.9 LOCKS AND LATCHES

1. Mortise Lock and Latch Sets: Conform to ANSI/BHMA A156.13. Mortise locksets shall be series 1000, minimum Grade 2. All locksets and latchsets, except on designated doors in Psychiatric (Mental Health) areas, shall have lever handles fabricated from cast stainless steel. Provide sectional (lever x rose) lever design matching. No substitute lever material shall be accepted. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Lock function F02 shall be furnished with emergency tools/keys for emergency entrance. All lock cases installed on lead lined doors shall be lead lined before applying final hardware finish. Furnish armored fronts for all mortise locks. Where mortise locks are installed in high-humidity locations or where exposed to the exterior on both sides of the opening, provide non-ferrous mortise lock case.
3. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.5.
4. Locks on designated doors in Psychiatric (Mental Health) areas shall be paddle type with arrow projection covers and be UL Listed. Provide these locks with paddle in the down position on both sides of the door. Locks shall be fabricated of wrought stainless steel.
5. Privacy locks in non-mental-health patient rooms shall have an inside thumbturn for privacy and an outside thumbturn for emergency entrance. Single occupancy patient privacy doors shall typically swing out; where such doors cannot swing out, provide center-pivoted doors with rescue hardware (see HW-2B).

2.10 PUSH-BUTTON COMBINATION LOCKS

A. ANSI/BHMA A156.13, Grade 1. Battery operated pushbutton entry.
B. Construction: Heavy duty mortise lock housing conforming to ANSI/BHMA A156.13, Grade 1. Lever handles and operating components in compliance

with the UFAS and the ADA Accessibility Guidelines. Match lever handles of locks and latchsets on adjacent doors.

C. Special Features: Key override to permit a master keyed security system and a pushbutton security code activated passage feature to allow access without using the entry code.

2.13 KEYS

A. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

Locks/Keys	**Quantity**
Cylinder locks	2 keys each
Cylinder lock change key blanks	100 each different key way
Master-keyed sets	6 keys each
Grand Master sets	6 keys each
Great Grand Master set	5 keys
Control key	2 keys

B. Psychiatric keys shall be cut so that first two bittings closest to the key shoulder are shallow to provide greater strength at point of greatest torque.

2.14 KEY CABINET

A. ANSI Standard A156.5. Provide key cabinet made of cold rolled, 1.2 mm (0.0478 inch) thick furniture steel electro-welded. Doors shall have "no sag" continuous brass-pin piano type hinge and be equipped with chrome plated locking door handles, hook cam and mechanical pushbutton door lock. Key Cabinet and Key Control System shall accommodate all keys for this project plus 25 percent. Provide minimum number of multiple cabinets where a single cabinet of largest size will not accommodate the required number of keys.

B. Key tags shall consist of two sets: Permanent self-locking and loan key snaphook type with tag colors as follows: Red fiber marker of the permanent self-locking type approximately 32 mm (1-1/4 inch) in diameter engraved with the legend "FILE KEY MUST NOT BE LOANED." Also furnish for each hook a white cloverleaf key marker with snap-hooks engraved with the legend "LOAN KEY."

C. The manufacturer of the lock cylinders and locks shall attach a key tag to keys of each lock cylinder and shall mark thereon the respective item number and key change number. Provide each group of keys in a key gathering envelope (supplied by Key Cabinet Manufacturer) in which the lock manufacturer shall include the following information: Item number, key change number and door number. The contractor shall furnish the Key Cabinet Manufacturer the hardware and keying schedules and change keys.

D. The Key Cabinet Manufacturer shall set up a three-way cross index system, including master keys, listing the keys alphabetically, the hooks numerically and the key changes numerically on different colored index cards. Index cards shall be typewritten and inserted in a durable binder. Attach the keys to the two sets of numbered tags supplied with the cabinet. (The permanent tag and the loan key tag). Instruct the owner in proper use of the system. Install cabinet as directed by the Resident Engineer.

2.15 ARMOR PLATES, KICK PLATES, MOP PLATES AND DOOR EDGING

A. Conform to ANSI Standard A156.6.

B. Provide protective plates as specified below:

1. Kick plates, mop plates and armor plates of metal, Type J100 series.
2. Provide kick plates and mop plates where specified. Kick plates shall be 254 mm (10 inches) or 305 mm (12 inches) high. Mop plates shall be 152 mm (6 inches) high. Both kick and mop plates shall be minimum 1.27 mm (0.050 inches) thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors which shall have plates 25 mm (1 inch) less than width of each door. Extend all other kick and mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick and mop plates shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.
3. Kick plates and/or mop plates are not required on following door sides:
   a. Armor plate side of doors;
   b. Exterior side of exterior doors;
   c. Closet side of closet doors;
   d. Both sides of aluminum entrance doors.

5. Where louver or grille occurs in lower portion of doors, substitute stretcher plate and kick plate in place of armor plate. Size of stretcher plate and kick plate shall be 254 mm (10 inches) high.
6. Provide stainless steel edge guards where so specified at wood doors. Provide mortised type instead of surface type except where door construction and/or ratings will not allow. Provide edge guards of bevel and thickness to match wood door. Provide edge guards with factory cut-outs for door hardware that must be installed through or extend through the edge guard. Provide full-height edge guards except where door rating does not allow; in such cases, provide edge guards to height of bottom of typical lockset armor front. Forward edge guards to wood door manufacturer for factory installation on doors.

2.16 EXIT DEVICES

A. Conform to ANSI Standard A156.3. Exit devices shall be Grade 1; type and function are specified in hardware sets. Provide flush with finished floor strikes for vertical rod exit devices in interior of building. Trim shall have cast satin stainless steel lever handles of design similar to locksets, unless otherwise specified. Provide key cylinders for keyed operating trim and, where specified, cylinder dogging.

B. Surface vertical rod panics shall only be provided less bottom rod; provide fire pins as required by exit device and door fire labels. Do not provide surface vertical rod panics at exterior doors.

C. Concealed vertical rod panics shall be provided less bottom rod at interior doors, unless lockable or otherwise specified; provide fire pins as required by exit device and door fire labels. Where concealed vertical rod panics are specified at exterior doors, provide with both top and bottom rods.

D. Where removable mullions are specified at pairs with rim panic devices, provide mullion with key-removable feature.

E. At non-rated openings with panic hardware, provide panic hardware with key cylinder dogging feature.

F. Exit devices for fire doors shall comply with Underwriters Laboratories, Inc., requirements for Fire Exit Hardware. Submit proof of compliance.

2.17 FLUSH BOLTS (LEVER EXTENSION)

A. Conform to ANSI A156.16. Flush bolts shall be Type L24081 unless otherwise specified. Furnish proper dustproof strikes conforming to ANSI A156.16, for flush bolts required on lower part of doors.

B. Lever extension manual flush bolts shall only be used at non-fire-rated pairs for rooms only accessed by maintenance personnel.

C. Face plates for cylindrical strikes shall be rectangular and not less than 25 mm by 63 mm (1 inch by 2-1/2 inches).

D. Friction-fit cylindrical dustproof strikes with circular face plate may be used only where metal thresholds occur.

E. Provide extension rods for top bolt where door height exceeds 2184 mm (7 feet 2 inches).

2.18 FLUSH BOLTS (AUTOMATIC)

A. Conform to ANSI A156.3. Dimension of flush bolts shall conform to ANSI A115. Bolts shall conform to Underwriters Laboratories, Inc., requirements for fire door hardware. Flush bolts shall automatically latch and unlatch. Furnish dustproof strikes conforming to ANSI A156.16 for bottom flushbolt. Face plates for dustproof strike shall be rectangular and not less than 38 mm by 90 mm (1-1/2 by 3-1/2 inches).

B. At interior doors, provide auto flush bolts less bottom bolt, unless otherwise specified, except at wood pairs with fire-rating greater than 20 minutes; provide fire pins as required by auto flush bolt and door fire labels.

2.19 DOOR PULLS WITH PLATES

A. Conform to ANSI A156.6. Pull Type J401, 152 mm (6 inches) high by 19 mm (3/4 inches) diameter with plate Type J302, 90 mm by 350 mm (3-1/2 inches by 14 inches), unless otherwise specified. Provide pull with projection of 70 mm (2 3/4 inches) and a clearance of 51 mm (2 inches). Cut plates of door pull plate for cylinders, or turn pieces where required.

2.20 PUSH PLATES

A. Conform to ANSI A156.6. Metal, Type J302, 200 mm (8 inches) wide by 350 mm (14 inches) high. Provide metal Type J302 plates 100 mm (4 inches wide by 350 mm (14 inches) high) where push plates are specified for doors with stiles less than 200 mm (8 inches) wide. Cut plates for cylinders, and turn pieces where required.

2.21 COMBINATION PUSH AND PULL PLATES

A. Conform to ANSI 156.6. Type J303, stainless steel 3 mm (1/8 inch) thick, 80 mm (3-1/3 inches) wide by 800 mm (16 inches) high), top and bottom edges shall be rounded. Secure plates to wood doors with 38 mm (1-1/2 inch) long No. 12 wood screws. Cut plates for turn pieces, and cylinders where required. Pull shall be mounted down.

2.22 COORDINATORS

A. Conform to ANSI A156.16. Coordinators, when specified for fire doors, shall comply with Underwriters Laboratories, Inc., requirements for fire door hardware. Coordinator may be omitted on exterior pairs of doors where either door will close independently regardless of the position of the other door. Coordinator may be omitted on interior pairs of non-labeled open where open back strike is used. Open back strike shall not be used on labeled doors. Paint coordinators to match door frames, unless coordinators are plated. Provide bar type coordinators, except where gravity coordinators are required at acoustic pairs. For bar type coordinators, provide filler bars for full width and, as required, brackets for push-side surface mounted closers, overhead stops, and vertical rod panic strikes.

2.23 THRESHOLDS

A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. In existing construction, thresholds shall be installed in a bed of sealant with ¼-20 stainless steel machine screws and expansion shields. In new construction, embed aluminum anchors coated with epoxy in concrete to secure thresholds. Furnish thresholds for the full width of the openings.

B. For thresholds at elevators entrances see other sections of specifications.

C. At exterior doors and any interior doors exposed to moisture, provide threshold with non-slip abrasive finish.

D. Provide with miter returns where threshold extends more than 12 mm (0.5 inch) from fame face.

2.25 WEATHERSTRIPS (FOR EXTERIOR DOORS)

A. Conform to ANSI A156.22. Air leakage shall not to exceed 0.50 CFM per foot of crack length (0.000774m^3/s/m).

2.26 MISCELLANEOUS HARDWARE

A. Access Doors (including Sheet Metal, Screen and Woven Wire Mesh Types): Except for fire-rated doors and doors to Temperature Control Cabinets, equip each single or double metal access door with Lock Type E76213, conforming to ANSI A156.5. Key locks as directed. Ship lock prepaid to the door manufacturer. Hinges shall be provided by door manufacturer.

B. Cylinders for Various Partitions and Doors: Key cylinders same as entrance doors of area in which partitions and door occur, // except as otherwise specified //. Provide cylinders to operate locking devices where specified for following partitions and doors:

1. Folding doors and partitions.
2. Wicket door (in roll-up door assemblies).
3. Slide-up doors.
4. Swing-up doors.
5. Fire-rated access doors-Engineer's key set.
6. Doors from corridor to electromagnetic shielded room.
7. Day gate on vault door.

C. Mutes: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011 or L03021, depending on frame material, of white or light gray color, on each steel or wood door frame, except at fire-rated frames, lead-lined frames and frames for sound-resistant, lightproof and electromagnetically shielded doors. Furnish 3 mutes for single doors and 2 mutes for each pair of doors, except double-acting doors. Provide 4 mutes or silencers for frames for each Dutch type door. Provide 2 mutes for each edge of sliding door which would contact door frame.

2.27 PADLOCKS FOR VARIOUS DOORS, GATES AND HATCHES

A. ASTM E883, size 50 mm (2 inch) wide chain; furnish extended shackles as required by job conditions. Provide padlocks, with key cylinders, for each door in following areas as noted.

B. Key padlocks as follows:

1. Constant Temperature Rooms in Research Departments: Research Laboratory Set.
2. Cold Room in Morgue Department: Autopsy Set.
3. Refrigerators in Canteen Department: Canteen Storage Set.

4. All Refrigerator Rooms in Main Kitchen Department: Kitchen Storage Set.
5. Chain Link Fence Gates for Electrical Substation and other Fenced Buildings or Areas: Engineer's set, except as otherwise specified.
6. Chain Link Fence Gates for Oxygen Storage Buildings: Maintenance supply set.
7. Roof Access and Scuttles: Engineer's set.
8. Hinged Wicket in Post Office Partitions: Post Office set.

C. Omit padlocks on communicating refrigerator doors.

2.28 THERMOSTATIC TEMPERATURE CONTROL VALVE CABINETS

A. Where lock is shown, equip each cabinet door (metal) with lock Type E06213, conforming to ANSI A156.5. Key locks in Key Sets approved by Contracting Officer. See mechanical drawings and specifications for location of cabinets.

B. Cabinet manufacturer shall supply the hinges, bolts and pulls. Ship locks to cabinet manufacturer for installation.

2.29 HINGED WIRE GUARDS (FOR WINDOWS, DOORS AND TRANSOMS) AND WIRE PARTITION DOORS

A. Butt hinges, type A8133 (special swaging) 100 mm by 90 mm (4 inches by 3-1/2 inches), Finish US2C.
   1. 3 hinges for guards over 1060 mm (3-1/2 feet) high.
   2. 2 hinges for guards less than 1060 mm (3-1/2 feet) high.

B. Conform to ANSI A156.5. Lock Type E06081 for guards and Type E06061 for partitions.
   1. Keying: Except as noted otherwise, key locks like entrance door or space wherein guards and partitions are located except as otherwise specified.
   2. Key locks for partitions enclosing mechanical and electrical equipment in Engineer's Set. (See detailed drawings for number of locks and butt hinges required for each guard).

2.30 FINISHES

A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.

B. 626 or 630: All surfaces on exterior and interior of buildings, except where other finishes are specified.

C. Miscellaneous Finishes:

1. Hinges --exterior doors: 626 or 630.
2. Hinges --interior doors: 652 or 630.
3. Pivots: Match door trim.
4. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
5. Thresholds: Mill finish aluminum.
6. Cover plates for floor hinges and pivots: 630.
7. Other primed steel hardware: 600.

D. Hardware Finishes for Existing Buildings: U.S. Standard finishes shall match finishes of hardware in (similar) existing spaces except where otherwise specified.

F. Anti-microbial Coating: All hand-operated hardware (levers, pulls, push bars, push plates, paddles, and panic bars) shall be provided with an anti-microbial/anti-fungal coating that has passed ASTM E2180 tests. Coating to consist of ionic silver (Ag+). Silver ions surround bacterial cells, inhibiting growth of bacteria, mold, and mildew by blockading food and respiration supplies.

2.31 BASE METALS

A. Apply specified U.S. Standard finishes on different base metals as following:

Finish	**Base Metal**
652	Steel
626	Brass or bronze
630	Stainless steel

PART 3 - EXECUTION

3.1 HARDWARE HEIGHTS

A. For new buildings locate hardware on doors at heights specified below, with all hand-operated hardware centered within 864 mm (34 inches) to 1200 mm (48 inches), unless otherwise noted:

B. Hardware Heights from Finished Floor:

1. Exit devices centerline of strike (where applicable) 1024 mm (40-5/16 inches).

2. Locksets and latch sets centerline of strike 1024 mm (40-5/16 inches).
3. Deadlocks centerline of strike 1219 mm (48 inches).
4. Hospital arm pull 1168 mm (46 inches) to centerline of bottom supporting bracket.
5. Centerline of door pulls to be 1016 mm (40 inches).
6. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
7. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.
8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

3.2 INSTALLATION

A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors except security bedroom, bathroom and anteroom doors which shall have closer installed parallel arm on exterior side of doors. At exterior doors, closers shall be mounted on interior side. Where closers are mounted on doors they shall be mounted with sex nuts and bolts; foot shall be fastened to frame with machine screws.

B. Hinge Size Requirements:

Door Thickness	**Door Width**	**Hinge Height**
45 mm (1-3/4 inch)	900 mm (3 feet) and less	113 mm (4-1/2 inches)
45 mm (1-3/4 inch)	Over 900 mm (3 feet) but not more than 1200 mm (4 feet)	125 mm (5 inches)
35 mm (1-3/8 inch) (hollow core wood doors)	Not over 1200 mm (4 feet)	113 mm (4-1/2 inches)

C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim and surrounding conditions.

D. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of existing hinges; or, contractor may reuse existing hinges provided

hinges are restored to satisfactory operating condition as approved by Resident Engineer. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

E. Hinges Required Per Door:

Doors 1500 mm (5 ft) or less in height	2 butts
Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high	3 butts
Doors over 2280 mm (7 feet 6 inches) high	4 butts
Dutch type doors	4 butts
Doors with spring hinges 1370 mm (4 feet 6 inches) high or less	2 butts
Doors with spring hinges over 1370 mm (4 feet 6 inches)	3 butts

F. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Provide machine screws and lead expansion shields to secure hardware to concrete, ceramic or quarry floor tile, or solid masonry. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.

G. After locks have been installed; show in presence of Resident Engineer that keys operate their respective locks in accordance with keying requirements. (All keys, Master Key level and above shall be sent Registered Mail to the Medical Center Director along with the bitting list. Also a copy of the invoice shall be sent to the Resident Engineer for his records.) Installation of locks which do not meet specified keying requirements shall be considered sufficient justification for rejection and replacement of all locks installed on project.

3.3 FINAL INSPECTION

A. Installer to provide letter to VA Resident/Project Engineer that upon completion, installer has visited the Project and has accomplished the following:
   1. Re-adjust hardware.
   2. Evaluate maintenance procedures and recommend changes or additions, and instruct VA personnel.
   3. Identify items that have deteriorated or failed.
   4. Submit written report identifying problems.

3.4 DEMONSTRATION

A. Demonstrate efficacy of mechanical hardware and electrical, and electronic hardware systems, including adjustment and maintenance procedures, to satisfaction of Resident/Project Engineer and VA Locksmith.

3.5 HARDWARE SETS

A. Following sets of hardware correspond to hardware symbols shown on drawings. Only those hardware sets that are shown on drawings will be required. Disregard hardware sets listed in specifications but not shown on drawings.

B. Hardware Consultant working on a project will be responsible for providing additional information regarding these hardware sets. The numbers shown in the following sets come from BHMA standards.

Hardware Schedule

Set: 1.0
Doors: 1A05, 1A29

2	Continuous Hinge (A156.1, G1, EPT Prep)	630
1	Exit Device (Type 8, 03 Fct w/ latch retraction)	630
1	Exit Device (Type 8, 01 Fct)	630
1	Cylinder (As Specified)	626
2	Concealed Overhead Holder/Stop (C01511)	630
2	Surface Closer (C02041)	689
1	Threshold (J32300)	
2	Frame Harness (Molex Connector 15')	
2	Door Harness (Molex Connector Length / Type as Required)	
2	Electric Power Transfer (Concealed w/ Molex Connectors)	
1	Power Supply (Regulated, Filtered, 24VDC, Amperage as Req)	
1	Wiring Diagram Elevation and Point to Point)	

Notes: Card reader by division 28. 120VAC power, conduit, wiring by division 26.

Set: 2.0
Doors: 1A04C, 1A37B

1	Continuous Hinge (A156.1, G1, EPT Prep)	630
1	Security Mortise Lock (F32)	626
2	Cylinder (As Specified)	626
1	Surface Closer (C02011 / C02021)	689
1	Threshold (J32300)	

Set: 3.0
Doors: 1A18A, 1A25A

1	Continuous Hinge (A156.1, G1, EPT Prep)	630

1	Electrified Mortise Lock (fail secure)	626
1	Cylinder (As Specified)	626
1	Surface Closer (C02011 / C02021)	689
1	Threshold (J32300)	
1	Frame Harness (Molex Connector 15')	
1	Door Harness (Molex Connector Length / Type as Required)	
1	Electric Power Transfer (Concealed w/ Molex Conectors)	
1	Power Supply (Regulated, Filtered, 24VDC, Amperage as Req)	
1	Wiring Diagram Elevation and Point to Point)	

Notes: Card reader by division 28. 120VAC power, conduit, wiring by division 26.

Set: 4.0
Doors: BA01

2	Continuous Hinge (A156.1, G1, EPT Prep)	630
1	Flush Bolt (Type 25)	US26D
1	Storeroom Mortise Lock (F07)	626
1	Cylinder (As Specified)	626
2	Concealed Overhead Holder/Stop (C01511)	630
2	Surface Closer (C02021 w/ offset arm)	689
1	Threshold (J32300)	
1	Gasketing (R0Y164)	
1	Astragal	

Set: 5.0
Doors: 1A10A

3	Hinge (Quantity and Type as Required)	US26D
1	Classroom Mortise Lock (F05)	626
1	Cylinder (As Specified)	626
1	Surface Overhead Stop (C02511)	630
1	Surface Closer (C02021 w/ offset arm)	689
1	Kickplate (J102)	US32D
1	Threshold (J32300)	
1	Gasketing (R0Y164)	

Set: 6.0
Doors: BA02

3	Hinge (Quantity and Type as Required)	US26D
1	Fire Exit Device (Type 1, 09 Fct)	630
1	Cylinder (As Specified)	626
1	Surface Overhead Stop (C02511)	630
1	Surface Closer (C02021 w/ offset arm)	689
1	Kickplate (J102)	US32D
1	Gasketing (R0Y154)	

Set: 7.0
Doors: 1A28

2	Continuous Hinge (A156.1, G1)	630
2	Fire Exit Device (Type 2, 14 Fct)	630

2	Surface Closer (C02011 / C02021)	689
2	Kickplate (J102)	US32D
2	Door Stop (L02101 Convex)	US26D
1	Gasketing (R0Y154)	
1	Astragal	

Set: 8.0
Doors: 1A02

1	Continuous Hinge (A156.1, G1)	630
1	Fire Exit Device (Type 1, 14 Fct)	630
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
1	Gasketing (R0Y154)	

Set: 9.0
Doors: 2A00

2	Hinge (Quantity and Type as Required)	US26D
1	Electric Hinge (Molex Connector, 8 wire)	US26D
1	Electrified Mortise Lock (fail safe)	626
1	Cylinder (As Specified)	626
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	
1	Frame Harness (Molex Connector 15')	
1	Door Harness (Molex Connector Length / Type as Required)	
1	Power Supply (Regulated, Filtered, 24VDC, Amperage as Req)	
1	Wiring Diagram Elevation and Point to Point)	

Notes: Card reader by division 28. 120VAC power, conduit, wiring by division 26.

Set: 10.0
Doors: 2A05

2	Hinge (Quantity and Type as Required)	US26D
1	Electric Hinge (Molex Connector, 8 wire)	US26D
1	Electrified Mortise Lock (fail safe)	626
1	Cylinder (As Specified)	626
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
1	Gasketing (R0Y154)	
1	Frame Harness (Molex Connector 15')	
1	Door Harness (Molex Connector Length / Type as Required)	
1	Power Supply (Regulated, Filtered, 24VDC, Amperage as Req)	
1	Wiring Diagram Elevation and Point to Point)	

Notes: Card reader by division 28. 120VAC power, conduit, wiring by division 26.

Set: 11.0
Doors: 1A39, 2A03, 2A09B

2	Hinge (Quantity and Type as Required)	US26D
1	Electric Hinge (Molex Connector, 8 wire)	US26D
1	Electrified Mortise Lock (fail secure)	626
1	Cylinder (As Specified)	626
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	
1	Frame Harness (Molex Connector 15')	
1	Door Harness (Molex Connector Length / Type as Required)	
1	Power Supply (Regulated, Filtered, 24VDC, Amperage as Req)	
1	Wiring Diagram Elevation and Point to Point)	

Notes: Card reader by division 28. 120VAC power, conduit, wiring by division 26.

Set: 12.0
Doors: 1A20

3	Hinge (Quantity and Type as Required)	US26D
1	Storeroom Mortise Lock (F07)	626
1	Cylinder (As Specified)	626
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 13.0
Doors: 2A04

3	Hinge (Quantity and Type as Required)	US26D
1	Storeroom Mortise Lock (F07)	626
1	Cylinder (As Specified)	626
1	Surface Overhead Stop (C02511)	630
1	Kickplate (J102)	US32D
3	Silencer (L03011)	

Set: 14.0
Doors: 1A11, 1A38

3	Hinge (Quantity and Type as Required)	US26D
1	Storeroom Mortise Lock (F07)	626
1	Cylinder (As Specified)	626
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 15.0
Doors: 1A08, 1A09, 1A13, 1A16, 1A22, 1A32, 1A33, 1A34, 1A35

3	Hinge (Quantity and Type as Required)	US26D

1	Entry Mortise Lock (F04)	626
1	Cylinder (As Specified)	626
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 16.0
Doors: 1A10B, 2A09A

3	Hinge (Quantity and Type as Required)	US26D
1	Classroom Mortise Lock (F05)	626
1	Cylinder (As Specified)	626
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 17.0
Doors: 2A07

3	Hinge (Quantity and Type as Required)	US26D
1	Classroom Mortise Lock (F05)	626
1	Cylinder (As Specified)	626
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 18.0
Doors: 1A19, 1A26

3	Hinge (Quantity and Type as Required)	US26D
1	Privacy Mortise Lock (F19 w/ Indicator)	626
2	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 19.0
Doors: 1A23

3	Hinge (Quantity and Type as Required)	US26D
1	Push Button Combination Lock	626
1	Cylinder (As Specified)	626
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 20.0
Doors: BA03

3	Hinge (Quantity and Type as Required)	US26D
1	Push Button Combination Lock	626
1	Cylinder (As Specified)	626
1	Surface Overhead Stop (C02511)	630

1	Surface Closer (C02021 w/ offset arm)	689
1	Kickplate (J102)	US32D
1	Gasketing (R0Y154)	

Set: 21.0
Doors: 2A02, 2A06

3	Hinge (Quantity and Type as Required)	US26D
1	Push Plate (J304 8" x 16")	US32D
1	Pull Plate (J401 x J302)	US32D
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 22.0
Doors: 1A18B, 1A25B

3	Hinge (Quantity and Type as Required)	US26D
1	Electrified Mortise Lock (fail secure)	626
1	Cylinder (As Specified)	626
1	Surface Overhead Stop (C02511)	630
1	Surface Closer (C02021 w/ offset arm)	689
1	Kickplate (J102)	US32D
3	Silencer (L03011)	
1	Frame Harness (Molex Connector 15')	
1	Door Harness (Molex Connector Length / Type as Required)	
1	Electric Power Transfer (Concealed w/ Molex Conectors)	
1	Power Supply (Regulated, Filtered, 24VDC, Amperage as Req)	
1	Wiring Diagram Elevation and Point to Point)	

Notes: Card reader by division 28. 120VAC power, conduit, wiring by division 26.

Set: 23.0
Doors: 2A01

3	Hinge (Quantity and Type as Required)	US26D
1	Storeroom Mortise Lock (F07)	626
1	Cylinder (As Specified)	626
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 24.0
Doors: 1A12

3	Hinge (Quantity and Type as Required)	US26D
1	Storeroom Mortise Lock (F07)	626
1	Cylinder (As Specified)	626
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D

1	Door Stop (L02101 Convex)	US26D
1	Gasketing (R0Y154)	

Set: 25.0
Doors: 2A30

3	Hinge (Quantity and Type as Required)	US26D
1	Mortise Passage Lock (F01)	626
1	Surface Closer (C02011 / C02021)	689
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
1	Gasketing (R0Y154)	

Set: 26.0
Doors: 1A40

6	Hinge (Quantity and Type as Required)	US26D
1	Flush Bolt (Type 25)	US26D
1	Electrified Mortise Lock (fail secure)	626
1	Cylinder (As Specified)	626
1	Coordinator (Type 21A)	Black
2	Surface Closer (C02011 / C02021)	689
2	Kickplate (J102)	US32D
2	Door Stop (L02101 Convex)	US26D
2	Silencer (L03011)	
1	Frame Harness (Molex Connector 15')	
1	Door Harness (Molex Connector Length / Type as Required)	
1	Electric Power Transfer (Concealed w/ Molex Conectors)	
1	Power Supply (Regulated, Filtered, 24VDC, Amperage as Req)	
1	Wiring Diagram Elevation and Point to Point)	

Notes: Card reader by division 28. 120VAC power, conduit, wiring by division 26.

Set: 27.0
Doors: 1A02A, 1A04A

3	Hinge (Quantity and Type as Required)	US26D
1	Classroom Mortise Lock (F05)	626
1	Cylinder (As Specified)	626
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 28.0
Doors: 1A04B, 1A31, 1A37A

3	Hinge (Quantity and Type as Required)	US26D
1	Security Mortise Lock (F32)	626
1	Cylinder (As Specified)	626
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Set: 29.0
Doors: 1A17, 1A24

3	Hinge (Quantity and Type as Required)	US26D
1	Push Plate (J304 8" x 16")	US32D
1	Pull Plate (J401 x J302)	US32D
1	Kickplate (J102)	US32D
1	Door Stop (L02101 Convex)	US26D
3	Silencer (L03011)	

Notes: Automatic operator and controls by section 08 71 13.

Set: 30.0
Doors: 1A00B

1	Cylinder (As Specified)	626

Notes: Balance of hardware by door supplier. Card reader by division 28. 120VAC power, conduit, wiring by division 26. Coordinate with automatic sliding door.

Set: 31.0
Doors: 1A00A

2	Continuous Hinge (A156.1, G1, EPT Prep)	630
1	Exit Device (Type 8, 03 Fct w/ latch retraction)	630
1	Exit Device (Type 8, 01 Fct w/ latch retraction)	630
1	Cylinder (As Specified)	626
2	Door Stop (L02101 Convex)	US26D
2	Frame Harness (Molex Connector 15')	
2	Door Harness (Molex Connector Length / Type as Required)	
2	Electric Power Transfer (Concealed w/ Molex Connectors)	
1	Power Supply (Regulated, Filtered, 24VDC, Amperage as Req)	
1	Wiring Diagram Elevation and Point to Point)	

Notes: Automatic operator and controls by section 08 71 13.

Set: 32.0
Doors: 1A01A, 1A01C

2	Continuous Hinge (A156.1, G1)	630
2	Exit Device (Type 8, 08 Fct)	630
2	Cylinder (As Specified)	626
2	Concealed Overhead Holder/Stop (C01511)	630
2	Surface Closer (C02041)	689
1	Threshold (J32300)	

Set: 33.0
Doors: 1A02B

6	Hinge (Quantity and Type as Required)	US26D
1	Flush Bolt (Type 25)	US26D
1	Classroom Mortise Lock (F05)	626
1	Cylinder (As Specified)	626

2	Surface Overhead Stop (C02511)	630
2	Kickplate (J102)	US32D
2	Silencer (L03011)	

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SECTION 08 71 13.11

LOW ENERGY POWER ASSIST DOOR OPERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies equipment, controls and accessories required to provide low energy power assisted automatic operation of swing doors. The door operator system shall be complete including operator, controls, door arm and operator enclosure (header and cover).

1.2 RELATED WORK

A. Masonry; Section 07 92 00, JOINT SEALANTS.

B. Steel doors; Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.

C. Wood doors; Section 08 14 00, INTERIOR WOOD DOORS.

D. Door hardware; Section 08 71 00, DOOR HARDWARE.

E. Glass and glazing of doors and frames; Section 08 80 00, GLAZING.

F. Finish Color, Section 09 06 00, SCHEDULE FOR FINISHES.

G. Smoke detectors for control of fire/smoke doors to be wired per Section 28 31 00, FIRE DETECTION AND ALARM.

H. Electric general wiring, connections and equipment requirements; Division 26, ELECTRICAL.

1.3 MANUFACTURER'S QUALIFICATIONS

A. Power assisted door operators, controls and other equipment shall be products of a manufacturer regularly engaged in manufacturing such equipment for a minimum of three years.

B. One manufacturer of automatic door equipment shall be used throughout the building project .

1.4 WARRANTY

A. Power assisted door operators, controls and other related equipment shall be subject to the terms of the "Warranty of Construction", Article of Section 00 72 00, GENERAL CONDITIONS, except that the warranty period shall be two years in lieu of one year.

1.5 MAINTENANCE MANUALS

A. In accordance with section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS," furnish three copies of maintenance manuals and instructions on automatic door operators.

1.6 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:
   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).
   c. Provide material costs for the materials included in the contractor's or subcontractor's work. Material cost does not include costs associated with labor and equipment.
2. Letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the amount of recycled content.
3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's literature and data describing operators, power units, controls, door hardware and safety devices.

D. Shop Drawings:
   1. Showing location of controls and safety devices in relationship to each automatically operated door. This includes templates, wiring diagrams, fabrication details, anchorage and other information to providers of related work to coordinate the proper installation of the door operators.

1.7 DESIGN CRITERIA

A. Power assisted automatic door equipment shall accommodate normal traffic as well as the weight of the doors.

B. Equipment: UL approved and comply with applicable codes. Motors shall be rated minimum one-quarter horsepower and shall be single phase and 115 volts.

C. Electrical Wiring; Provide wiring so that only a single power supply is required. Equipment and wiring shall be as specified in Division 26, ELECTRICAL.

1.8 QUALITY ASSURANCE CRITERIA

A. LEED Building Performance Requirements
   1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.9 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI):

1. ICC/ANSI A117.1-03 Guideline for Accessible and Usable Buildings and Facilities-Providing Accessibility and Usability for Physically Handicapped People

C. Builders Hardware Manufacturers Association, Inc. (BHMA):

1. 156.19-07 Power Assist and Low Energy Power Operated Doors

PART 2 - PRODUCTS

2.1 OPERATORS

A. Automatic door operators shall be for commercial doors and shall be electromechanical and surface mounted above the door to the header or transom bar. The opening force shall be generated by a permanent magnet DC motor driving a combination spiral bevel/spur gear reducer and transmitted to the door through an arm linkage. Opening speed shall be adjustable and feature dual backcheck control allowing adjustment of backcheck speed and position. Closing shall be by spring force generated by a metal compression spring. The spring shall reduce manual opening force to not more than 67 N (15 lbf). The minimum diameter of spring wire shall be .007mm (172 in.). Under the specified design load of the door, the spring shall be capable of performing 2,000,000 cycles before fracture. Adjustable closing speed and fixed latch speed shall control the door in the closing cycle. The doors shall be operated manually at any time without damage to the operator or components.

B. All operators shall have checking mechanism providing cushioning action at last part of door travel, in both opening and closing cycle. Operators shall recycle doors instantaneously to full open position from any point in closing cycle when control switch is reactivated.

C. Operator shall be swinging type enclosed in housing. Operator shall open door by energizing motor and shall stop by electrically reducing voltage and stalling motor against mechanical stop. Door shall close by means of spring energy, and close force shall be controlled by gear system and motor (or hydraulic closer for electro-hydraulic units) being used as dynamic break without power. System shall operate as manual door control in event of power failure. Opening and closing speeds shall be adjustable:

1. Swing Operator Housing: Houseing shall be aluminum extrusions with enclosed end caps for application to 100mm (4inch) and larger frame systems.. All structural sections shall have a minimum thickness of 3.7 mm (0.146 inch) and be fabricated of 6063-T5 aluminum alloy.

2. Swing Power Operator: Completely assembled and sealed unit located in cast aluminum case and filled with special lubricant for extreme temperature conditions. A "DC" shunt-wound permanent magnet motor with sealed ball bearings shall be attached to transmission system. Complete unit shall be rubber mounted with provisions for easy maintenance and replacement, without removing door from pivots or frame.

3. Connecting hardware for swing overhead concealed type power operator shall have drive arm attached to door with a pin linkage rotating in a self-lubricating bearing and adjustable slide block, traveling in an interconnected track and top pivot assembly. Top track and pivot assembly shall be fabricated of steel. Door shall not pivot on shaft of operator.

4. Electrical Control: Operator shall have a self contained electrical control unit, including necessary transformers, relays, rectifiers, and other electronic components for proper operation and switching of power operator. Relays shall be plug-in type for individual replacement and all connecting harnesses shall have interlocking plugs. Control shall also include time delay for normal cycle. Swing door control shall include safe-swing circuit with optional switching which automatically limits power and slows door when approached from the doors swing area.

5. On pairs of doors, operators shall allow either door to be opened manually without the other door opening.

2.2 MICROPROCESSOR CONTROLS

A. The system shall include a multi-function microprocessor control providing adjustable hold open time (1 to 30 sec.), LED indications for actual position unknown, system status, open obstruction shutdown, activation signal, safety sensor signal, Stop-and-Hold signal, and mode selector switches providing a means for easy field selection of the following functions: push-to-operate, latch assist and stack pressure. Control shall be capable of receiving activation signals from any device with normally open dry contact output.

1. With push-to-operate function enabled, the control shall provide a means of initiating a self-start activation circuit by slightly pushing the door open at any point in the door swing.

2. Latch Assist shall provide a two second impulse in the close direction to overcome restrictions with locking devices of pressure differentials, allowing the unit to operate in standard time delay mode, and permitting the door to close from the full open position after the hold time is satisfied. All activation modes shall provide fully adjustable opening speed.

B. The door shall be held open by low voltage applied to the continuous duty motor. The control shall include an adjustable safety circuit that monitors door operation and shuts the motor off if an open obstruction is sensed. The control shall include a recycle feature the reopens the door if an obstruction is sensed at any point during its closing cycle. The control shall include a standard three position toggle switch with functions for ON, OFF, and HOLD OPEN.

2.3 ENCLOSURE

A. Operator shall be completely self-contained within an extruded aluminum

housing (alloy 6063-T6) to conceal operator mechanism and mounting brackets and with removable access cover with an overall maximum size of 140 mm (5-1/2 inches) wide by 150 mm (6 inches) deep. Header color shall be integral color painted to match adjacent storefront frame finish.

2.4 ACTIVATION DEVICES

A. Automatic: Opening cycle shall be activated by pressing switches with international symbol of accessibility and "PRESS TO OPERATE DOOR" engraved on the faceplate. Switches shall be installed in a standard 2-gang electrical wall box and placed in a location in compliance with ANSI A117.1. Switches may be wall mounted or mounted on a free standing post or guard rail.

B. Manual: Push-to-operate; manually pushing the door shall activate the automatic opening cycle. Door shall automatically close after timer delay expires.

C. Opening and closing force, measured 25 mm (1 inch) out from the lock stile of the door, shall not exceed 67 N (15 lbf) to stop the door when operating in either direction or cycle.

D. Opening Time: Doors shall be field adjusted so that opening time to back check or 80 degrees, whichever occurs first, shall be 3 seconds or longer as required in Table 1. Backcheck shall not occur before 60 degrees opening.

1. Total opening time to fully open shall be as in Table II.

E. Closing Time:

1. Doors shall be field adjusted to close from 90 degrees to 10 degrees in 3 seconds or longer as required in Table 1.

2. Doors shall be field adjusted to close from 10 degrees to fully close position in not less than 1.5 seconds.

3. Doors shall be field adjusted to remain fully open for not less than 5 seconds.

4. Table 1 provides speed settings for various widths and weights of doors for obtaining results complying with this paragraph.

F. Cycle Tests:

1. Low Energy Power Operated, Low Energy Power Open and Power Assist Operators shall be cycle tested for 300,000 cycles.

2. Use the widest and heaviest door specified as a test specimen. Narrower or lighter doors of the same configurations shall then be considered to meet the cycle test requirements.

TABLE 1
Minimum Opening Time to Backcheck or 80 degrees, which ever occurs first and the Minimum Closing Time from 90 degrees to Latch Check or 10 degrees.

"D" Door Leaf Width- mm (inches)	"W" Door Weight in kg (pounds) Matrix Values are in seconds				
	(100) 45.4	(56.7) 125	(68.0) 150	(79.4) 175	(90.7) 200
(762) 30	3.0	3.0	3.0	3.0	3.5

(914) 36	3.0	3.5	3.5	4.0	4.0
(1067) 42	3.5	4.0	4.0	4.5	4.5
(1219) 48	4.0	4.5	4.5	5.0	5.5

Doors of other weights and widths can be calculated using the formula;

T = DvW/133 in US units T = DvW/2260 in SI (metric) units
Where:
T= Time, seconds
D= Door width, mm (inches)
W= Door weight, kg (lbs)

The values for "T" time have been rounded up to the nearest half second. These values are based on a kinetic energy of (1.25 lbf-ft).

TABLE II

Total Opening Time to Full Open Position

Backcheck at 60 degrees	Backcheck at 70 degrees	Backcheck at 80 degrees
Table 1 plus 2 seconds	Table 1 plus 1.5 seconds	Table 1 plus 1 second

Note: To determine maximum times from close to full open, the operator shall be adjusted as shown in the chart. Backcheck occurring at a point between positions in Table II shall use the lowest setting. For example, if the backcheck occurs at 75 degrees, the full open shall be the time shown in Table 1 plus 1.5 seconds.

2.5 POWER UNITS

A. Provide separate self-contained electric circuits for automatic operators located on each floor of the building. Interruption or failure of power circuits for operators located on one floor of the building shall not interfere with continuous performance of automatic operated doors located on other floors. Capacity and size of power circuits shall be in accordance with automatic operator manufacturer's specifications.

2.6 SAFETY DEVICES

A. Time delay switches shall be adjustable between 5 to 60 seconds and shall control closing cycle of doors.

B. Decals with sign "In" or "Do Not Enter" shall be installed on both faces of each door where shown and shall conform to the requirements of ANSI/BHMA A156.19.

C. Each swing door shall have installed a motion sensor to detect any person standing in the door swing path and prevent the door from opening.

D. Motion sensors shall consist of detection modules, factory prepared to be attached to each side of the lock/strike stile, an armored flex link power cable and bracket assembly, factory prepared for attachment to the pivot stile; a logic board and a position encoder which shall mount to the operator. The detection modules shall contain transmitting and receiving diodes and

sense multidimensional zones for detection of people and/or objects in the door area. Detection modules shall be high impact, shock resistant zinc castings with tinted lenses. The swing door sensor system shall provide complete operate and safety zone coverage. These zones shall be fully adjusted to meet specific jobsite conditions (sidewalls, adjacent panels, etc.) The system shall not be affected by ultrasonic, ambient light or radios frequencies within the vicinity of the swing door.

E. Each swing door shall have installed a re-activation sensor mounted on the push-side door face near the top detect any person standing in the door swing path and prevent the door from closing. Wiring for the re-activation sensor between the door and frame shall be concealed in a power transfer device, hinge or pivot provided under Section 08 71 00; wire chase in door provided under door section.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate installation of equipment with other related work. Manual controls and power disconnect switches shall be recessed or semi-flush mounted in partitions. Secure operator components to adjacent construction with suitable fastenings. Conceal conduits, piping, and electric equipment in finish work.

B. Install power units in locations shown. Where units are to be mounted on walls, provide metal supports or shelves for the units. All equipment, including time delay switches, shall be accessible for maintenance and adjustment.

C. Operators shall be adjusted and must function properly for the type of traffic (pedestrians, carts, stretchers and wheelchairs) expected to pass through doors. Each door leaf of pairs of doors shall open and close in synchronization. On pairs of doors, operators shall allow either door to be opened manually without the other door opening.

D. Install controls at positions shown and make them convenient for particular traffic expected to pass through openings. Maximum height of push plate wall switches from finished floors shall be 40 inches unless otherwise approved by the Resident Engineer.

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SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies glass, plastic, related glazing materials and accessories. Glazing products specified apply to factory or field glazed items.

1.2 RELATED WORK

A. Factory glazed by manufacturer in following units:

1. Sound resistant doors: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, and Section 08 14 00, WOOD DOORS.
2. Mirrors: Section 10 28 00, TOILET, BATH, AND LAUNDRY ACCESSORIES.
3. Section 08 52 23, ALUMINUM-Clad Wood WINDOWS (Double Hung).
4. Section 08 44 13, GLAZED ALUMINUM CURTAIN WALLS.
5. Color of glass, and tinted (heat absorbing or light reducing) glass: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 LABELS

A. Temporary labels:

1. Provide temporary label on each light of glass[and plastic material] identifying manufacturer or brand and glass type, quality and nominal thickness.
2. Label in accordance with NFRC (National Fenestration Rating Council) label requirements.
3. Temporary labels shall remain intact until glass and plastic material is approved by Resident Engineer.

B. Permanent labels:

1. Locate in corner for each pane.
2. Label in accordance with ANSI Z97.1 and SGCC (Safety Glass Certification Council) label requirements.
   a. Tempered glass.
   b. Laminated glass or have certificate for panes without permanent label.
   c. Organic coated glass.
3. Plastic assemblies:
   a. Plastic assemblies in accordance with UL 752 requirements for power rating specified.
   b. Identify each security glazing permanently with glazing manufacturer's name, date of manufacture, product number, and DOS Code number inconspicuously located in lower corner on protective side and

visible after glazing is framed.

c. The "attack (threat) side" shall be identified in bold lettering on each side of glazing with removable label.

1.4 PERFORMANCE REQUIREMENTS

A. Building Enclosure Vapor Retarder and Air Barrier:

1. Utilize the inner pane of multiple pane sealed units for the continuity of the air barrier and vapor retarder seal.

2. Maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

B. Glass Thickness:

1. Select thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with ASCE 7 code.

2. Test in accordance with ASTM E 330.

3. Thicknesses listed are minimum. Coordinate thicknesses with framing system manufacturers.

C. Plastic assemblies:

1. For blast resistant windows follow Unified Facilities Criteria, DOD Minimum Antiterrorism Standards for Buildings UFC4-010-01.

2. Spall Resistance: Laminated glazing shall not produce spall to interior (protected side) when impacted with scheduled ballistics. Tolerances.

3. Outside dimensions: Overall outside dimensions (height and width) of laminated security glazing shall maintain tolerance of ± 3 mm.

4. Coordinate with Physical Security Design Manual requirements.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance

Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

C. Manufacturer's Certificates:

1. Certificates stating that wire glass, meets requirements for safety glazing material as specified in ANSI Z97.1.
2. Certificate on shading coefficient.
3. Certificate on "R" value when value is specified.

D. Warranty:

1. Submit written guaranty, conforming to General Condition requirements, and to "Warranty of Construction" Article in this Section.

E. Manufacturer's Literature and Data:

1. Glass, each kind required.
2. Insulating glass units.
3. Elastic compound for metal sash glazing.
4. Putty, for wood sash glazing.
5. Glazing cushion.
6. Sealing compound.
7. Plastic glazing material, each type required.

F. Samples:

1. Size: 150 mm by 150 mm (6 inches by 6 inches).
2. Tinted glass.

G. Preconstruction Adhesion and Compatibility Test Report: Submit glazing sealant manufacturer’s test report indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery: Schedule delivery to coincide with glazing schedules so minimum handling of crates is required. Do not open crates except as required for inspection for shipping damage.

B. Storage: Store cases according to printed instructions on case, in areas least subject to traffic or falling objects. Keep storage area clean and dry.

C. Handling: Unpack cases following printed instructions on case. Stack individual windows on edge leaned slightly against upright supports with separators between each.

D. Protect laminated security glazing units against face and edge damage during entire sequence of fabrication, handling, and delivery to installation location. Provide protective covering on exposed faces of glazing plastics, and mark inside as "INTERIOR FACE" or "PROTECTED FACE":

1. Treat security glazing as fragile merchandise, and packaged and shipped in export wood cases with width end in upright position and blocked together in a mass. Storage and handling shall comply with Manufacturer's directions and as required to prevent edge damage or other damage to glazing resulting from effects of moisture, condensation, temperature changes, direct exposure to sun, other environmental conditions, and contact with chemical solvents.

2. Protect sealed-air-space insulating glazing units from exposure to abnormal pressure changes, as could result from substantial changes in altitude during delivery by air freight. Provide temporary breather tubes which do not nullify applicable warranties on hermetic seals.

3. Temporary protections: The glass front and polycarbonate/Noviflex back of glazing shall be temporarily protected with compatible, peelable, heat-resistant film which will be peeled for inspections and re-applied and finally removed after doors and windows are installed at destination. Since many adhesives will attack polycarbonate, the film used on exposed polycarbonate surfaces shall be approved and applied by manufacturer.

4. Edge protection: To cushion and protect glass clad, polycarbonate, and Noviflex edges from contamination or foreign matter, the four edges shall be sealed the depth of glazing with continuous standard-thickness Santoprene tape. Alternatively, continuous channel shaped extrusion of Santoprene shall be used, with flanges extending into face sides of glazing.

5. Protect "Constant Temperature" units including every unit where glass sheet is directly laminated to or directly sealed with metal-tube type spacer bar to polycarbonate sheet, from exposures to ambient temperatures outside the range of 16 to 24 C, during the fabricating, handling, shipping, storing, installation, and subsequent protection of glazing.

1.7 PROJECT CONDITIONS

A. Field Measurements: Field measure openings before ordering tempered glass products. Be responsible for proper fit of field measured products.

1.8 WARRANTY

A. Warranty: Conform to terms of "Warranty of Construction", FAR clause 52.246-21, except extend warranty period for the following:

1. Insulating glass units to remain sealed for 10 years.

2. Polycarbonate to remain clear and ultraviolet light stabilized for 5 years.

1.9 QUALITY ASSURANCE

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints

and Coatings", where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.10 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American National Standards Institute (ANSI):

1. Z97.1-04 Safety Glazing Material Used in Building - Safety Performance Specifications and Methods of Test.

C. American Society for Testing and Materials (ASTM):

1. C1363-05 Thermal Performance of Building Assemblies, by Means of A Hot Box Apparatus

2. C542-05 Lock-Strip Gaskets.

3. C716-06 Installing Lock-Strip Gaskets and Infill Glazing Materials.

4. C794-06 Adhesion-in-Peel of Elastomeric Joint Sealrnts.

5. C864-05 Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

6. C920-08 Elastomeric Joint Sealants.

7. C964-07 Standard Guide for Lock-Strip Gasket Glazing

8. C1036-06 Flat Glass.

9. C1048-04 Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.

10. C1172-09 Laminated Architectural Flat Glass.

11. C1376-10 Pyrolytic and Vacuum Deposition Coatings on Flat Glass.

12. D635-06 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastic in a Horizontal Position.

13. D4802-07 Poly (Methyl Methacrylate) Acrylic Plastic Sheet.

14. E84-08 Surface Burning Characteristics of Building Materials.

15. E1300-09 Determining Load Resistance of Glass in Buildings.

16. E2190-08 Insulating Glass Unit

D. Commercial Item Description (CID):

1. A-A-59502 Plastic Sheet, Polycarbonate

E. Code of Federal Regulations (CFR):

1. 16 CFR 1201 Safety Standard for Architectural Glazing Materials; 1977, with 1984 Revision.

F. National Fire Protection Association (NFPA):

1. 80-08 Fire Doors and Windows.

G. National Fenestration Rating Council (NFRC):

H. Safety Glazing Certification Council (SGCC)2009:

1. Certified Products Directory (Issued Semi-Annually).

I. Underwriters Laboratories, Inc. (UL):

1. 752-06 Bullet-Resisting Equipment.

J. Unified Facilities Criteria (UFC):

1. 4-010-01-2007 DOD Minimum Antiterrorism Standards for Buildings

K. Glass Association of North America (GANA):

1. Glazing Manual (Lastest Edition)
2. Sealant Manual (2008)

L. American Society of Civil Engineers (ASCE):

1. ASCE 7-10 Wind Load Provisions

PART 2 - PRODUCTS

2.1 GLASS

A. Use thickness stated unless specified otherwise in assemblies.

B. Clear Glass:

1. ASTM C1036, Type I, Class 1, Quality q3.
2. Thickness, no less than 6 mm (1/4 inch) or as indicated.

2.2 HEAT-TREATED GLASS

A. Tinted Heat Strengthened Glass:

1. ASTM C1048, Kind HS, Condition A, Type I, Class 2, Quality q3.
2. Color: Gray.
3. Thickness, 6 mm (1/4 inch)or as indicated].

B. Clear Tempered Glass:

1. ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.
2. Thickness, 6 mm (1/4 inch)or as indicated].

C. Tinted Tempered Glass.

1. ASTM C1048, Kind FT, Condition A, Type I, Class 2, Quality q3.
2. Thickness, 6 mm (1/4 inch)or as indicated].

2.3 COATED GLASS

A. Low-E Tempered Glass:

1. ASTM C1048, Kind FT, Condition C, Type I, Class 1, Quality q3 with low emissivity pyrolytic coating having an E of 0.15.
2. Apply coating to second surface of insulating glass units.

3. Thickness, 4.8 mm (3/16 inch) or as indicated.

B. Ceramic Coated Vision Glass:

1. ASTM C1048, Kind HS FT, Condition C, Type I, Class 1 2, Quality q3 with ceramic coating applied by silk-screen process.
2. Pattern as indicated in Drawings.
3. Apply coating to third surface of insulating glass units.
4. Thickness, as indicated.

2.4 LAMINATED GLAZING ASSEMBLIES

A. Clear Glazing:

1. Both panes clear glass ASTM C1036, Type I, Class 1, Quality q3.
2. Thickness: Each pane, 3 mm (1/8 inch) thick.

B. Cleared Tempered Glazing:

1. Both panes ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.
2. Thickness: Each pane 4.8 mm (3/16 inch) thick.

C. Tinted Tempered Glazing:

1. Exterior pane ASTM C1036, Type I, Class 3, Quality q3, 3 mm (1/8 inch) thick.
2. Interior pane ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3, 3 mm (1/8 inch) thick.

D. Clear Polycarbonate Sheet, Abrasion Resistant:

1. Fed. Spec. A-A-59502, Type III, coated mar resistant, Class 1, ultraviolet light stabilized, Grade A, High abrasion resistance. Flame spread of 10 or less when tested per ASTM E84.
2. Thickness: Each pane, as indicated .

2.5 INSULATING GLASS UNITS

A. Provide factory fabricated, hermetically sealed glass unit consisting of two panes of glass separated by a dehydrated air space and comply with ASTM E2190.

B. Assemble units using glass types specified:

C. Sealed Edge Units (SEU):

1. Insulating Glass Unit Makeup
   a. Outboard Lite
      1) Glass Type: Clear float glass.
      2) Glass Tint: Gray.
      3) Nominal Thickness: 6 mm (1/4 inch).
      4) Glass Strenght: Tempered
      5) Coating Orietnation: (N/A)

b. Spacer

1) Nominal Thickenss:12 mm (1/2 inch)

2) Gas Fill: (Air or 90% Argon)

c. Inboard Lite

1) Glass Type: Clear float glass

2) Glass Tint: None.

3) Nominal Thickness: 6 mm (1/4 inch).

4) Glass Strength: Tempered

5) Coating Orientation: Surface #1

2. Performance Characteristics (Center of Glass)

a. Visible Tansmittance: 72%)

b. Winter U-factor (U-value): 26

c. Solar heat Gain Coefficient (SHGC): 41

3. Glass shall be tempered as required by codes, or as required to meet thermal stress and wind loads.

4. Glass heat-treated by horizontal (roller hearth) pres with inherent roller wave distortion parallel to the bottom edge of the glass as installed when specified.

2.6 FIRE RESISTANT GLASS WITHOUT WIRE MESH

A. Fire resistant glass or glass assembly classified by UL in Building Materials Directory or other approved testing laboratory bearing permanent mark of classification.

B. Basis of Design: Firelite or equal.

1. UL listing R13377-1, 4.8 mm (3/16 inch) thick, unpolished.

2. Distributed by Technical Glass Products; Kirkland, WA 98033.

2.7 GLAZING ACCESSORIES

A. As required to supplement the accessories provided with the items to be glazed and to provide a complete installation. Ferrous metal accessories exposed in the finished work shall have a finish that will not corrode or stain while in service.

B. Setting Blocks: ASTM C864:

1. Channel shape; having 6 mm (1/4 inch) internal depth.

2. Shore a hardness of 80 to 90 Durometer.

3. Block lengths: 50 mm (2 inches) except 100 to 150 mm (4 to 6 inches) for insulating glass.

4. Block width: Approximately 1.6 mm (1/16 inch) less than the full width of the rabbet.

5. Block thickness: Minimum 4.8 mm (3/16 inch). Thickness sized for rabbet depth as required.

C. Spacers: ASTM C864:

1. Channel shape having a 6 mm (1/4 inch) internal depth.
2. Flanges not less 2.4 mm (3/32 inch) thick and web 3 mm (1/8 inch) thick.
3. Lengths: One to 25 to 76 mm (1 to 3 inches).
4. Shore a hardness of 40 to 50 Durometer.

D. Sealing Tapes:

1. Semi-solid polymeric based material exhibiting pressure-sensitive adhesion and withstanding exposure to sunlight, moisture, heat, cold, and aging.
2. Shape, size and degree of softness and strength suitable for use in glazing application to prevent water infiltration.

E. Spring Steel Spacer: Galvanized steel wire or strip designed to position glazing in channel or rabbeted sash with stops.

F. Glazing Clips: Galvanized steel spring wire designed to hold glass in position in rabbeted sash without stops.

G. Lock-Strip Glazing Gaskets: ASTM C542, shape, size, and mounting as indicated.

H. Glazing Sealants: ASTM C920, silicone neutral cure:

1. Type S.
2. Class 25
3. Grade NS.
4. Shore A hardness of 25 to 30 Durometer.

I. Neoprene, EPDM, or Vinyl Glazing Gasket: ASTM C864.

1. Channel shape; flanges may terminate above the glazing channel or flush with the top of the channel.
2. Designed for dry glazing.

J. Color:

1. Color of glazing compounds, gaskets, and sealants used for aluminum color frames shall match color of the finished aluminum and be nonstaining.
2. Color of other glazing compounds, gaskets, and sealants which will be exposed in the finished work and unpainted shall be black, gray, or neutral color.

K. Smoke Removal Unit Targets: Adhesive targets affixed to glass to identify glass units intended for removal for smoke control. Comply with requirements of local Fire Department.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Examine openings for glass and glazing units; determine they are proper size; plumb; square; and level before installation is started.

2. Verify that glazing openings conform with details, dimensions and tolerances indicated on manufacturer’s approved shop drawings.

B. Advise Contractor of conditions which may adversely affect glass and glazing unit installation, prior to commencement of installation: Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Verify that wash down of adjacent masonry is completed prior to erection of glass and glazing units to prevent damage to glass and glazing units by cleaning materials.

3.2 PREPARATION

A. For sealant glazing, prepare glazing surfaces in accordance with GANA-02 Sealant Manual.

B. Determine glazing unit size and edge clearances by measuring the actual unit to receive the glazing.

C. Shop fabricate and cut glass with smooth, straight edges of full size required by openings to provide GANA recommended edge clearances.

D. Verify that components used are compatible.

E. Clean and dry glazing surfaces.

F. Prime surfaces scheduled to receive sealants, as determined by preconstruction sealant- substrate testing.

3.3 INSTALLATION - GENERAL

A. Install in accordance with GANA-01 Glazing Manual and GANA-02 Sealant Manual unless specified otherwise.

B. Glaze in accordance with recommendations of glazing and framing manufacturers, and as required to meet the Performance Test Requirements specified in other applicable sections of specifications.

C. Set glazing without bending, twisting, or forcing of units.

D. Do not allow glass to rest on or contact any framing member.

E. Glaze doors and operable sash, in a securely fixed or closed and locked position, until sealant, glazing compound, or putty has thoroughly set.

F. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.

G. Laminated Glass:

1. Tape edges to seal interlayer and protect from glazing sealants.

2. Do not use putty or glazing compounds.

H. Insulating Glass Units:

1. Glaze in compliance with glass manufacturer's written instructions.

2. When glazing gaskets are used, they shall be of sufficient size and depth to cover glass seal or metal channel frame completely.

3. Do not use putty or glazing compounds.

4. Do not grind, nip, cut, or otherwise alter edges and corners of fused glass units after shipping from factory.

5. Install with tape or gunnable sealant in wood sash.

I. Fire Resistant Glass:

1. Wire glass: Glaze in accordance with NFPA 80.
2. Other fire resistant glass: Glaze in accordance with UL design requirements.

3.4 INSTALLATION - DRY METHOD (TAPE AND GASKET SPLINE GLAZING)

A. Cut glazing tape to length; install on glazing pane. Seal corners by butting and sealing junctions with butyl sealant.

B. Place setting blocks at 1/4 points with edge block no more than 150 mm (6 inches) from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.

D. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Trim protruding tape edge.

3.5 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

A. Cut glazing tape to length and install against permanent stops, projecting 1.6 mm (1/16 inch) above sight line.

B. Place setting blocks at 1/4 points with edge block no more than 150 mm (6 inches) from corners.

C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.

D. Install removable stops, spacer shims inserted between glazing and applied stops at 600 mm (24 inch) intervals, 6 mm (1/4 inch) below sight line.

E. Fill gaps between pane and applied stop with specified sealant to depth equal to bite on glazing, to uniform and level line.

F. Trim protruding tape edge.

3.6 REPLACEMENT AND CLEANING

A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by Resident Engineer.

B. Replace cracked, broken, and imperfect glass, or glass which has been installed improperly.

C. Leave glass, putty, and other setting material in clean, whole, and acceptable condition.

3.7 PROTECTION

A. Protect finished surfaces from damage during erection, and after completion of work. Strippable plastic coatings on colored anodized finish are not acceptable.

3.8 GLAZING SCHEDULE

A. Fire Resistant Glass:

1. Install clear wire glass in interior fire rated or labeled doors and windows.
2. Use Fire Resistant Glass without wire mesh in the following:
   a. Fire-rated doors with glass lights, 1 HR rated

B. Tempered Glass:

1. Install in full and half glazed doors unless indicated otherwise.
2. Install in storefront, windows, and door sidelights adjacent to doors.
3. Use clear tempered glass on interior side lights and doors, and on exterior doors and sidelights unless otherwise indicated or specified.

C. Clear Glass

1. Interior observation windows not specified otherwise.
2. Interior pane of dual glazed windows not receiving tempered, laminated or organic coated glass, or other special glass indicated or specified.

D. Insulating Glass:

1. Install SEU clear tempered glass in windows, interior pane of dual glazed windows, adjacent to entrances or walks.
2. Install SEU clear glass in windows, interior pane of dual glazed windows, not adjacent to entrances or walks.
3. Install SEU tinted tempered and clear tempered glass in storefronts, curtain walls adjacent to entrances or walks.

E. Laminated Glass: Install as specified in interior pane of dual glazed windows where indicated.

1. Laminated glass shall be 5/16 inch thick elsewhere.(min. 1.5 mm interlayer)
2. If laminated glass is required for double glazed windows, provide it for interior panes only.
3. Where laminated glass is required for blast-resistant windows, follow UFC4-010-01, DOD Minimum Antiterrorism Standards for Buildings.

- - - E N D - - -

SECTION 08 90 00

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies fixed wall louvers, and wall vents.

1.2 RELATED WORK

A. Color of finish: Section 09 06 00, SCHEDULE FOR FINISHESS.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Shop Drawings:

1. Each type, showing material, finish, size of members, method of assembly, and installation and anchorage details.

D. Manufacturer's Literature and Data:

1. Each type of louver and vent.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. The Master Painters Institute (MPI):

1. Approved Product List – November 2007

C. American Society for Testing and Materials (ASTM):

1. A167-99(R2004) Stainless and Heat-Resisting Chromium - Nickel Steel Plate, Sheet, and Strip
2. A1008/A1008M REV A-07 Steel, Sheet, Carbon, Cold Rolled, Structural, and High Strength Low-Alloy with Improved Formability
3. B209/B209M-07 Aluminum and Aluminum Alloy, Sheet and Plate
4. B221-06 Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
5. B221M-07 Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Shapes, and Tubes

D. National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 500-505 (1988) Metal Finishes Manual

E. National Fire Protection Association (NFPA):

1. 90A-02 Installation of Air Conditioning and Ventilating Systems

F. American Architectural Manufacturers Association (AAMA):

1. 605-98 High Performance Organic Coatings on Architectural Extrusions and Panels

G. Air Movement and Control Association, Inc. (AMCA):

1. 500-L-99 Testing Louvers

H. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum, Extruded: ASTM B221/B221M.

B. Stainless Steel: ASTM A167, Type 302B.

C. Fasteners: Fasteners for securing louvers and wall vents to adjoining construction, except as otherwise specified or shown, shall be toggle or expansion bolts, of size and type as required for each specific type of installation and service condition.

1. Where type, size, or spacing of fasteners is not shown or specified, submit shop drawings showing proposed fasteners, and method of installation.

2. Fasteners for louvers, louver frames, and wire guards shall be of stainless steel or aluminum.

D. Inorganic Zinc Primer: MPI No. 19.

2.2 EXTERIOR WALL LOUVERS

A. General:

1. Provide fixed type louvers of size and design shown.

2. Heads, sills and jamb sections shall have formed caulking slots or be designed to retain caulking. Head sections shall have exterior drip lip, and sill sections an integral water stop.

3. Furnish louvers with sill extension or separate sill as shown.

4. Frame shall be mechanically fastened or welded construction with welds dressed smooth and flush.

B. Performance Characteristics:

1. Weather louvers shall have a minimum of 55.3 percent free area and shall pass 4.59 mm/s (904fpm) free area velocity at a pressure drop not exceeding 0.13 inch water gage and carry not more than 0.01 ounces of water per square foot) of free area for 15 minutes when tested per AMCA Standard 500-L.

2. Louvers shall bear AMCA certified rating seals for air performance and water penetration ratings.

C. Aluminum Louvers:

1. General: Frames, blades, **sills** and mullions (sliding interlocking type); 2 mm (0.081 inch) thick extruded aluminum. Blades shall be **standard drainable** type and have reinforcing bosses.

2. Louvers, fixed: Make frame sizes 13 mm (1/2-inch) smaller than openings. Single louvers frames shall not exceed 1700 mm (66 inches) wide. When openings exceed 1700 mm (66 inches), provide twin louvers separated by mullion members.

2.3 CLOSURE ANGLES AND CLOSURE PLATES

A. Fabricate from 2 mm (0.074-inch) thick stainless steel or aluminum.

B. Provide continuous closure angles and closure plates on inside head, jambs and sill of exterior wall louvers.

C. Secure angles and plates to louver frames with screws, and to masonry or concrete with fasteners as specified.

2.4 WIRE GUARDS

A. Provide wire guards on outside of all exterior louvers, except on exhaust air louvers.

B. Fabricate frames from 1.5 mm (0.059 inch) thick stainless steel designed to retain wire mesh.

C. Wire mesh shall be woven from not less than 1.6 mm (0.063 inch) diameter aluminum wire in 13 mm (1/2 inch) square mesh.

D. Miter corners and join by concealed corner clips or locks extending about 57 mm (2 inches) into rails and stiles. Equip wire guards over four feet in height with a mid-rail constructed as specified for frame components.

E. Fasten frames to outside of louvers with aluminum or stainless steel devices designed to allow removal and replacement without damage to the wire guard or the louver.

2.5 WALL VENTS

A. Fabricate exterior wall vents from either 4.7 mm (0.187 inch) thick aluminum plate of 6 mm (1/4 inch) thick cast iron, perforated in diamond lattice pattern, with not over 19 mm (3/4 inch) openings.

B. Vents shall have aluminum screen frame with aluminum alloy insect screening mounted on back of vent by means of 19 mm x 5 mm (3/4 inch by 3/16 inch) top and bottom bars screwed to grille.

C. Vent Frames In Masonry: Fabricate of 45 mm x 30 mm x 5 mm (1-3/4 inch by 1-1/4 inch by 3/16 inch) steel angles bolted with 6 mm (1/4 inch) diameter expansion bolts at jambs.

2.6 AIR INTAKE VENTS

A. Fabricate exterior louvered wall ventilators for fresh air intake for air conditioning units from extruded aluminum, ASTM B221. Form with integral horizontal louvers and frame, with drip extending beyond face of wall and integral water stops.

B. Provide aluminum closures where shown for inside face of dummy vents.

C. Provide 0.8 m (0.032 inch) thick aluminum sleeves[**in cavity walls**][**where shown**].

2.7 FINISH

A. In accordance with NAAMM Metal Finishes Manual: AMP 500-505

B. Aluminum Louvers Air Intake Vents Wire Guards:

.

1. Organic Finish: AAMA 605 (Fluorocarbon coating).

C. Aluminum **Wall Vents**: Sand blasted satin finish.

2.8 PROTECTION

A. Provide protection for aluminum against galvanic action wherever dissimilar materials are in contact, by painting the contact surfaces of the dissimilar material with a heavy coat of bituminous paint (complete coverage), or by separating the contact surfaces with a performed synthetic rubber tape

having pressure sensitive adhesive coating on one side.

B. Isolate the aluminum from plaster, concrete and masonry by coating aluminum with zinc-chromate primer.

C. Protect finished surfaces from damage during fabrication, erection, and after completion of the work. Strippable plastic coating on **organic** finish is not approved.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set work accurately, in alignment and where shown. Items shall be plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.

B. Furnish setting drawings and instructions for installation of anchors and for the positioning of items having anchors to be built into masonry construction. Provide temporary bracing for such items until masonry is set.

C. Provide anchoring devices and fasteners as shown and as necessary for securing louvers[**and vents**]to building construction as specified. Power actuated drive pins may be used, except for removal items and where members would be deformed or substrate damaged by their use.

D. Generally, set wall louvers **and vents** in masonry walls during progress of the work. If wall louvers **and vents**]are not delivered to job in time for installation in prepared openings, make provision for later installation. Set in cast-in-place concrete in prepared openings.

3.2 CLEANING AND ADJUSTING

A. After installation, all exposed prefinished and plated items and all items fabricated from stainless steel and aluminum shall be cleaned as recommended by the manufacturer and protected from damage until completion of the project.

B. All movable parts, including hardware, shall be cleaned and adjusted to operate as designed without binding or deformation of the members, so as to be centered in the opening of frame, and where applicable, to have all contact surfaces fit tight and even without forcing or warping the components

- - - E N D - - -

SECTION 09 06 00

SCHEDULE FOR FINISHES

VAMC: Lebanon VA Medical Center
Location: Lebanon, PA 17042
Project no. and Name: 595-109 Behavioral Health Complex
Submission: 100% Construction Documents
Date: April 27, 2012

SECTION 09 06 00 - SCHEDULE FOR FINISHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section contains a coordinated system in which requirements for materials specified in other sections shown are identified by abbreviated material names and finish codes in the room finish schedule or shown for other locations.

1.2 MANUFACTURERS

A. Manufacturer’s trade names and numbers used herein are only to identify colors, finishes, textures and patterns. Products of other manufacturer’s equivalent to colors, finishes, textures and patterns of manufacturers listed that meet requirements of technical specifications will be acceptable upon approval in writing by contracting officer for finish requirements.

B. Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES–provide quadruplicate samples for color approval of materials and finishes specified in this section.

1.3 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.

B. MASTER PAINTING INSTITUTE: (MPI)

1. 2001 Architectural Painting Specification Manual

PART 2 - PRODUCTS

2.1 DIGITAL COLOR PHOTOS

A. Size 24 x 35 mm.

B. Labeled for:

1. Building name and Number.

2. Room Name and Number.

C. SECTION 32 17 23, PAVEMENT MARKINGS.

Color	Manufacturer	MFG. Color Name/No.
Yellow		
White		

D. SITE AND STREET FURNISHINGS

Item	Style Name/No.	Finish	Manufacture	Mfg. Color Name/No.
Bike Rack				Black
Benches				
Planters				
Tree Grates				
Trash Receptacles				
Ash Receptacles				

2.2 DIVISION 03 – CONCRETE

A. SECTION 03 45 00, PRECAST ARCHITECTURAL CONCRETE

Finish Color	Texture	Finish	Manufacturer	Mfg. Color Name/No.
	TBD		Paul Brothers, Inc	#501

B. SECTION 03 36 00, CONCRETE FINISHES

Finish Color	Texture	Finish	Manufacturer	Mfg. Color Name/No.
Beige	TBD	TBD	SureCrete	TBD

2.3 DIVISON 04 – MASONRY

A. SECTION 04 05 13, MASONRY MORTARING and Section 04 05 16, MASONRY GROUTING

Finish Code	Manufacturer	Mfg. Color Name
	Glen Gerry	Portland Cement & Lime Blend

B. SECTION 04 20 00, UNIT MASONRY

3. CONCRETE MASONRY UNIT (CMU)				
Type	Size	Pattern	Finish	Mfg. Color Name/No.
Chamfered Ground Face	Nom. 8 x 16 x 4 x 2″ chamfer	Running Bond		Fizzano Bros. F-518

C. STONE FACING

Name of Stone	Color, Texture, Finish	Stone Source
"Appalachian Blue" (Exterior)	Core Series Real Stone Veneer	Rolling Rock Building Stone
Silver Ledgestone (Interior)	Ledgestone	Natural Stone Veneers, Inc.

2.4 DIVISION 05 – METALS

A. SECTION 05 50 00, METAL FABRICATION

Item	Finish
Steel Ladders	Paint, Black, Satin
Steel Ladder Rungs	Paint, Black, Satin
Ceiling Hatch	Match to adjacent ceiling

2.5 DIVISION 06 WOOD, PLASTICS, AND COMPOSITES

Type	Finish/Color
PL-1 Plastic Laminate	Manufacturer: Pionite Pattern: Silvio WY131 Finish: Suede
SSP-1 Solid Surfacing	Manufacturer: LG Hausys Color: Venus T001 Dimension: ½" thick

WM-1 Running Trim – Stone Top Cap	Wood Species and stain to match engineered wood truss system
WM-2 Running Trim – Window Trim	Wood Species and stain to match engineered wood truss system
WM-3 Running Trim – Wood Mantel	Wood Species and stain to match engineered wood truss system

2.6 DIVISION 07 - THERMAL AND MOISTURE PROTECTION

A. SECTION 07 31 13, ASPHALT SHINGLES

Size	Shape	Manufacturer	Mfg. Color Name/No.
Standard	Architectural	Certainteed	Landmark Solaris Weathered Wood

B. SECTION 07 46 00, **FIBER-CEMENT SIDING, TRIM AND SOFFIT**

Item	Manufacturer	Mfg. Color Name/No.
Siding, Trim and Soffits	James Hardie	Monterey Taupe, JH40-20

C. SECTION 07 60 00, FLASHING AND SHEET METAL

Item	Material	Finish
Hanging Gutters and Downspouts	Aluminum	Match adjacent surface

D. SECTION 07 92 00, JOINT SEALANTS

Location	Color	Manufacturer	Manufacturer Color
Masonry Expansion Joints		Tremco	Match adjacent surface
CMU Control Joints		Tremco	Match adjacent surface
Stone Sealed Joints		Tremco	Match adjacent surface

2.7 DIVISION 08 - OPENINGS

A. SECTION 08 11 13, HOLLOW METAL DOORS AND FRAMES

Paint both sides of door and frames same color including ferrous metal louvers, and hardware attached to door	
Component	Color of Paint Type and Gloss
Door	Sherwin Williams, Grays Harbor SW6236, Level 1
Frame	Sherwin Williams, Grays Harbor SW6236, Level 1

B. SECTION 08 14 00, WOOD DOORS

Component	Finish/Color
Doors	Marshfield, Plain Sliced White Maple, Nutmeg 48-97
Frames (Interior)	PT-2, Level 5

A. SECTION 08 14 23, ALUMINUM CLAD WOOD DOORS

Component	Finish/Color
Doors	Exterior – 2 coat kynar to match Sherwin Williams, Grays Harbor SW6236 Interior – wood veneer to match Marshfield, Plain Sliced Maple, Nutmeg 48-97

B. SECTION 08 31 13, ACCESS DOORS AND FRAMES

Material	Finish/Color
Steel	Match adjacent surface

Stainless steel	Match adjacent surface

C. SECTION 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

Material	Finish	Manufacturer	Manufacturer./Color Name/No.
Aluminum	2-coat kynar, to be selected from manufacturer's full range	Besam	Sherwin Williams, Alabaster SW7008, Level 1 (PT-6
Aluminum	2-coat kynar, to be selected from manufacturer's full range	Pella	Sherwin Williams, Grays Harbor SW6236, Level 1
Aluminum	2-coat kynar, Sterling Gray	Kawneer	Tri-Fab VG(Versa Glaze)451T, Inside Glazed
Glass			

D. SECTION 08 52 23, ALUMINUM CLAD WOOD WINDOWS

Material	Finish	Manufacturer	Manufacturer./Color Name/No.
Exterior - At stone veneer walls		Pella	To match PT-6
Exterior - At fiber cement walls		Pella	To match PT-7

E. WINDOW SILLS

Location	Material	Finish
Exterior - At fiber cement walls	Fiber cement trim as detailed	Painted - To match Sherwin Williams Grays Harbor 6236
Exterior - At stone veneer walls	Cast Stone as detailed	Paul Brothers, Inc., #501
Interior	Solid Surface as detailed	To match SSP-1

F. SECTION 08 80 00, GLAZING

Glazing Type	Manufacturer	Mfg. Color Name/No.
Vision Windows & Doors	Window manufacturer’s standard supplier	Clear spectrally selective Low-E double pane glazing units

1.2 DIVISION 09 - FINISHES

A. SECTION 09 30 13, CERAMIC TILING

2. SECTION 09 30 13, CERAMIC TILING (CT)

Finish code	Size	Manufacturer	Mfg. Color Name/No
CT-1	12″x24″	GARDEN STATE TILE	TRAVERTINI, BEIGE MATTE GSP1036717

CT-2	6″x12″	HEATH CERAMICS	BLUE LAKE/ M-25
CTF-1	2″x2″	GARDEN STATE TILE	TRAVERTINI, BEIGE MATTE GSP1037075
CTB-1	6″X12″	GARDEN STATE TILE	TRAVERTINI, BEIGE MATTE GSP1036717

8. SECTION 09 30 13, CERAMIC TILE GROUT

Finish Code	Manufacturer	Mfg. Color Name/No.
G-1	Mapei	39 Ivory

11. SECTION 09 30 13, METAL DIVIDER STRIPS

Size	Material	Manufacturer
T-1 Cove Base	Stainless Steel	Schluter, Dilex-EHK, Stainless Steel 304 For use as cove base in Toilet Rooms

T-2 Transition Strip	Stainless Steel	Schluter, Quadec Q100E, Stainless Steel For use at all outside corner transitions & exposed tile edges in Toilet Rooms For use as outside corner on bench in Shower Room

B. SECTION 09 51 00, ACOUSTICAL CEILINGS

Finish Code	Component	Color Pattern	Manufacturer	Mfg Name/No.
GR-1	Exposed Suspension System	White	USG	Donn 15/16″
C-1	Type IV	White	USG	Mars ClimaPlus, 86785
C-4	Type XX B	White	USG	CleanRoom ClimaPlus, 56099
C-5 (For use at Consult Rooms)	Type III	White	USG	Radar ClimaPlus High CAC/High NRC 22523

C. SECTION 09 65 19, RESILIENT TILE FLOORING

Finish Code	Size	Material/Component	Manufacturer	Mfg Name/No.
LVT-1	6″x36″	Luxury Vinyl Tile	Centiva	Contour, Trio Walnut CP 3213-C
LVT-2	12″ x 18″	Luxury Vinyl Tile	Centiva	Event, Toscano Travertine, NS 7212-E

RT-1	19 11/16″ x 19 11/16″	Rubber Tile	Roppe	SafeTCork, Z114 Lunar Dust

D. SECTION 09 65 13, RESILIENT BASE STAIR TREADS AND ACCESSORIES

Finish Code	Item	Height	Manufacturer	Mfg Name/No.
RB-1	Rubber Base (RB)	4″	Johnsonite	Cove w/ Toe 09 Clay
RB-2	Rubber Base (RB)	6″	Johnsonite	Reveal 6" MW-XXX-F6 09 Clay
RST-1	Resilient Stair Treads (RST)		Roppe	114 Lunar Dust

1. SECTION 09 68 00, CARPET EDGE STRIP

Finish Code	Material	Manufacturer	Mfg. Color Name/No.
TS-1	Stainless Steel	Schluter	
TS-2	Vinyl	Johnsonite	09 Clay

E. SECTION 09 68 00, CARPET MODULES (CPT)

Finish Code	Size	Pattern direction	Manufacturer	Mfg. Color Name/No.

CPT-1	50cm x 50cm	ASHLAR	MILLIKEN	SOUND & FURY, INTENSITY, PITCH IN301

F. SECTION 09 67 23, EPOXY RESINOUS FLOORING (PE)

Finish code	Manufacturer	Mfg. Color Name/No.
PE-1	Stonhard	Stoneres RTZ, StonHenge
PEB-1	Stonhard	6”H Stoneres RTZ, StonHenge

G. SECTION 09 91 00, PAINT AND COATINGS

1. MPI Gloss and Sheen Standards

		Gloss @60	Gloss @85
Gloss Level 1	a traditional matte finish-flat	max 5 units and	max 10 units
Gloss Level 2	a high side sheen flat-“a velvet-like” finish	max 10 units and	10-35 units
Gloss Level 3	a traditional “egg-shell like” finish	10-25 units and	10-35 units
Gloss Level 4	a “satin-like” finish	20-35 units and	min. 35 units
Gloss Level 5	a traditional semi-gloss	35-70 units	
Gloss Level 6	a traditional gloss	70-85 units	
Gloss level 7	a high gloss	more than 85 units	

2. Paint code	Gloss	Manufacturer	Mfg. Color Name/No.

PT-1	3	Sherwin Williams	MODERATE WHITE SW6140
PT-2	4	Sherwin Williams	BASKET BEIGE SW6143
PT-3	3	Sherwin Williams	MINERAL DEPOSIT SW7652
PT-4	3	Sherwin Williams	ESCAPE GRAY SW6185
PT-5	3	Sherwin Williams	BLONDE SW6128
PT-6	1	Sherwin Williams	Alabaster SW7008
PT-7	1	Sherwin Williams	Grays Harbor SW6236

3. Stain Code (S)	Gloss and Transparency	Manufacturer	Mfg. Color Name/No.
S-1	Transparent		Wood Species and stain to match engineered wood truss system

H. SECTION 10 21 13, TOILET COMPARTMENTS

Component	Material	Manufacturer	Mfg. Color Name/No.

1. Panels	Solid Phenolic	Ampco, Inco	Euroline (without feet) To match PL-1
Urinal Screens	Solid Phenolic	Ampco, Inco	Euroline (without feet) To match PL-1
Doors	Solid Phenolic	Ampco, Inco	Euroline (without feet) To match PL-1

I. SECTION 08 90 00, LOUVERS AND WALL VENTS

Item	Material	Finish	Manufacturer	Mfg. Color Name/No.
Exterior - At stone veneer walls			Northeast Louvers	To match Sherwin Williams Alabaster SW7008
Exterior - At fiber cement walls			Northeast Louvers	To match Sherwin Williams Grays Harbor SW6236

J. SECTION 10 26 00, WALL GUARDS AND CORNER GUARDS

Item	Material	Manufacturer	Mfg. Color Name/No.
Corner Guards	WOOD	CS Group	Renaissance SMWS-10 Finish: #061 Light Oak Wood: Maple

K. SECTION 10 13 00 / 10 14 00, INTERIOR SIGNS

Sign Type	Component	Manufacturer	Mfg. Color Name/No.

Navigo Conference/Consult Screens	15” Tablet PC	Interactive Touchscreen Solutions	
	Bracket	Chief Manufacturing	FSR-4000

L. SECTION 10 44 13, FIRE EXTNGUISHER CABINETS

Component	Material	Finish
		White

1.3 DIVISION 12- FURNISHINGS

A. SECTION 12 36 00, COUNTERTOPS AND ACCESSORIES

Type	Finish/Color
Methyl Methacrylic Polymer (Solid Surface Polymer)	LG Hausys, Venus T001

B. SECTION 12 24 00, WINDOW SHADES (N.I.C)

Component	Material	Manufacturer	Mfg. Color Name/No.

Shade Cloth		Lutron	Classico Collection, Basketweave 27, Oyster Chestnut SP92-27
Support Hardware		Lutron	Anodized Aluminum

C. SECTION 12 32 00, MANUFACTURED WOOD CASEWORK

Finish Code	Material	Manufacturer	Mfg. Color Name/No.
PL-1	Plastic Laminate	Pionite	Silvio WY131 Finish: Suede
SSP-1	Solid Surfacing	LG Hausys	Venus T001 ½″ thk.

D. SECTION 12 48 16, ENTRANCE FLOOR GRILLS

Item	Material	Manufacturer	Mfg. Color Name/No.

Gridline 2 w/ carpet inserts (G6PC)	Satin finished type 304 stainless steel & Carpet	C-S Group	Carpet Inserts: 9330 Cocoa Mat

1.2 DIVISION 13 - SPECIAL CONSTRUCTION

A. SECTION 14 24 00, HYDRAULIC ELEVATORS

	Component	Material	Color
1. Passenger Elevator No. 1	Hoistway Entrances	Stainless Steel	Thyssen Krupp #4 Stainless Steel
	Hoistway Doors	Stainless Steel	Thyssen Krupp #4 Stainless Steel
	Corridor Position Indicator	Stainless Steel	Thyssen Krupp #4 Stainless Steel
	Car Canopy	White Translucent & Stainless Steel	Thyssen Krupp #4 Stainless Steel
	Car Wainscot	Stainless Steel	Thyssen Krupp #4 Stainless Steel
	Panels Above Wainscot	Plastic Laminate	Thyssen Krupp, Cognac Maple

	Car Floor	Luxury Vinyl Tile	LVT-2
	Corridor Call Buttons	Stainless Steel	Thyssen Krupp #4 Stainless Steel
	Car Doors	Baked Enamel	Thyssen Krupp #4 Stainless Steel
	Car Door Frame	Stainless Steel	Thyssen Krupp #4 Stainless Steel
	Corridor Position Indicator		
	Car Operating Panel	Stainless Steel	Thyssen Krupp #4 Stainless Steel
	1 ½″ Dia. Handrail	Stainless Steel	Thyssen Krupp #4 Stainless Steel

1.3 Division 22 - PLUMBING

A. SECTION 22 40 00, PLUMBING FIXTURES AND TRIM

Item	Color

Water Closet	White
Urinal	White
Lavatories	LG Hausys, Ivory White
Service Sink	White

1.4 DIVISON 26 - ELECTRICAL

A. SECTION 26 51 00, BUILDING LIGHTING INTERIOR

Fixture Type	Exterior Finish	Manufacturer	Mfg. Name/No.
Decorative Pendant	Glass	Tech Lighting	Sara Grande Clear

B. SECTION 26 56 00, SITE LIGHTING

Type and Component	Exterior Finish	Manufacturer	Mfg. Name/No.
C		Kim Lighting	1A-AR2-250WPSMH-VOLTS-COLOR-A3 Dark Bronze
D		Kim Lighting	2B-AR2-250PSMH-VOLTS-COLOR-A3 Dark Bronze
F		Kim Lighting	1A-AR4-250WPSMH-VOLTS-COLOR-A3 Dark Bronze
L		Kim Lighting	50W ED-17, Coated Dark Bronze

PART 2 - EXECUTION

2.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS	
Term	Abbreviation
Acoustical Ceiling	C
Anodized Aluminum Colored	AAC
Anodized Aluminum Natural Finish	AA
Baked On Enamel	BE

Brick Face	BR
Carpet Module Tile	CPT
Ceramic Glazed Facing Brick	CGFB
Ceramic Tile	CT
Concrete	C
Concrete Masonry Unit	CMU
Epoxy Coating	EC
Epoxy Resin Flooring	PE
Existing	E
Exposed Divider Strips	EXP
Exterior	EXT
Exterior Finish System	EFS
Exterior Paint	EXT-P
Exterior Stain	EXT-ST
Facing Tile	SCT
Feature Strips	FS
Floor Tile, Mosaic	FT
Fluorocarbon	FC
Glass Masonry Unit	GUMU
Glazed Face CMU	GCMU
Glazed Structural Facing Tile	SFTU
Granite	GT
Gypsum Wallboard	GWB
Material	MAT
Mortar	M
Natural Finish	NF
Paint	PT
Perforated Metal Facing (Tile or Panels)	PMF
Plaster	PL
Plaster High Strength	HSPL
Plaster Keene Cement	KC
Plastic Laminate	PL

Radiant Ceiling Panel System	RCP
Resilient Stair Tread	RST
Rubber Base	RB
Rubber Tile Flooring	RT
Sealed Concrete	SC
Spandrel Glass	SLG
Stain	S
Stained/Stamped Concrete	STC
Suspension Grids	GR
Veneer Plaster	VP
Vinyl Base	VB
Wood	WD

2.2 FINISH SCHEDULE SYMBOLS

Symbol	Definition
**	Same finish as adjoining walls
-	No color required
E	Existing
XX	To match existing
EFTR	Existing finish to remain
RM	Remove

- - - E N D - - -

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies steel studs wall systems, shaft wall systems, ceiling or soffit suspended or furred framing, wall furring, fasteners, and accessories for the screw attachment of gypsum board, plaster bases or other building boards.

1.2 RELATED WORK

A. Load bearing framing: Section 05 40 00, COLD-FORMED METAL FRAMING.

B. Support for wall mounted items: Section 05 50 00, METAL FABRICATIONS.

C. Pull down tabs in steel decking: Section 05 36 00, COMPOSITE METAL DECKING.

D. Ceiling suspension systems for acoustical tile or panels and lay in gypsum board panels: Section 09 51 00, ACOUSTICAL CEILINGS Section 09 29 00, GYPSUM BOARD.

1.3 TERMINOLOGY

A. Description of terms shall be in accordance with ASTM C754, ASTM C11, ASTM C841 and as specified.

B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by beams, trusses, or bar joists. In interstitial spaces with walk-on floors the underside of the walk-on floor is the underside of structure overhead.

C. Thickness of steel specified is the minimum bare (uncoated) steel thickness.

1.4 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED BUILDING Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's Literature and Data:
1. Studs, runners and accessories.
2. Hanger inserts.
3. Channels (Rolled steel).
4. Furring channels.
5. Screws, clips and other fasteners.

D. Shop Drawings:
1. Typical ceiling suspension system.
2. Typical metal stud and furring construction system including details around openings and corner details.
3. Typical shaft wall assembly
4. Typical fire rated assembly and column fireproofing showing details of construction same as that used in fire rating test.

E. Test Results: Fire rating test designation, each fire rating required for each assembly.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

A. In accordance with the requirements of ASTM C754.

1.6 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance RequirementS
1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

4. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society For Testing And Materials (ASTM)

1. A123-09 Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

2. A653/A653M-09 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process

3. A641-09 Zinc-Coated (Galvanized) Carbon Steel Wire

4. C11-09 Terminology Relating to Gypsum and Related Building Materials and Systems

5. C635-07 Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings

6. C636-06 Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

7. C645-09 Non-Structural Steel Framing Members

8. C754-09 Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

9. C841-03 (R2008) Installation of Interior Lathing and Furring

10. C954-07 Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

11. C1002-07 Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

12. E580-09 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint.

PART 2 - PRODUCTS

2.1 PROTECTIVE COATING

A. Galvanize steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with coating designation of G-60 minimum, per ASTM 123.

2.2 STEEL STUDS AND RUNNERS (TRACK)

A. ASTM C645, modified for thickness specified and sizes and shown.

1. Use ASTM A525 steel, 0.8 mm (0.0329-inch) thick bare metal (33 mil).

2. Runners same thickness as studs.

B. Provide not less than two cutouts in web of each stud, approximately 300

mm (12 inches) from each end, and intermediate cutouts on approximately 600 mm (24-inch) centers.

C. Doubled studs for openings and studs for supporting concrete backer-board.

D. Studs 3600 mm (12 feet) or less in length shall be in one piece.

E. Shaft Wall Framing:

1. Conform to rated wall construction.

2. C-H Studs.

3. E Studs.

4. J Runners.

5. Steel Jamb-Strut.

2.3 FURRING CHANNELS

A. Rigid furring channels (hat shape): ASTM C645.

B. Resilient furring channels:

1. Not less than 0.45 mm (0.0179-inch) thick bare metal.

2. Semi-hat shape, only one flange for anchorage with channel web leg slotted on anchorage side, channel web leg on other side stiffens fastener surface but shall not contact anchorage surface other channel leg is attached to.

C. "Z" Furring Channels:

1. Not less than 0.45 mm (0.0179-inch)-thick bare metal, with 32 mm (1-1/4 inch) and 19 mm (3/4-inch) flanges.

1. Web furring depth to suit thickness of insulation with slotted perforations.

D. Rolled Steel Channels: ASTM C754, cold rolled; or, ASTM C841, cold rolled.

2.4 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES

A. ASTM C754, except as otherwise specified.

B. For fire rated construction: Type and size same as used in fire rating test.

C. Fasteners for steel studs thicker than 0.84 mm (0.033-inch) thick. Use ASTM C954 steel drill screws of size and type recommended by the manufacturer of the material being fastened.

D. Clips: ASTM C841 (paragraph 6.11), manufacturer’s standard items. Clips used in lieu of tie wire shall have holding power equivalent to that provided by the tie wire for the specific application.

E. Concrete ceiling hanger inserts (anchorage for hanger wire and hanger straps): Steel, zinc-coated (galvanized), manufacturers standard items, designed to support twice the hanger loads imposed and the type of hanger used.

F. Tie Wire and Hanger Wire:

1. ASTM A641, soft temper, Class 1 coating.

2. Gage (diameter) as specified in ASTM C754 or ASTM C841.

G. Attachments for Wall Furring:

1. Manufacturers standard items fabricated from zinc-coated (galvanized) steel sheet.

2. For concrete or masonry walls: Metal slots with adjustable inserts or adjustable wall furring brackets. Spacers may be fabricated from 1 mm (0.0396-inch) thick galvanized steel with corrugated edges.

H. Power Actuated Fasteners: Type and size as recommended by the manufacturer of the material being fastened.

2.5 SUSPENDED CEILING SYSTEM FOR GYPSUM BOARD (OPTION)

A. Conform to ASTM C635, heavy duty, with not less than 35 mm (1-3/8 inch) wide knurled capped flange face designed for screw attachment of gypsum board.

B. Wall track channel with 35 mm (1-3/8 inch) wide flange.

PART 3 - EXECUTION

3.1 INSTALLATION CRITERIA

A. Where fire rated construction is required for walls, partitions, columns, beams and floor-ceiling assemblies, the construction shall be same as that used in fire rating test.

B. Construction requirements for fire rated assemblies and materials shall be as shown and specified, the provisions of the Scope paragraph (1.2) of ASTM C754 and ASTM C841 regarding details of construction shall not apply.

3.2 INSTALLING STUDS

A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.

B. Space studs not more than 400 mm (16 inches) on center.

C. Cut studs 6 mm to 9 mm (1/4 to 3/8-inch) less than floor to underside of structure overhead when extended to underside of structure overhead.

D. Where studs are shown to terminate above suspended ceilings, provide bracing as shown or extend studs to underside of structure overhead.

E. Extend studs to underside of structure overhead for fire, rated partitions, smoke partitions, shafts, and sound rated partitions and insulated exterior wall furring.

F. Openings:

1. Frame jambs of openings in stud partitions and furring with two studs placed back to back or as shown.

2. Fasten back to back studs together with 9 mm (3/8-inch) long Type S pan head screws at not less than 600 mm (two feet) on center, staggered along webs.

3. Studs fastened flange to flange shall have splice plates on both sides approximately 50 X 75 mm (2 by 3 inches) screwed to each stud with two screws in each stud. Locate splice plates at 400 mm (16 inches) on center between runner tracks.

G. Fastening Studs:

1. Fasten studs located adjacent to partition intersections, corners and studs at jambs of openings to flange of runner tracks with two screws through each end of each stud and flange of runner.

2. Do not fasten studs to top runner track when studs extend to underside of structure overhead.

H. Chase Wall Partitions:

1. Locate cross braces for chase wall partitions to permit the installation of pipes, conduits, carriers and similar items.

2. Use studs or runners as cross bracing not less than 63 mm (2-1/2 inches wide).

I. Form building seismic or expansion joints with double studs back to back spaced 75 mm (three inches) apart plus the width of the seismic or expansion joint.

J. Form control joint, with double studs spaced 13 mm (1/2-inch) apart.

3.3 INSTALLING WALL FURRING FOR FINISH APPLIED TO ONE SIDE ONLY

A. In accordance with ASTM C754, or ASTM C841 except as otherwise specified or shown.

B. Wall furring-Stud System:

1. Framed with 63 mm (2-1/2 inch) or narrower studs, 400 mm (16 inches) on center.

2. Brace as specified in ASTM C754 for Wall Furring-Stud System or brace with sections or runners or studs placed horizontally at not less than three foot vertical intervals on side without finish.

3. Securely fasten braces to each stud with two Type S pan head screws at each bearing.

C. Direct attachment to masonry or concrete; rigid channels or "Z" channels:

1. Install rigid (hat section) furring channels at 400 mm (16 inches) on center, horizontally or vertically.

2. Install "Z" furring channels vertically spaced not more than 600 mm (24 inches) on center.

3. At corners where rigid furring channels are positioned horizontally, provide mitered joints in furring channels.

4. Ends of spliced furring channels shall be nested not less than 200 mm (8 inches).

5. Fasten furring channels to walls with power-actuated drive pins or hardened steel concrete nails. Where channels are spliced, provide two fasteners in each flange.

6. Locate furring channels at interior and exterior corners in accordance with wall finish material manufacturers printed erection instructions. Locate "Z" channels within 100 mm (4 inches) of corner.

D. Installing Wall Furring-Bracket System: Space furring channels not more than 400 mm (16 inches) on center.

3.4 INSTALLING SUPPORTS REQUIRED BY OTHER TRADES

A. Provide for attachment and support of electrical outlets, plumbing, laboratory or heating fixtures, recessed type plumbing fixture accessories, access panel frames, wall bumpers, wood seats, toilet stall partitions, dressing booth partitions, urinal screens, chalkboards, tackboards, wall-hung casework, handrail brackets, recessed fire extinguisher cabinets and other items like auto door buttons and auto door operators supported by stud construction.

B. Provide additional studs where required. Install metal backing plates, or special metal shapes as required, securely fastened to metal studs.

3.5 INSTALLING SHAFT WALL SYSTEM

A. Conform to UL Design No. U438 for two-hour fire rating. Provide one hour fire rating Shaft wall at elevator .

B. Position J runners at floor and ceiling with the short leg toward finish side of wall. Securely attach runners to structural supports with power driven fasteners at both ends and 400 mm (16 inches) on center.

C. After liner panels have been erected, cut C-H studs and E studs, from 9 mm (3/8-inch) to not more than 13 mm (1/2-inch) less than floor-to-ceiling height. Install C-H studs between liner panels with liner panels inserted in the groove.

D. Install full-length steel E studs over shaft wall line at intersections, corners, hinged door jambs, columns, and both sides of closure panels.

E. Suitably frame all openings to maintain structural support for wall:

1. Provide necessary liner fillers and shims to conform to label frame requirements.

2. Frame openings cut within a liner panel with E studs around perimeter.

3. Frame openings with vertical E studs at jambs, horizontal J runner at head and sill.

F. Elevator Shafts:

1. Frame elevator door frames with 0.87 mm (0.0341-inch) thick J strut or J stud jambs having 75 mm (three-inch) long legs on the shaft side.

2. Protrusions including fasteners other than flange of shaft wall framing system or offsets from vertical alignments more than 3 mm (1/8-inch) are not permitted unless shown.

3. Align shaft walls for plumb vertical flush alignment from top to bottom of shaft.

3.6 INSTALLING FURRED AND SUSPENDED CEILINGS OR SOFFITS

A. Install furred and suspended ceilings or soffits in accordance with ASTM C754 or ASTM C841 except as otherwise specified or shown for screw attached gypsum board ceilings and for plaster ceilings or soffits.

1. Space framing at 400 mm (16-inch) centers for gypsum board anchorage.

B. New exposed concrete slabs:

1. Use metal inserts required for attachment and support of hangers or hanger

wires with tied wire loops for embedding in concrete.

2. Furnish for installation under Division 3, CONCRETE.

C. Concrete slabs on steel decking composite construction:

1. Use pull down tabs when available.

2. Use power activated fasteners when direct attachment to structural framing can not be accomplished.

D. Where bar joists or beams are more than 1200 mm (48 inches) apart, provide intermediate hangers so that spacing between supports does not exceed 1200 mm (48 inches). Use clips, bolts, or wire ties for direct attachment to steel framing.

E. Steel decking without concrete topping:

1. Do not fasten to steel decking 0.76 mm (0.0299-inch) or thinner.

2. Toggle bolt to decking 0.9 mm (0.0359-inch) or thicker only where anchorage to steel framing is not possible.

F. Installing suspended ceiling system for gypsum board (ASTM C635 Option):

1. Install only for ceilings to receive screw attached gypsum board.

2. Install in accordance with ASTM C636.

a. Install main runners spaced 1200 mm (48 inches) on center.

b. Install 1200 mm (four foot) tees not over 600 mm (24 inches) on center; locate for edge support of gypsum board.

c. Install wall track channel at perimeter.

G. Installing Ceiling Bracing System:

1. Construct bracing of 38 mm (1-1/2 inch) channels for lengths up to 2400 mm (8 feet) and 50 mm (2 inch) channels for lengths over 2400 mm (8 feet) with ends bent to form surfaces for anchorage to carrying channels and over head construction. Lap channels not less than 600 mm (2 feet) at midpoint back to back. Screw or bolt lap together with two fasteners.

2. Install bracing at an approximate 45 degree angle to carrying channels and structure overhead; secure as specified to structure overhead with two fasteners and to carrying channels with two fasteners or wire ties.

3. Brace suspended ceiling or soffit framing in seismic areas in accordance with ASTM E580.

3.7 TOLERANCES

A. Fastening surface for application of subsequent materials shall not vary more than 3 mm (1/8-inch) from the layout line.

B. Plumb and align vertical members within 3 mm (1/8-inch.)

C. Level or align ceilings within 3 mm (1/8-inch.)

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SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies installation and finishing of gypsum board.

1.2 RELATED WORK

A. Installation of steel framing members for walls, partitions, furring, soffits, and ceilings: Section 05 40 00, COLD-FORMED METAL FRAMING, and Section 09 22 16, NON- STRUCTURAL METAL FRAMING.

B. Sound deadening board: Section 07 21 13, THERMAL INSULATION.

C. Acoustical Sealants: Section 07 92 00, JOINT SEALANTS.

D. Lay in gypsum board ceiling panels: Section 09 51 00, ACOUSTICAL CEILING.

1.3 TERMINOLOGY

A. Definitions and description of terms shall be in accordance with ASTM C11, C840, and as specified.

B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by the trusses or bar joists.

C. "Yoked": Gypsum board cut out for opening with no joint at the opening (along door jamb or above the door).

1.4 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013300 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products.

Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's Literature and Data:

1. Cornerbead and edge trim.
2. Finishing materials.
3. Laminating adhesive.
4. Gypsum board, each type.

D. Shop Drawings:

1. Typical gypsum board installation, showing corner details, edge trim details and the like.
2. Typical sound rated assembly, showing treatment at perimeter of partitions and penetrations at gypsum board.
3. Typical shaft wall assembly.
4. Typical fire rated assembly and column fireproofing, indicating details of construction same as that used in fire rating test.

E. Samples:

1. Cornerbead.
2. Edge trim.
3. Control joints.

F. Test Results:

1. Fire rating test, each fire rating required for each assembly.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

A. In accordance with the requirements of ASTM C840.

1.6 ENVIRONMENTAL CONDITIONS

A. In accordance with the requirements of ASTM C840.

1.7 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements:

1. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable.
2. Materials manufactured within a radius of 500 miles from the project site

where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Gypsum materials shall be manufactured out of minimum 75% synthetic gypsum.

4. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

5. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.8 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing And Materials (ASTM):

1. C11-08 Terminology Relating to Gypsum and Related Building Materials and Systems

2. C475-02 Joint Compound and Joint Tape for Finishing Gypsum Board

3. C840-08 Application and Finishing of Gypsum Board

4. C919-08 Sealants in Acoustical Applications

5. C954-07 Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Stud from 0.033 in. (0.84mm) to 0.112 in. in thickness

6. C1002-07 Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

7. C1047-05 Accessories for Gypsum Wallboard and Gypsum Veneer Base

8. C1177-06 Glass Mat Gypsum Substrate for Use as Sheathing

9. C1658-06 Glass Mat Gypsum Panels

10. C1396-06 Gypsum Board

11. E84-08 Surface Burning Characteristics of Building Materials

C. Underwriters Laboratories Inc. (UL):

1. Latest Edition Fire Resistance Directory

D. Inchcape Testing Services (ITS):

1. Latest Editions Certification Listings

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

A. Gypsum Board: ASTM C1396, Type X, 16 mm (5/8 inch) thick unless shown

otherwise. Shall contain a minimum of 20 percent recycled gypsum.

B. Coreboard or Shaft Wall Liner Panels.

1. ASTM C1396, Type X.

2. ASTM C1658: Glass Mat Gypsum Panels,

3. Coreboard for shaft walls 300, 400, 600 mm (12, 16, or 24 inches) wide by required lengths 25 mm (one inch) thick with paper faces treated to resist moisture.

C. Water Resistant Gypsum Backing Board: ASTM C620, Type X, 16 mm (5/8 inch) thick.

D. Gypsum cores shall contain a minimum of 95 percent post industrial recycled gypsum content. Paper facings shall contain 100 percent post-consumer recycled paper content.

2.2 GYPSUM SHEATHING BOARD

A. ASTM C1396, Type X, water-resistant core, 16 mm (5/8 inch) thick.

B. ASTM C1177, Type X.

2.3 ACCESSORIES

A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.

B. Flanges not less than 22 mm (7/8 inch) wide with punchouts or deformations as required to provide compound bond.

2.4 FASTENERS

A. ASTM C1002 and ASTM C840, except as otherwise specified.

B. ASTM C954, for steel studs thicker than 0.04 mm (0.33 inch).

C. Select screws of size and type recommended by the manufacturer of the material being fastened.

D. For fire rated construction, type and size same as used in fire rating test.

E. Clips: Zinc-coated (galvanized) steel; gypsum board manufacturer's standard items.

2.5 FINISHING MATERIALS AND LAMINATING ADHESIVE

A. ASTM C475 and ASTM C840. Free of antifreeze, vinyl adhesives, preservatives, biocides and other VOC. Adhesive shall contain a maximum VOC content of 50 g/l.

PART 3 - EXECUTION

3.1 GYPSUM BOARD HEIGHTS

A. Extend all layers of gypsum board from floor to underside of structure overhead on following partitions and furring:

1. Two sides of partitions:

a. Fire rated partitions.

b. Smoke partitions.

c. Sound rated partitions.

d. Full height partitions shown (FHP).

2. One side of partitions or furring:

a. Inside of exterior wall furring or stud construction.

b. Room side of room without suspended ceilings.

c. Furring for pipes and duct shafts, except where fire rated shaft wall construction is shown.

3. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of structure overhead, unless shown otherwise.

B. In locations other than those specified, extend gypsum board from floor to heights as follows:

1. Not less than 100 mm (4 inches) above suspended acoustical ceilings.

2. At ceiling of suspended gypsum board ceilings.

3. At existing ceilings.

3.2 INSTALLING GYPSUM BOARD

A. Coordinate installation of gypsum board with other trades and related work.

B. Install gypsum board in accordance with ASTM C840, except as otherwise specified.

C. Moisture and Mold-Resistant Assemblies: Provide and install moisture and mold-resistant glass mat gypsum wallboard products with moisture-resistant surfaces complying with ASTM C1658 where shown and in locations which might be subject to moisture exposure during construction.

D. Use gypsum boards in maximum practical lengths to minimize number of end joints.

E. Bring gypsum board into contact, but do not force into place.

F. Ceilings:

1. For single-ply construction, use perpendicular application.

G. Walls (Except Shaft Walls):

1. When gypsum board is installed parallel to framing members, space fasteners 300 mm (12 inches) on center in field of the board, and 200 mm (8 inches) on center along edges.

2. When gypsum board is installed perpendicular to framing members, space fasteners 300 mm (12 inches) on center in field and along edges.

3. Stagger screws on abutting edges or ends.

4. For single-ply construction, apply gypsum board with long dimension either parallel or perpendicular to framing members as required to minimize number of joints except gypsum board shall be applied vertically over "Z" furring channels.

5. No offset in exposed face of walls and partitions will be permitted

because of single-ply and two-ply or three-ply application requirements.

6. Installing Two Layer Assembly Over Sound Deadening Board:

   a. Apply face layer of wallboard vertically with joints staggered from joints in sound deadening board over framing members.

   b. Fasten face layer with screw, of sufficient length to secure to framing, spaced 300 mm (12 inches) on center around perimeter, and 400 mm (16 inches) on center in the field.

7. Control Joints ASTM C840 and as follows:

   a. Locate at both side jambs of openings if gypsum board is not "yoked". Use one system throughout.

   b. Not required for wall lengths less than 9000 mm (30 feet).

   c. Extend control joints the full height of the wall or length of soffit/ceiling membrane.

H. Acoustical or Sound Rated Partitions, Fire and Smoke Partitions:

1. Cut gypsum board for a space approximately 3 mm to 6 mm (1/8 to 1/4 inch) wide around partition perimeter.

2. Coordinate for application of caulking or sealants to space prior to taping and finishing.

3. For sound rated partitions, use sealing compound (ASTM C919) to fill the annular spaces between all receptacle boxes and the partition finish material through which the boxes protrude to seal all holes and/or openings on the back and sides of the boxes. STC minimum values as shown.

I. Electrical and Telecommunications Boxes:

1. Seal annular spaces between electrical and telecommunications receptacle boxes and gypsum board partitions.

J. Accessories:

1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.

2. Install in one piece, without the limits of the longest commercially available lengths.

3. Corner Beads:

   a. Install at all vertical and horizontal external corners and where shown.

   b. Use screws only. Do not use crimping tool.

4. Edge Trim (casings Beads):

   a. At both sides of expansion and control joints unless shown otherwise.

   b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.

   c. Where gypsum board surfaces of non-load bearing assemblies abut load bearing members.

d. Where shown.

3.3 INSTALLING GYPSUM SHEATHING

A. Install in accordance with ASTM C840, except as otherwise specified or shown.

B. Use screws of sufficient length to secure sheathing to framing.

C. Space screws 9 mm (3/8 inch) from ends and edges of sheathing and 200 mm (8 inches) on center. Space screws a maximum of 200 mm (8 inches) on center on intermediate framing members.

D. Apply 600 mm by 2400 mm (2 foot by 8 foot) sheathing boards horizontally with tongue edge up.

E. Apply 1200 mm by 2400 mm or 2700 mm (4 ft. by 8 ft. or 9 foot) gypsum sheathing boards vertically with edges over framing.

3.4 CAVITY SHAFT WALL

A. Coordinate assembly with Section 09 22 16, NON-STRUCTURAL METAL FRAMING, for erection of framing and gypsum board.

B. Conform to UL Design No. U438 or FM WALL CONSTRUCTION 12-2/HR (Nonbearing for two-hour fire rating. Conform to FM WALL CONSTRUCTION 25- 1/HR (Non-loadbearing) for one-hour fire rating where shown.

C. Cut coreboard (liner) panels 25 mm (one inch) less than floor-to-ceiling height, and erect vertically between J-runners on shaft side.

1. Where shaft walls exceed 4300 mm (14 feet) in height, position panel end joints within upper and lower third points of wall.

2. Stagger joints top and bottom in adjacent panels.

3. After erection of J-struts of opening frames, fasten panels to J-struts with screws of sufficient length to secure to framing staggered from those in base, spaced 300 mm (12 inches) on center.

D. Gypsum Board:

1. One hour wall with one layer on finish side of wall: Apply face layer of gypsum board vertically. Attach to studs with screws of sufficient length to secure to framing, spaced 300 mm (12 inches) on center in field and along edges.

2. Where coreboard is covered with face layer of gypsum board, stagger joints of face layer from those in the coreboard base.

E. Treat joints, corners, and fasteners in face layer as specified for finishing of gypsum board.

F. Elevator Shafts:

1. Protrusions including fasteners other than flange of shaft wall framing system or offsets from vertical alignments more than 3 mm (1/8-inch) are not permitted unless shown.

2. Align shaft walls for plumb vertical flush alignment from top to bottom of shaft.

3.5 FINISHING OF GYPSUM BOARD

A. Finish joints, edges, corners, and fastener heads in accordance with ASTM

C840. Use Level 5 finish for al finished areas open to public view.

B. Before proceeding with installation of finishing materials, assure the following:

1. Gypsum board is fastened and held close to framing or furring.
2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.

C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non decorated fire rated and sound rated gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar work, seal remaining openings and maintain the integrity of the fire rated and sound rated construction/ Sanding is not required of non decorated surfaces.

3.6 REPAIRS

A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces.

B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.

C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.

D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction.

3.7 UNACCESSIBLE CEILINGS

A. At Mental Health and Behavioral Nursing Units, areas accessible to patients and not continuously observable by staff (e.g., Toilet Rooms), ceilings should be a solid material such as gypsum board. This will limit patient access. Access doors are needed to access electrical and mechanical equipment above the ceiling. These doors should be locked to prevent unauthorized access and secured to ceiling using tamper resistant fasteners.

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SECTION 09 30 13

CERAMIC/PORCELAIN TILING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies ceramic, porcelain and quarry tile, waterproofing membranes for thin-set applications, crack isolation membranes, tile backer board.

1.2 RELATED WORK

A. Preformed sealant joints in tile flooring: Section 07 95 13, EXPANSION JOINT COVER ASSEMBLIES.

B. Sealing of joints where specified: Section 07 92 00, JOINT SEALANTS.

C. Color, texture and pattern of field tile and trim shapes, size of field tile, and color of grout specified: Section 09 06 00, SCHEDULE FOR FINISHES.

D. Plastering:

E. Metal and resilient edge strips at joints with new resilient flooring, and carpeting: Section 09 65 19, RESILIENT TILE FLOORING Section 09 68 00, CARPETING.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Provide manufacture documentation that all flooring including vinyl, linoleum, laminate, wood, ceramic and rubber and all wall base shall meet the following criteria.:

   a. Installed hard surface flooring must be certified as compliant with the FloorScore Standard as developed by the Resilient Floor Covering Institute. This includes all vinyl, linoleum, laminate flooring, wood flooring, ceramic flooring, rubber flooring and wall base.

   b. The Volatile Organic Compound (VOC) content of any field applied

interior Floor Adhesive & grout, must meet SCAQMD Rule 1168 VOC limits
interior Floor Adhesive & grout, must meet SCAQMD Rule 1168 VOC limits.

4. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

5. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Samples:

1. Base tile, each type, each color, each size.

2. Mosaic floor tile panels, 225 mm by 225 mm (9 inches by 9 inches), each type, color, size and pattern.

3. Porcelain tile, each type, color, patterns and size.

4. Wall (or wainscot) tile, each color, size and pattern.

5. Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, color, and size.

D. Product Data:

1. Ceramic and porcelain tile, marked to show each type, size, and shape required.

2. Cementitious backer unit.

3. Dry-set Portland cement mortar and grout.

4. Divider strip.

5. Elastomeric membrane and bond coat.

6. Reinforcing tape.

7. Leveling compound.

8. Latex-Portland cement mortar and grout.

9. Commercial Portland cement grout.

10. Waterproofing isolation membrane.

E. Certification:

1. Master grade, ANSI A137.1.

2. Manufacturer's certificates indicating that the following materials comply with specification requirements:

a. Modified epoxy emulsion.

b. Commercial Portland cement grout.

c. Cementitious backer unit.

d. Dry-set Portland cement mortar and grout.

e. Elastomeric membrane and bond coat.

f. Reinforcing tape.

g. Latex-Portland cement mortar and grout.

h. Leveling compound.

i. Organic adhesive.

j. Waterproof isolation membrane.

1.4 DELIVERY AND STORAGE

A. Deliver materials in containers with labels legible and intact and grade-seals unbroken.

B. Store material to prevent damage or contamination.

1.5 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

   a. Subfloor Adhesives- 50g/l.

   b. Ceramic Tile Adhesives- 65g/l.

   c. Cove Base Adhesives- 50g/l

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.

B. American National Standards Institute (ANSI):

1. A10.20-05 Safety Requirements for Ceramic Tile, Terrazzo, and Marble Works

2. A108.1A-05 Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar

3. A108.1B-05 Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with dry-Set or latex-Portland Cement Mortar

4. A108.1C-05 Contractors Option; Installation of Ceramic Tile in the Wet-Set method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar

5. A108.4-05 Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesives
6. A108.5-05 Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
7. A108.6-05 Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy
8. A108.8-05 Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout
9. A108.10-05 Installation of Grout in Tilework
10. A108.11-05 Interior Installation of Cementitious Backer Units
11. A108.13-05 Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone
12. A118.1-05 Dry-Set Portland Cement Mortar
13. A118.3-05 Chemical Resistant, Water Cleanable Tile-Setting Epoxy and Water Cleanable Tile-Setting and Grouting Epoxy Adhesive
14. A118.4-05 Latex-Portland Cement Mortar
15. A118.5-05 Chemical Resistant Furan Mortars and Grouts for Tile Installation
16. A118.6-05 Standard Cement Grouts for Tile Installation
17. A118.9-05 Cementitious Backer Units
18. A118.10-05 Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation
19. A136.1-05 Organic Adhesives for Installation of Ceramic Tile
20. A137.1-88 Ceramic Tile

C. American Society For Testing And Materials (ASTM):

1. A185-07 Steel Welded Wire Fabric, Plain, for Concrete Reinforcing
2. C109/C109M-07 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch. or (50-mm) Cube Specimens)
3. C241-90 (R2005) Abrasion Resistance of Stone Subjected to Foot Traffic
4. C348-02 Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars
5. C627-93(R2007) Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester
6. C954-07 Steel Drill Screws for the Application of Gypsum Board on Metal Plaster Base to Steel Studs from 0.033 in (0.84 mm) to 0.112 in (2.84 in thickness
7. C979-05 Pigments for Integrally Colored Concrete
8. C1002-07 Steel Self-Piercing Tapping Screws for the Application of Panel Products
9. C1027-99(R2004) Determining "Visible Abrasion Resistance on Glazed Ceramic Tile"

10. C1028-07 Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull Meter Method

11. C1127-01 Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface

12. C1178/C1178M-06 Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel

13. D4397-02 Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

14. D5109-99(R2004) Standard Test Methods for Copper-Clad Thermosetting Laminates for Printed Wiring Boards

D. Marble Institute of America (MIA):

1. Design Manual III-2007

E. Tile Council of America, Inc. (TCA):

1. 2007 Handbook for Ceramic Tile Installation

PART 2 - PRODUCTS

2.1 TILE

A. Comply with ANSI A137.1, Standard Grade, except as modified:

1. Inspection procedures listed under the Appendix of ANSI A137.1.

2. Abrasion Resistance Classification:

a. Tested in accordance with values listed in Table 1, ASTM C 1027.

b. Class V, 12000 revolutions for floors in Corridors, Kitchens, Storage including Refrigerated Rooms

c. Class IV, 6000 revolutions for remaining areas.

3. Slip Resistant Tile for Floors:

a. Coefficient of friction, when tested in accordance with ASTM C1028, required for level of performance:

1) Not less than 0.7 (wet condition) for bathing areas.

2) Not less than 0.6, except 0.8 on ramps as stated above, for wet and dry conditions for other areas.

b. Porcelain Paver Tile: Matte surface finish.

4. Mosaic tile may be mounted or joined together by a resinous bonding material along tile edges.

5. Do not use back mounted tiles in showers unless certified by manufacturer as noted in paragraph 1.3.D.

6. Factory Blending: For tile with color variations, within the ranges selected during sample submittals blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.

B. Unglazed Ceramic Mosaic Tile: Nominal 6 mm (1/4 inch) thick with cushion edges.

C. Glazed Wall Tile: Cushion edges, glazing, as specified in Section 09 06 00, SCHEDULE FOR FINISHES.

D. Porcelain Paver Tile: Nominal 8 mm (5/16 inch) thick, with cushion edges. Porcelain tile produced by the dust pressed method shall be made of approximately 50% feldspar; the remaining 50% shall be made up of various high-quality light firing ball clays yielding a tile with a water absorption rate of 0.5% or less and a breaking strength of between 390 to 400 pounds.

E. Trim Shapes:

1. Internal and External Corners:

a. External corners including edges: Use special shapes providing stainless steel vertical and horizontal joint edge.

b. Base to floor internal corners: Use special shapes providing stainless steel integral cove vertical and horizontal joint.

c. Wall top edge external corners: Use special shapes providing stainless steel vertical and horizontal joint edge.

d. Provide cove and bullnose shapes where shown, and required to complete tile work.

2.2 CEMENTITIOUS BACKER UNITS

A. Use in showers or wet areas.

B. ANSI A118.9.

C. Use Cementitious backer units in maximum available lengths.

D. Backer unit meet or exceed the following additional physical properties:

Property	Test Method	Value
Water absorption	ASTM C948	Less than 20 percent by weight

2.3 JOINT MATERIALS FOR CEMENTITIOUS BACKER UNITS

A. Reinforcing Tape: Vinyl coated woven glass fiber mesh tape, open weave, 50 mm (2 inches) Tape with pressure sensitive adhesive backing will not be permitted.

B. Tape Embedding Material: Latex-Portland cement mortar complying with ANSI A118.4.

C. Joint material, including reinforcing tape, and tape embedding material, shall be as specifically recommended by the backer unit manufacturer.

2.4 FASTENERS

A. Screws for Cementitious Backer Units.

1. Standard screws for gypsum board are not acceptable.

2. Minimum 11 mm (7/16 inch) diameter head, corrosion resistant coated, with washers.

3. ASTM C954 for steel 1 mm (0.033 inch) thick.

4. ASTM C1002 for steel framing less than 0.0329 inch thick.

B. Washers: Galvanized steel, 13 mm (1/2 inch) minimum diameter.

2.5 GLASS MAT WATER RESISTANT GYPSUM BACKER BOARD

A. Confirm to ASTM C1178/C1178M, Optional System for Cementitious Backer Units.

2.6 SETTING MATERIALS OR BOND COATS

A. Conform to TCA Handbook for Ceramic Tile Installation.

B. Portland Cement Mortar: ANSI A108.1.

C. Latex-Portland Cement Mortar: ANSI A118.4.

1. For wall applications, provide non-sagging, latex-Portland cement mortar complying with ANSI A118.4.
2. Prepackaged Dry-Mortar Mix: Factory-prepared mixture of Portland cement; dry, re-dispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.

D. Organic Adhesives: ANSI A136.1, Type 1.

E. Waterproofing Isolation Membrane:

1. Sheet System TCA F122-02.
2. Optional System to elastomeric waterproof membrane.
3. Composite sheet consisting of ASTM D5109, Type II, Grade I Chlorinated Polyethylene sheet reinforced on both sides with a non-woven polyester fiber.
4. Designed for use in wet areas as an isolation and positive waterproofing membranes for thin-set bonding of sheet to substrate and thin-set bonding of ceramic and porcelain tile or marble to sheet. Suited for both horizontal and vertical applications.
5. Conform to the following additional physical properties:

Property	Units	Results	Test Method
Hardness Shore A	Points	70-80	ASTM D2240 (10 Second Reading)
Shrinkage	Percent	5 maximum	ASTM D1204
Brittleness		No crack remains flexible at temperature-37 degrees C (-25 degrees F)	ASTM D2497 13 mm (1/2- inch) Mandrel Bend
Retention of Properties after Heat Aging	Percent of original	80 Tensile 80 Breaking 80 Elongation	ASTM D3045, 90 degrees C (194 degrees F) for 168 hours

6. Manufacturer’s standard sheet size with prefabricated or preformed inside and outside corners.
7. Sheet manufacturer’s solvent welding liquid or xylene and edge sealant.

2.7 GROUTING MATERIALS

A. Coloring Pigments:

1. Pure mineral pigments, limeproof and non-fading, complying with ASTM C979.
2. Add coloring pigments to grout by the manufacturer.
3. Job colored grout is not acceptable.
4. Use is required in Commercial Portland Cement Grout, Dry-Set Grout, and Latex-Portland Cement Grout.

B. Commercial Portland Cement Grout: ANSI A118.6 color as specified.

C. Dry-Set Grout: ANSI A118.6 color as specified.

D. Latex-Portland Cement Grout: ANSI A118.6 color as specified.

1. Unsanded grout mixture for joints 3.2 mm (1/8 inch) and narrower.
2. Sanded grout mixture for joints 3.2 mm (1/8 inch) and wider.

2.8 PATCHING AND LEVELING COMPOUND

A. Portland cement base, polymer-modified, self-leveling compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.

B. Shall have minimum following physical properties:

1. Compressive strength - 25 MPa (3500 psig) per ASTM C109/C109M.
2. Flexural strength - 7 MPa (1000 psig) per ASTM C348 (28 day value).
3. Tensile strength - 600 psi per ANSI 118.7.
4. Density “ 1.9.

C. Capable of being applied in layers up to 38 mm (1-1/2 inches) thick without fillers and up to 100 mm (four inches) thick with fillers, being brought to a feather edge, and being trowelled to a smooth finish.

D. Primers, fillers, and reinforcement as required by manufacturer for application and substrate condition.

E. Ready for use in 48 hours after application.

2.9 METAL DIVIDER STRIPS

A. Heavy top type strip with 5 mm (3/16 inch) wide top and 38 mm (1-1/2 inch) long leg.

B. Embedded leg perforated and deformed for keying to mortar.

C. Stainless steel as specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2.10 WATER

A. Clean, potable and free from salts and other injurious elements to mortar and grout materials.

2.11 CLEANING COMPOUNDS

A. Specifically designed for cleaning masonry and concrete and which will not

prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.

B. Materials containing acid or caustic material not acceptable.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperature of work areas at not less than 16 degree C (60 degrees F), without interruption, for not less than 24 hours before installation and not less than three days after installation.

B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation and ANSI Specifications for installation.

C. Do not install tile when the temperature is above 38 degrees C (100 degrees F).

D. Do not install materials when the temperature of the substrate is below 16 degrees C (60 degrees F).

E. Do not allow temperature to fall below 10 degrees C (50 degrees F) after fourth day of completion of tile work.

3.2 ALLOWABLE TOLERANCE

A. Variation in plane of sub-floor, including concrete fills leveling compounds and mortar beds:

1. Not more than 1 in 500 (1/4 inch in 10 feet) from required elevation where Portland cement mortar setting bed is used.

2. Not more than 1 in 1000 (1/8 inch in 10 feet) where dry-set Portland cement, and latex-Portland cement mortar setting beds and chemical-resistant bond coats are used.

B. Variation in Plane of Wall Surfaces:

1. Not more than 1 in 400 (1/4 inch in eight feet) from required plane where Portland cement mortar setting bed is used.

2. Not more than 1 in 800 (1/8 inch in eight feet) where dry-set or latex-Portland cement mortar or organic adhesive setting materials is used.

3.3 SURFACE PREPARATION

A. Cleaning New Concrete or Masonry:

1. Chip out loose material, clean off all oil, grease dirt, adhesives, curing compounds, and other deterrents to bonding by mechanical method, or by using products specifically designed for cleaning concrete and masonry.

2. Use self-contained power blast cleaning systems to remove curing compounds and steel trowel finish from concrete slabs where ceramic tile will be installed directly on concrete surface with thin-set materials.

3. Steam cleaning or the use of acids and solvents for cleaning will not be permitted.

B. Patching and Leveling:

1. Mix and apply patching and leveling compound in accordance with manufacturer's instructions.
2. Fill holes and cracks and align concrete floors that are out of required plane with patching and leveling compound.
   a. Thickness of compound as required to bring finish tile system to elevation shown.
   b. Float finish except finish smooth for elastomeric waterproofing.
   c. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
3. Apply patching and leveling compound to concrete and masonry wall surfaces that are out of required plane.
4. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces, other than concrete and masonry that are out of required plane.

C. Mortar Bed for Slopes to Drains:
1. Slope compound to drain where drains are shown.
2. Install mortar bed in depressed slab sloped to drains not less than 1 in 200 (1/16 inch per foot).
3. Allow not less than 50 mm (2 inch) depression at edge of depressed slab.
4. Screed for slope to drain and float finish.
5. Cure mortar bed for not less than seven days. Do not use curing compounds or coatings.

D. Additional preparation of concrete floors for tile set with epoxy, or furan-resin shall be in accordance with the manufacturer's printed instructions.

E. Cleavage Membrane:
1. Install polythene sheet as cleavage membrane in depressed slab when waterproof membrane is not scheduled or indicated.
2. Turn up at edge of depressed floor slab to top of floor.

F. Walls:
1. In showers or other wet areas cover studs with polyethylene sheet.
2. Apply patching and leveling compound to concrete and masonry surfaces that are out of required plane.
3. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces, other than concrete and masonry that are out of required plane.
4. Apply metal lath to framing in accordance with ANSI A108.1:
   a. Use fasteners specified in paragraph "Fasteners." Use washers when lath opening is larger than screw head.
   b. Apply scratch and leveling coats to metal lath in accordance with ANSI A108.1.C.
   c. Total thickness of scratch and leveling coats:

1) Apply 9 mm to 16 mm (3/8 inch to 5/8 inch) thick over solid backing.

2) 16 mm to 19 mm (5/8 to 3/4 inch) thick on metal lath over studs.

3) Where wainscots are required to finish flush with wall surface above, adjust thickness required for flush finish.

d. Apply scratch and leveling coats more than 19 mm (3/4 inch) thick in two coats.

3.4 GLASS MAT WATER-RESISTANT GYPSUM BACKER BOARD

A. Install in accordance with manufacturer’s instructions. TCA Systems W245-01.

B. Treat joints with tape and latex-Portland cement mortar or adhesive.

3.5 METAL DIVIDER STRIPS

A. Install metal divider strips in floor joints between ceramic and quarry tile floors and between tile floors and adjacent flooring of other materials where the finish floors are flush unless shown otherwise.

B. Set divider strip in mortar bed to line and level centered under doors or in openings.

C. At preformed sealant joint: Refer to Section 07 95 13, EXPANSION JOINT COVER ASSEMBLIES.

1. Comply with recommendations in TCA "Handbook for Ceramic Tile Installation" Vertical and Horizontal Joint Design Essentials. TCA System EJ 171-02.

a. Locate joint in tile surfaces directly above joint in sub-floor or where indicated when used with isolation membranes to allow off-setting of joint location from sub-floor joint.

b. Fasten full length to sub-floor using a construction adhesive.

c. Trowel setting material with full coverage over the entire leg.

2. Set tile up against the joint ensuring that the top edge of the joint is flush or slightly below the top of the tile.

3.6 CERAMIC TILE - GENERAL

A. Comply with ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" applicable to methods of installation.

B. Comply with TCA Installation Guidelines:

C. Installing Mortar Beds for Floors:

1. Install mortar bed to not damage cleavage or waterproof membrane; 32 mm (1- 1/2 inch) minimum thickness.

2. Install floor mortar bed reinforcing centered in mortar fill.

3. Screed finish to level plane or slope to drains where shown, float finish.

4. For thin set systems cure mortar bed not less than seven days. Do not use curing compounds or coatings.

5. For tile set with Portland cement paste over plastic mortar bed coordinate

to set tile before mortar bed sets.

D. Setting Beds or Bond Coats:

1. Where recessed or depressed floor slabs are filled with Portland cement mortar bed, set ceramic mosaic floor tile in either Portland cement paste over plastic mortar bed or latex-Portland cement mortar over cured mortar bed except as specified otherwise, ANSI A108-1C, TCA System F121-02 or F111-02.
2. Set floor tile in elastomeric bond coat over elastomeric membrane ANSI 108. 13, TCA System F122 where scheduled,.
3. Set wall tile installed over concrete or masonry in dry-set Portland cement mortar, or latex-Portland cement mortar, ANSI 108.1B.and TCA System W211-02, W221-02 or W222-02.
4. Set wall tile installed over concrete backer board in latex-Portland cement mortar, ANSI A108.1B.
5. Set wall tile installed over Portland cement mortar bed on metal lath base in Portland cement paste over plastic mortar bed, or dry-set Portland cement mortar or latex-Portland cement mortar over a cured mortar bed, ANSI A108.1C, TCA System W231-02, W241-02.
6. Set tile installed over gypsum board and gypsum plaster in organic adhesive, ANSI A108.4, TCA System W242-02.
7. Set trim shapes in same material specified for setting adjoining tile.

E. Workmanship:

1. Lay out tile work so that no tile less than one-half full size is used. Make all cuts on the outer edge of the field.
2. Set tile firmly in place with finish surfaces in true planes. Align tile flush with adjacent tile unless shown otherwise.
3. Form intersections and returns accurately.
4. Cut and drill tile neatly without marring surface.
5. Cut edges of tile abutting penetrations, finish, or built-in items:
   a. Fit tile closely around electrical outlets, piping, fixtures and fittings, so that plates, escutcheons, collars and flanges will overlap cut edge of tile.
   b. Seal tile joints water tight as specified in Section 07 92 00, JOINT SEALANTS, around electrical outlets, piping fixtures and fittings before cover plates and escutcheons are set in place.
6. Completed work shall be free from hollow sounding areas and loose, cracked or defective tile.
7. Remove and reset tiles that are out of plane or misaligned.
8. Floors:
   a. Extend floor tile beneath casework and equipment, except those units mounted in wall recesses.
   b. Align finish surface of new tile work flush with other and existing

adjoining floor finish where shown.

c. In areas where floor drains occur, slope to drains where shown.

d. Shove and vibrate tiles over 200 mm (8 inches) square to achieve full support of bond coat.

9. Walls:

a. Cover walls and partitions, including pilasters, furred areas, and freestanding columns from floor to ceiling, or from floor to nominal wainscot heights shown with tile.

b. Finish reveals of openings with tile, except where other finish materials are shown or specified.

c. At window openings, provide tile stools and reveals, except where other finish materials are shown or specified.

d. Finish wall surfaces behind and at sides of casework and equipment, except those units mounted in wall recesses, with same tile as scheduled for room proper.

10. Joints:

a. Keep all joints in line, straight, level, perpendicular and of even width unless shown otherwise.

b. Make joints 2 mm (1/16 inch) wide for glazed wall tile and mosaic tile work.

11. Back Buttering: For installations indicated below, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:

a. Tile wall installations in wet areas, including showers, tub enclosures, laundries and swimming pools.

b. Tile wall installations composed of tiles 200 by 200 mm (8 by 8 inches or larger.

3.7 PORCELAIN TILE INSTALLED WITH LATEX PORTLAND CEMENT BONDING MORTAR

A. Due to the denseness of porcelain tile use latex Portland cement bonding mortar that meets the requirements of ANSI A118.4. Bonding mortars shall be mixed in accordance with manufacturer’s instructions. Improper liquid ratios and dwell time before placement of bonding mortar and tile shall affect bond.

3.8 THIN SET CERAMIC AND PORCELAIN TILE INSTALLED WITH DRY-SET PORTLAND CEMENT AND LATEX-PORTLAND CEMENT MORTAR

A. Installation of Tile: ANSI A108.5, except as specified otherwise.

B. Slope tile work to drains not less than 1 in 100 (1/8 inch per foot).

3.9 THIN SET CERAMIC AND PORCELAIN TILE INSTALLED WITH ORGANIC ADHESIVE

A. Installation of Tile: ANSI A108.4.

3.10 CERAMIC AND PORCELAIN TILE INSTALLED WITH ELASTOMERIC BOND COAT

A. Surface Preparation: Prepare surfaces as specified in paragraph 3.3G

B. Installation of Elastomeric Membrane: ANSI A108.13 and TCA F122-02.

1. Prime surfaces, where required, in accordance with manufacturer's instructions.

2. Install first coat of membrane material in accordance with manufacturer's instructions, in thickness of 0.75 to 1.3 mm (30 to 50 mils).

3. Extend material over flashing rings of drains and turn up vertical surfaces not less than 100 mm (four inches) above finish floor surface.

4. When material has set, recoat areas with a second coat of elastomeric membrane material for a total thickness of 1.3 to 1.9 mm (50 to 75 mils).

5. After curing test for leaks with 25 mm (one inch) of water for 24 hours.

C. Installation of Tile in Elastomeric Membrane:

1. Spread no more material than can be covered with tile before material starts to set.

2. Apply tile in second coat of elastomeric membrane material in accordance with the coating manufacturer's instructions in lieu at aggregate surfacing specified in ASTM C1127. Do not install top coat over tile.

3.11 GROUTING

A. Grout Type and Location:

1. Grout for glazed wall and base tile, paver tile and unglazed mosaic tile Portland cement grout, latex-Portland cement grout, dry-set grout, or commercial Portland cement grout.

B. Workmanship:

1. Install and cure grout in accordance with the applicable standard.

2. Portland Cement grout: ANSI A108.10.

3. Epoxy Grout: ANSI A108.6.

4. Furan and Commercial Portland Cement Grout: ANSI A108.8 and in accordance with the manufacturer's printed instructions.

5. Dry-set grout: ANSI A108.5.

3.12 MOVEMENT JOINTS

A. Prepare tile expansion, isolation, construction and contraction joints for installation of sealant. Refer to Section 07 92 00, JOINT SEALANTS.

B. TCA details EJ 171-02.

C. At expansion joints, rake out joint full depth of tile and setting bed and mortar bed. Do not cut waterproof or isolation membrane.

D. Rake out grout at joints between tile, at toe of base, and where shown not less than 6 mm (1/4 inch) deep.

3.13 CLEANING

A. Thoroughly sponge and wash tile. Polish glazed surfaces with clean dry

cloths.

B. Methods and materials used shall not damage or impair appearance of tile surfaces.

C. The use of acid or acid cleaners on glazed tile surfaces is prohibited.

D. Clean tile grouted with epoxy, furan and commercial Portland cement grout and tile set in elastomeric bond coat as recommended by the manufacturer of the grout and bond coat.

3.14 PROTECTION

A. Keep traffic off tile floor, until grout and setting material is firmly set and cured.

B. Where traffic occurs over tile floor, cover tile floor with not less than 9 mm (3/8 inch) thick plywood, wood particle board, or hardboard securely taped in place. Do not remove protective cover until time for final inspection. Clean tile of any tape, adhesive and stains.

3.15 TESTING FINISH FLOOR

A. Test floors in accordance with ASTM C627 to show compliance with codes 1 through 10.

B. Test kitchen and storage rooms.

- - - E N D - - -

SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Metal ceiling suspension system for acoustical ceilings.

B. Acoustical units.

C. Adhesive application.

1.2 RELATED WORK

A. Color, pattern, and location of each type of acoustical unit:

1. Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Samples:

1. Acoustical units, each type, with label indicating conformance to specification requirement.

2. Colored markers for units providing access.

D. Manufacturer's Literature and Data:

1. Ceiling suspension system, each type, showing complete details of installation.

2. Acoustical units, each type

3. Runners designed for snap-in attachment of metal pans.

E. Manufacturer's Certificates: Acoustical units, each type, in accordance with specification requirements.

1.4 DEFINITIONS

A. Standard definitions as defined in ASTM C634.

B. Terminology as defined in ASTM E1264.

1.5 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.

B. American Society for Testing and Materials (ASTM):

1. A641/A641M-03 Zinc-coated (Galvanized) Carbon Steel Wire

2. A653/A653M-07 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process

3. C423-07 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

4. C634-02 (E2007) Standard Terminology Relating to Environmental Acoustics

5. C635-04 Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

6. C636-06 Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

7. E84-07 Surface Burning Characteristics of Building Materials

8. E119-07 Fire Tests of Building Construction and Materials

9. E413-04 Classification for Rating Sound Insulation.
10. E580-06 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint
11. E1264-(R2005) Classification for Acoustical Ceiling Products

PART 2 - PRODUCTS

2.1 METAL SUSPENSION SYSTEM

A. ASTM C635, heavy-duty system, except as otherwise specified.

1. Ceiling suspension system members may be fabricated from either of the following unless specified otherwise.

a. Galvanized cold-rolled steel, bonderized.

b. Extruded aluminum.

c. Fire resistant plastic (glass fiber) having a flame spread and smoke developed rating of not more than 25 when tested in accordance with ASTM E84.

2. Use same construction for cross runners as main runners. Use of lighter-duty sections for cross runners is not acceptable.

3. Use aluminum suspension in kitchens and aluminum or fire resistant plastic in toilets adjacent to shower areas, hydrotherapy, and swimming pools.

B. Exposed grid suspension system for support of lay-in panels:

1. Exposed grid width not less than 22 mm (7/8 inch) with not less than 8 mm (5/16 inch) panel bearing surface.

2. Fabricate wall molding and other special molding from the same material with same exposed width and finish as the exposed grid members.

3. On exposed metal surfaces apply baked-on enamel flat texture finish in color to match adjacent acoustical units unless specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.

2.2 PERIMETER SEAL

A. Vinyl, polyethylene or polyurethane open cell sponge material having density of 1.3 plus or minus 10 percent, compression set less than 10 percent with pressure sensitive adhesive coating on one side.

B. Thickness as required to fill voids between back of wall molding and finish wall.

C. Not less than 9 mm (3/8 inch) wide strip.

2.3 WIRE

A. ASTM A641.

B. For wire hangers: Minimum diameter 2.68 mm (0.1055 inch).

C. For bracing wires: Minimum diameter 3.43 mm (0.1350 inch).

2.4 ANCHORS AND INSERTS

A. Use anchors or inserts to support twice the loads imposed by hangers attached thereto.

B. Hanger Inserts:

1. Fabricate inserts from steel, zinc-coated (galvanized after fabrication).

C. Clips:

1. Galvanized steel.
2. Designed to rigidly secure framing members together.
3. Designed to sustain twice the loads imposed by hangers or items supported.

D. Tile Splines: ASTM C635.

Size mm	Size Inches	Cold-rolled Kg	Pound	Hot-rolled Kg	Pound
38	1 1/2	215.4	475	508	1120
50	2	267.6	590	571.5	1260

2.5 ACOUSTICAL UNITS

A. General:

1. Ceiling Tile shall meet minimum 37% bio-based content in accordance with USDA Bio-Preferred Product requirements.
2. ASTM E1264, weighing 3.6 kg/m2 (3/4 psf) minimum for mineral fiber panels or tile.
3. Class A Flame Spread: ASTM 84
4. Minimum NRC (Noise Reduction Coefficient): 0.55 unless specified otherwise: ASTM C423.
5. Manufacturers standard finish, minimum Light Reflectance (LR) coefficient of 0.75 on the exposed surfaces, except as specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES. Colored units integrally colored throughout.
6. Lay-in panels: Sizes as shown, with reveal edges.

B. Type III Units - Mineral base with water-based painted finish less than 10 g/l VOC, Form 2 - Water felted, minimum 16 mm (5/8 inch) thick. Mineral base to contain minimum 65 percent recycled content.

C. Type IV Units - Mineral base with membrane-faced overlay, Form 2 - Water felted, minimum 16 mm (5/8 inch) thick. Apply over the paint coat on the face of the unit a poly (vinyl) chloride overspray having a flame spread index of 25 or less when tested in accordance with ASTM E84.

D. Type XX-B Units - Combination mineral base and glass fiber with fabric finish.

1. Back half of panel: Perforated water felted mineral fiber.

2. Face half of panel: Glass fiber with glass cloth face.
3. Minimum NRC of 0.75.
4. Minimum thickness of 28 mm (1 1/8 inches).

2.6 ACCESS IDENTIFICATION

A. Markers:
1. Use colored markers with pressure sensitive adhesive on one side.
2. Make colored markers of paper of plastic, 6 to 9 mm (1/4 to 3/8 inch) in diameter.

B. Use markers of the same diameter throughout building.

C. Color Code: Use following color markers for service identification:

Color	Service
1. Red	Sprinkler System: Valves and Controls
2. Green	Domestic Water: Valves and Controls
3. Yellow	Chilled Water and Heating Water
4. Orange	Ductwork: Fire Dampers
5. Blue	Ductwork: Dampers and Controls
6. Black	Gas: Laboratory, Medical, Air and Vacuum

PART 3 - EXECUTION

3.1 CEILING TREATMENT

A. Treatment of ceilings shall include sides and soffits of ceiling beams, furred work 600 mm (24 inches) wide and over, and vertical surfaces at changes in ceiling heights unless otherwise shown. Install acoustic tiles after wet finishes have been installed and solvents have cured.

B. Lay out acoustical units symmetrically about center lines of each room or space unless shown otherwise on reflected ceiling plan.

C. Moldings:
1. Install metal wall molding at perimeter of room, column, or edge at vertical surfaces.
2. Install special shaped molding at changes in ceiling heights and at other breaks in ceiling construction to support acoustical units and to conceal their edges.

D. Perimeter Seal:
1. Install perimeter seal between vertical leg of wall molding and finish wall, partition, and other vertical surfaces.
2. Install perimeter seal to finish flush with exposed faces of horizontal legs of wall molding.

3.2 CEILING SUSPENSION SYSTEM INSTALLATION

A. General:

1. Install metal suspension system for acoustical tile and lay-in panels in accordance with ASTM C636, except as specified otherwise.
2. Use direct or indirect hung suspension system or combination thereof as defined in ASTM C635.
3. Support a maximum area of 1.48 m2 (16 sf) of ceiling per hanger.
4. Prevent deflection in excess of 1/360 of span of cross runner and main runner.
5. Provide extra hangers, minimum of one hanger at each corner of each item of mechanical, electrical and miscellaneous equipment supported by ceiling suspension system not having separate support or hangers.
6. Provide not less than 100 mm (4 inch) clearance from the exposed face of the acoustical units to the underside of ducts, pipe, conduit, secondary suspension channels, concrete beams or joists; and steel beam or bar joist unless furred system is shown.
7. Use main runners not less than 1200 mm (48 inches) in length.
8. Install hanger wires vertically. Angled wires are not acceptable except for seismic restraint bracing wires.

B. Anchorage to Structure:

1. Steel:

   a. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels for attachment of hanger wires.

      1) Size and space carrying channels to insure that the maximum deflection specified will not be exceeded.

      2) Attach hangers to steel carrying channels, spaced four feet on center, unless area supported or deflection exceeds the amount specified.

   b. Attach carrying channels to the bottom flange of steel beams spaced not 1200 mm (4 feet) on center before fire proofing is installed. Weld or use steel clips to attach to beam to develop full strength of carrying channel.

   c. Attach hangers to bottom chord of bar joists or to carrying channels installed between the bar joists when hanger spacing prevents anchorage to joist. Rest carrying channels on top of the bottom chord of the bar joists, and securely wire tie or clip to joist.

C. Direct Hung Suspension System:

1. As illustrated in ASTM C635.
2. Support main runners by hanger wires attached directly to the structure overhead.
3. Maximum spacing of hangers, 1200 mm (4 feet) on centers unless interference occurs by mechanical systems. Use indirect hung suspension system where not possible to maintain hanger spacing.

D. Seismic Ceiling Bracing System:

1. Construct system in accordance with ASTM E580.

2. Connect bracing wires to structure above as specified for anchorage to structure and to main runner or carrying channels of suspended ceiling at bottom.

3.3 ACOUSTICAL UNIT INSTALLATION

A. Cut acoustic units for perimeter borders and penetrations to fit tight against penetration for joint not concealed by molding.

B. Install lay-in acoustic panels in exposed grid with not less than 6 mm (1/4 inch) bearing at edges on supports.

1. Install tile to lay level and in full contact with exposed grid.

2. Replace cracked, broken, stained, dirty, or tile not cut for minimum bearing.

C. Markers:

1. Install markers of color code specified to identify the various concealed piping, mechanical, and plumbing systems.

2. Attach colored markers to exposed grid on opposite sides of the units providing access.

3. Attach marker on exposed ceiling surface of upward access acoustical unit.

3.4 CLEAN-UP AND COMPLETION

A. Replace damaged, discolored, dirty, cracked and broken acoustical units.

B. Leave finished work free from defects.

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SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the installation of vinyl or rubber base and resilient stair treads with sheet rubber flooring on landings.

1.2 RELATED WORK

A. Color and texture: Section 09 06 00, SCHEDULE FOR FINISHESS.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Provide manufacture documentation that all flooring including vinyl, linoleum, laminate, wood, ceramic and rubber and all wall base shall meet the following criteria.

   a. Installed hard surface flooring must be certified as compliant with the FloorScore Standard as developed by the Resilient Floor Covering Institute. This includes all vinyl, linoleum, laminate flooring, wood flooring, ceramic flooring, rubber flooring and wall base.

   b. The Volatile Organic Compound (VOC) content of any field applied interior Floor Adhesive & grout, must meet SCAQMD Rule 1168 VOC limits.

4. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

5. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA,

AND SAMPLES.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Base and stair material manufacturer's recommendations for adhesives.
3. Application and installation instructions.

D. Samples:

1. Base: 150 mm (6 inches) long, each type and color.
2. Resilient Stair Treads: 150 mm (6 inches) long.
3. Adhesive: Literature indicating each type.

1.4 DELIVERY

A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.

B. Materials from containers which have been distorted, damaged or opened prior to installation will be rejected.

1.5 STORAGE

A. Store materials in weather tight and dry storage facility.

B. Protect material from damage by handling and construction operations before, during, and after installation.

1.6 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements:

1. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
   a. Rubber Floor Adhesives- 60g/l
   b. Subfloor Adhesives- 50g/l
   c. VCT & Asphalt Adhesives- 50g/l
   d. Ceramic Tile Adhesives- 65g/l
   e. Cove Base Adhesives- 50g/l

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section

3. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

4. Fiberglass insulation shall contain a minimum of 20% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Mineral-wool

insulation shall contain a minimum of 50% (combined) pre-consumer/post-consumer recycled content. Certification of recycled content shall be in accordance with the Submittal Requirements above.

5. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.7 APPLICABLE PUBLICATIONS

A. The publication listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

1. F1344-10 Rubber Floor Tile
2. F1859-10 Rubber Sheet Floor Covering without Backing
3. F1860-10 Rubber Sheet Floor Covering with Backing
4. F1861-08 Resilient Wall Base

C. Federal Specifications (Fed. Spec.):

1. RR-T-650E Treads, Metallic and Non-Metallic, Nonskid

PART 2 - PRODUCTS

2.1 GENERAL

A. Use only products by the same manufacturer and from the same production run.

2.2 RESILIENT BASE

A. ASTM F1861, 3 mm (1/8 inch) thick, 100 mm (4 inches) high, Thermoplastics, Group 2-layered . Style B-cove.

B. Where carpet occurs, use Style A-straight.

C. Use only one type of base throughout.

2.3 RESILIENT TREADS

A. Fed. Spec. RR-T-650, Composition A, Type 2, 5 mm (3/16 inch) thick on wear surface tapering to 3 mm (1/8 inch) thick at riser end.

2.4 PRIMER (FOR CONCRETE FLOORS)

A. As recommended by the adhesive and tile manufacturer.

2.5 LEVELING COMPOUND (FOR CONCRETE FLOORS)

A. Provide products with latex or polyvinyl acetate resins in the mix.

2.6 ADHESIVES

A. Use products recommended by the material manufacturer for the conditions of use.

B. Use low-VOC adhesive during installation. Water based adhesive with low VOC

is preferred over solvent based adhesive.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

A. Maintain temperature of materials above 21° C (70° F), for 48 hours before installation.

B. Maintain temperature of rooms where work occurs, between 21° C and 27° C (70° F and 80° F) for at least 48 hours, before, during, and after installation.

C. Do not install materials until building is permanently enclosed and wet construction is complete, dry, and cured.

3.2 INSTALLATION REQUIREMENTS

A. The respective manufacturer's instructions for application and installation will be considered for use when approved by the Resident Engineer.

B. Submit proposed installation deviation from this specification to the Resident Engineer indicating the differences in the method of installation.

C. The Resident Engineer reserves the right to have test portions of material installation removed to check for non-uniform adhesion and spotty adhesive coverage.

3.3 PREPARATION

A. Examine surfaces on which material is to be installed.

B. Fill cracks, pits, and dents with leveling compound.

C. Level to 3 mm (1/8 inch) maximum variations.

D. Do not use adhesive for leveling or filling.

E. Grind, sand, or cut away protrusions; grind high spots.

F. Clean substrate area of oil, grease, dust, paint, and deleterious substances.

G. Substrate area dry and cured. Perform manufacturer’s recommended bond and moisture test.

H. Preparation of existing installation:

1. Remove existing base and stair treads including adhesive.
2. Do not use solvents to remove adhesives.
3. Prepare substrate as specified.

3.4 BASE INSTALLATION

A. Location:

1. Unless otherwise specified or shown, where base is scheduled, install base over toe space of base of casework, lockers, laboratory, pharmacy furniture island cabinets and where other equipment occurs.
2. Extend base scheduled for room into adjacent closet, alcoves, and around columns.

B. Application:

1. Apply adhesive uniformly with no bare spots.
2. Set base with joints aligned and butted to touch for entire height.
3. Before starting installation, layout base material to provide the minimum number of joints with no strip less than 600 mm (24 inches) length.
   a. Short pieces to save material will not be permitted.
   b. Locate joints as remote from corners as the material lengths or the wall configuration will permit.

C. Form corners and end stops as follows:

1. Score back of outside corner.
2. Score face of inside corner and notch cove.

D. Roll base for complete adhesion.

3.5 STAIR TREAD INSTALLATION

A. Prepare surfaces to receive the treads in accordance with applicable portions of paragraph, preparation.

B. Layout of Treads.

1. No joints will be accepted in treads.,
2. Set full treads on intermediate and floor landings.

C. Application:

1. Apply adhesive uniformly with no bare spots.
2. Roll and pound treads to assure adhesion.

3.6 CLEANING AND PROTECTION

A. Clean all exposed surfaces of base and adjoining areas of adhesive spatter before it sets.

B. Keep traffic off resilient material for at least 72 hours after installation.

C. Clean and polish materials in the following order:

1. After two weeks, scrub resilient base, sheet rubber and treads materials with a minimum amount of water and a mild detergent. Leave surfaces clean and free of detergent residue. Polish resilient base to a gloss finish.
2. Do not polish tread and sheet rubber materials.

D. When construction traffic is anticipated, cover tread materials with reinforced kraft paper and plywood or hardboard properly secured and maintained until removal is directed by the Resident Engineer.

E. Where protective materials are removed and immediately prior to acceptance, replace damaged materials and re-clean resilient materials. Damaged materials are defined as having cuts, gouges, scrapes or tears and not fully adhered.

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SECTION 09 65 19

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the installation of solid vinyl tile flooring, vinyl composition tile flooring, rubber tile flooring, and accessories.

1.2 RELATED WORK

A. Color and pattern and location in room finish schedule: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Resilient Base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Provide manufacture documentation that all flooring including vinyl, linoleum, laminate, wood, ceramic and rubber and all wall base shall meet the following criteria:

   a. Installed hard surface flooring must be certified as compliant with the FloorScore Standard as developed by the Resilient Floor Covering Institute. This includes all vinyl, linoleum, laminate flooring, wood flooring, ceramic flooring, rubber flooring and wall base.

   b. The Volatile Organic Compound (VOC) content of any field applied interior Floor Adhesive & grout, must meet SCAQMD Rule 1168 VOC limits.

4. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

5. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of

products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's Literature and Data:

1. Description of each product.

2. Resilient material manufacturers recommendations for adhesives, underlayment, primers and polish.

3. Application and installation instructions.

D. Samples:

1. Tile: 300 mm by 300 mm (12 inches by 12 inches) for each type, pattern and color.

2. Edge Strips: 150 mm (6 inches) long, each type.

3. Feature Strips: 150 mm (6 inches) long.

E. Shop Drawings:

1. Layout of patterns shown on the drawings and in Section 09 06 00, SCHEDULE FOR FINISHES.

2. Edge strip locations showing types and detail cross sections.

F. Test Reports:

1. Abrasion resistance: Depth of wear for each tile type and color and volume loss of tile, certified by independent laboratory.

2. Tested per ASTM F510.

1.4 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements:

1. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants,Paints and Coatings ", where applicable.
   a. Rubber Floor Adhesives- 60g/l
   b. Subfloor Adhesives- 50g/l
   c. Resilient Tile & Asphalt Adhesives- 50g/l

   a. Cove Base Adhesives- 50g

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

4. All hard flooring including resilient tile must be certified as compliant with FloorScore Standard as developed by the Resilient Floor Covering Institute.

1.5 DELIVERY

A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.

B. Materials from containers which have been distorted, damaged or opened prior to installation will be rejected.

1.6 STORAGE

A. Store materials in weathertight and dry storage facility.

B. Protect from damage from handling, water, and temperature.

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

1. D4078-02(2008) Water Emulsion Floor Finish

2. E648-10 Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source

3. E662-06 Specific Optical Density of Smoke Generated by Solid Materials

4. E1155-96 (R2008) Determining Floor Flatness and Floor Levelness Numbers

5. F510-93 (R2008) Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Method

6. F710-08 Preparing Concrete Floors to Receive Resilient Flooring

7. F1066-04(R2010) Vinyl Composition Floor Tile

8. F1344-10 Rubber Floor Tile

9. F1700-04(R2010) Solid Vinyl Floor Tile

C. Resilient Floor Covering Institute (RFCI):

1. IP #2 Installation Practice for Vinyl Composition Tile (VCT)

D. Federal Specifications (Fed. Spec.):

1. SS-T-312 Tile Floor: Asphalt, Rubber, Vinyl and Vinyl Composition

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish product type, materials of the same production run and meeting following criteria.

B. Use adhesives, underlayment, primers and polish recommended by the floor resilient material manufacturer.

C. Critical Radiant Flux: 0.45 watts per sq.cm or more, Class I, per ASTM E

648.

D. Smoke density: Less than 450 per ASTM E662.

2.2 SOLID VINYL-TILE

A. ASTM F1700, Class III, size indicated in 09 06 00 SCHEDULE FOR FINISHES, 3 mm (1/8 inch) thick, homogenous throughout.

B. Color and Pattern uniformly distributed throughout thickness.

C. Where solid vinyl tiles are specified, seek products with recycled content.

2.3 RUBBER TILE

A. ASTM F1344, Class 1, homogenous rubber tile, B, through mottled, 300 mm (12 inches) square, 3 mm (1/8 inch) thick.

B. Color and pattern uniformly distributed throughout tile.

C. Molded pattern wearing surface base thickness 3 mm (1/8 inch) thick.

D. Where rubber tile is used provide tiles with a minimum of 90% post consumer rubber.

2.4 ADHESIVES

A. Comply with applicable regulations regarding toxic and hazardous materials Green Seal (GS-36) for commercial adhesive.

B. Use low-VOC adhesive during installation. Water based is preferred over solvent based adhesives.

2.5 PRIMER (FOR CONCRETE SUBFLOORS)

A. As recommended by the adhesive and tile manufacturer.

2.6 LEVELING COMPOUND (FOR CONCRETE FLOORS)

A. Provide cementitious products with latex or polyvinyl acetate resins in the mix.

B. Determine the type of underlayment selected for use by the condition to be corrected.

2.7 POLISH AND CLEANERS

A. Cleaners RFCI CL-1.

2.8 EDGE STRIPS

A. 28 mm (1-1/8 inch) wide unless shown otherwise.

B. Bevel from maximum thickness to minimum thickness for flush joint unless shown otherwise.

C. Extruded aluminum, mill finish, mechanically cleaned:

1. Drill and counter sink edge strip for flat head screws.

2. Space holes near ends and approximately 225 mm (9 inches) on center between.

D. Resilient Edge Strip or Reducer Strip: Fed. Specs. SS-T-312, Solid vinyl.

2.9 SCREWS

A. Stainless steel flat head screw.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

A. Maintain temperature of materials a minimum of 22°C (70°F,) for 48 hours before installation.

B. Maintain temperature of rooms where work occurs between 21°C and 27°C (70°F and 80°F), for at least 48 hours, before, during and after installation.

C. Do not install flooring until building is permanently enclosed and wet construction in or near areas to receive tile materials is complete, dry and cured.

3.2 SUBFLOOR PREPARATION

A. Verify that concrete slabs comply with ASTM F710. At existing slabs, determine levelness by F-number method in accordance with ASTM E1155. Overall value shall not exceed as follows:

1. FF30/FL20

B. Correct conditions which will impair proper installation.

C. Fill cracks, joints and other irregularities in concrete with leveling compound:

1. Do not use adhesive for filling or leveling purposes.

2. Do not use leveling compound to correct imperfections which can be corrected by spot grinding.

3. Trowel to smooth surface free of trowel marks, pits, dents, protrusions, cracks or joints.

D. Clean floor of oil, paint, dust, and deleterious substances: Leave floor dry and cured free of residue from existing curing or cleaning agents.

E. Concrete Subfloor Testing:

1. Determine Adhesion and dryness of the floor by bond and moisture tests as recommended by RFCI manual MRP.

F. Perform additional subfloor preparation to obtain satisfactory adherence of flooring if subfloor test patches allows easy removal of tile.

G. Prime the concrete subfloor if the primer will seal slab conditions that would inhibit bonding, or if priming is recommended by the tile or adhesive manufacturers.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions for application and installation unless specified otherwise.

B. Mix tile from at least two containers. An apparent line either of shades or pattern variance will not be accepted.

C. Tile Layout:

1. If layout is not shown on drawings, lay tile symmetrically about center of room or space with joints aligned.
2. No tile shall be less than 150 mm (6 inches) and of equal width at walls.
3. Place tile pattern in the same direction; do not alternate tiles.

D. Trim tiles to touch for the length of intersections at pipes and vertical projections, seal joints at pipes with waterproof cement.

E. Application:

1. Apply adhesive uniformly with no bare spots.
   a. Conform to RFC1-TM-6 for joint tightness and for corner intersection unless layout pattern shows random corner intersection.
   b. More than 5 percent of the joints not touching will not be accepted.
2. Roll tile floor with a minimum 45 kg (100 pound) roller. No exceptions.
3. The Resident Engineer may have test tiles removed to check for non-uniform adhesion, spotty adhesive coverage, and ease of removal. Install new tile for broken removed tile.

F. Installation of Edge Strips:

1. Locate edge strips under center line of doors unless otherwise shown.
2. Set resilient edge strips in adhesive. Anchor metal edge strips with anchors and screws specified.
3. Where tile edge is exposed, butt edge strip to touch along tile edge.
4. Where thin set ceramic tile abuts resilient tile, set edge strip against floor file and against the ceramic tile edge.

3.4 CLEANING AND PROTECTION

A. Clean adhesive marks on exposed surfaces during the application of resilient materials before the adhesive sets. Exposed adhesive is not acceptable.

B. Keep traffic off resilient material for a minimum 72 hours after installation.

C. Clean and polish materials in the following order:

1. For the first two weeks sweep and damp mopped only.
2. After two weeks, scrub resilient materials with a minimum amount of water and a mild detergent. Leave surface clean and free of detergent residue.
3. Apply polish to the floors in accordance with the polish manufacturer's instructions.

D. When construction traffic occurs over tile, cover resilient materials with reinforced kraft paper properly secured and maintained until removal is directed by Resident Engineer. At entrances and where wheeled vehicles or carts are used, cover tile with plywood, hardboard, or particle board over paper, secured and maintained until removal is directed by Resident Engineer.

E. When protective materials are removed and immediately prior to acceptance, replace any damage tile, re-clean resilient materials, lightly re-apply polish and buff floors.

3.5 LOCATION

A. Unless otherwise specified or shown, install tile flooring, on floor under areas where casework, laboratory and pharmacy furniture and other equipment occurs, except where mounted in wall recesses.

B. Extend tile flooring for room into adjacent closets and alcoves.

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SECTION 09 67 23.60

RESINOUS URETHANE FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies Resinous (Resinous urethane and epoxy mortars) flooring with integral cove base [and trench liner]:

1. High Abuse Climatic Troweled and Sealed Urethane Mortar Flooring System.

1.2 RELATED WORK

A. Concrete and Moisture Vapor Barrier: Section 03 30 00, CAST-IN-PLACE CONCRETE.

B. Color and location of each type of resinous (urethane and epoxy mortar) flooring: As indicated in Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's Literature and Data:

1. Description of each product to be provided.
2. Application and installation instructions.
3. Maintenance Instructions: Submit manufacturer™s written instructions for recommended maintenance practices.

D. Sustainable Submittal:

1. Product data for products having recycled content, submit documentation indicating percentages by weight of postconsumer and pre-consumer recycled content.
   a. Include statements indicating costs for each product having recycled content, and low emitting materials.
2. Product data for Environmental Quality Credit EQ 4.2 low emitting materials, include printed statement of VOC content indicating compliance with environmental requirements.
3. Product data for Material Resource Credit MR 4.1, 12%-35% post-consumer recycled glass content.
4. Product data for Material Resource Credit MR 6, renewable resin.
5. Product data for field applied, interior, paints, coatings, and primers, include printed statement of VOC content indicating compliance with environmental requirements.

E. Shop Drawings: Include plans, sections, component details, and attachment to other trades. Indicate layout of the following:

1. Patterns.
2. Edge configuration[s].

F. Warranty: As specified in this section.

1.4 QUALITY ASSURANCE

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section

B. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this project for a minimum period of five (5) years, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

2. Contractor shall have completed at least five (5) projects of similar size and complexity. Include list of at least five (5) projects. List must include owner (purchaser); address of installation, contact information at installation project site; and date of installation.
3. Installer's Personnel: Employ persons trained for application of specified product.

C. Manufacturer™s Field Services: Manufacturer™s representative shall provide technical assistance and guidance for surface preparation and application of resinous flooring systems.

D. Volatile Organic Compound content to remain under 100g/liter.

1.5 MATERIAL PACKAGING DELIVERY AND STORAGE

A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.

B. Protect materials from damage and contamination in storage or delivery, including moisture, heat, cold, direct sunlight, etc.

C. Maintain temperature of storage area between 60 and 80 degrees F (15 and 26 degrees C).

D. Keep containers sealed until ready for use.

E. Do not use materials beyond manufacturer’s shelf life limits.

F. Package materials in factory pre-weighed and in single, easy to manage batches sized for ease of handling and mixing proportions from entire package or packages. No On site weighing or volumetric measurements are allowed.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring applications.

1. Maintain material and substrate temperature between 65 and 85 degrees F (18 and 30 degrees C) during resinous flooring application and for not less than 24 hours after application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

D. Concrete substrate shall be properly cured for a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring.

1.7 WARRANTY

A. Work subject to the terms of the Article “Warranty of Construction” FAR clause 52.246-21.

B. Warranty: Manufacture shall furnish a single, written warranty covering the full assembly (including substrata) for both material and workmanship for a extended period of three (3) full years from date of installation, or provide a joint and several warranty signed on a single document by manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of three (3) full years from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

1.8 APPLICABLE PUBLICATIONS

A. The publication listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

1. B221-08 Standard Specification for Aluminum and Aluminum -Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

2. C307-03 (2008) Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings

3. C413-01(2006) Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes

4. C531-00(2005) Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

5. C579-01(2006) Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

6. C580-02(2008) Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

7. C811-98(2008) Standard Practice for Surface Preparation of Concrete for Application of Chemical-Resistant Resin Monolithic Surfacings

8. D1308-02(2007) Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes

9. D2047-04 Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine

10. D2240-05 Standard Test Method for Rubber Property — Durometer Hardness

11. D4060-07 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

12. D4226-09 Standard Test Methods for Impact Resistance of Rigid Poly(Vinyl Chloride) (PVC) Building Products

13. D7234-05 Standard Test Methods for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers

14. F1869-09 Standard Test Method for Measuring Moisture Vapor

Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

15. F2170-09 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

C. National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 501 Finishes for Aluminum

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION FOR PE-1 (heavy duty Climatic)

A. System Descriptions:

1. Monolithic, multi-component urethane chemistry resinous flooring system, Screed and steel finish trowel applied, chemical and thermal cycling and shock resistant. Self priming multiple component polyurethane mortar, quartz aggregates for texture and associated high performance urethane sealer. Temperature resistance to 250 degrees F (121 degrees C) where required.

B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up.

C. System Components: Verify specific requirements as systems vary by manufacturer. Verify mortar base product, build up layers of broadcast systems will not be accepted. Verify compatibility with substrate. Use Manufacturer™s standard components, compatible with each other and as follows:

1. Mortar (Body coat):

a. Resin: Urethane with rapidly renewable resin components.

b. Application Method: Screed and steel finish trowel.

c. Thickness of coat(s): Verify thickness as systems vary by manufacturer; Nominal thickness 3/16 to 1/4 inch (4.76 to 6.35mm).

d. Number of Coats: One.

e. Aggregates: Rubber broadcast into wet urethane mortar base.

2. Seal Coat(s):

a. Resin: Urethane.

b. Application Method: Squeegee and Back roll.

c. Number of Coats: One.

D. Physical Properties:

1. Physical Properties of flooring system when tested as follows:

Property	Test	Value
Compressive Strength	ASTM C579	5,000 psi after 7 days
Tensile Strength	ASTM C307	1,000 psi
Flexural Strength	ASTM C580	2,400 psi
Water Absorption	ASTM C413	0.056%
Coefficient of friction dry/slip index wet	ASTM D2047	>1.0 dry >1.0 wet
Impact Resistance	ASTM D4226	> 160 in. lbs
Abrasion Resistance	ASTM D4060	0.05 gm maximum weight loss
Thermal Coefficient of Linear Expansion	ASTM C531	1.1 x 10-5 mm/ °C mm
Hardness Shore D	ASTM D2240	80 to 84
Bond Strength	ASTM D7234	>300 psi 100% concrete failure
	ASTM D1308	No Effect
Acetic acid	5 percent	
Ammonium hydroxide	10 percent	
Citric Acid Fatty acid Motor Oil, 20W	50 percent	
Hydrochloric acid	10 percent	
Salt water		
Sodium Hydroxide	10 percent	
Sulfuric acid	10 percent	
Trisodium phosphate	5 percent	
Urine		
Feces		
Hydrogen peroxide	28 percent	
Distilled Water		
Sodium Hypochloride	5.28 percent	

2.2 SUPPLEMENTAL MATERIALS

A. Textured Top Coat: Type recommended or produced by manufacturer of seamless resinous flooring system, type and profile of for desired final finish.

B. Joint Sealant: Type recommended or produced by resinous flooring

manufacturer for type of service or joint conditioned indicated.

C. Waterproof Membrane: Type recommended or produced by manufacturer of resinous floor coatings for type of service and conditions as indicated in Drawings and/or specified.

D. Crack Isolation Membrane: Type recommended or produced by manufacturer of resinous flooring for conditions as indicated in Drawings and/or specified.

E. Anti-Microbial Additive: Incorporate anti-microbial chemical additive to prevent growth of most bacteria, algae, fungi, mold, mildew, yeast, etc.

F. Patching and Fill Material: Resinous product of or approved by resinous coating manufacturer for application indicated. Resinous based materials only. Cementitious or single component product are not expectable.

2.3 **TROWELED COVE BASE**

A. Same physical properties as specified resinous mortar system. climatic, non-climatic.

2.4 BASE CAP STRIP

A. Shape for 3/16 inch (4.76 mm) depth of base material, "J" configuration.

B. Finish:

1. Finish exposed surfaces in accordance with NAAMM Metal Finishes Manual.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where monolithic resinous (urethane and epoxy mortar) flooring system with integral base is to be installed with the VA Resident Engineer.

B. Moisture Vapor Emission Testing: Perform moisture vapor transmission testing in accordance with ASTM F1869 to determine the MVER of the substrate prior to commencement of the work. See section 3.4, 3.

3.2 PROJECT CONDITIONS

A. Maintain temperature of rooms (air and surface) where work occurs, between 70 and 90 degrees F (21 and 32 degrees C) for at least 48 hours, before, during, and 24 hours after installation. Maintain temperature at least 70 degrees F (21 degrees C) during cure period.

B. Maintain relative humidity less than 75 percent.

C. Do not install materials until building is permanently enclosed and wet construction is complete, dry, and cured.

D. Maintain proper ventilation of the area during application and curing time period.

1. Comply with infection control measures of the VA Medical Center.

3.3 INSTALLATION REQUIREMENTS

A. The manufacturer's instructions for application and installation shall be reviewed with the VA Resident Engineer for the seamless resinous (urethane

and epoxy mortar) flooring system with integral cove base [and trench liner].

B. Substrate shall be approved by manufacture technical representative.

3.4 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Prepare concrete substrates as follows:

a. Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent. Use of acids is never allowed.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.

3. Verify that concrete substrates are dry.

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

b. MVT threshold for monolithic resinous Non - climatic flooring shall not exceed 5 lbs/1000 square feet (0.0001437 kPa) in a 24 hour period. MVT threshold for monolithic resinous climatic flooring shall not exceed 6 lbs/1000 square feet (0.0002155 kPa) over a 24 hour period.

c. When MVT emission exceeds this limit, apply manufacturer’s recommended vapor control primer or other corrective measures as recommended by manufacturer prior to application of flooring or membrane systems.

d. Provide a written report showing test placement and results.

4. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for flooring manufacturer recommended joint fill material, and concrete crack treatment.

F. Prepare wall to receive integral cove base :

1. Verify wall material is acceptable for resinous flooring application, if not, install material (e.g. cement board) to receive base.

2. Fill voids in wall surface to receive base, install undercoats (e.g. water

proofing membrane, and/or crack isolation membrane) as recommended by resinous flooring manufacturer.

3. Install base prior to flooring if required by resinous flooring manufacturer.

4. Grind, cut or sand protrusions to receive base application.

3.5 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.

a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply Primer: over prepared substrate at manufacturer's recommended spreading rate.

C. Apply cove base: Trowel to wall surfaces at a 1 inch radius, before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, and troweling, sanding, and top coating of cove base. Round internal and external corners.

D. Trowel mortar base: Mix mortar material according to manufacturer's recommended procedures. Climatic and non-climatic resinous flooring systems may vary slightly on mode of application. Application should be based upon the following: Uniformly spread mortar over substrate using a specially designed screed box adjusted to manufacturer's recommended height. Metal trowel (hand or power) single mortar coat in thickness indicated for flooring system, grout to fill substrate voids. When cured, sand to remove trowel marks and roughness

E. Topcoat: Mix and roller apply the topcoat(s) with strict adherence to manufacturer's installation procedures and coverage rates.

3.6 Tolerance

A. From line of plane: Maximum 1/8 inch (3.18 mm) in total distance of flooring and base.

B. From radius of cove: Maximum of 1/8 inch (3.18 mm) plus or 1/16-inch (1.59 mm) minus.

3.7 CURING, PROTECTION AND CLEANING

A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process.

B. Close area of application for a minimum of 24 hours.

C. Protect resinous flooring materials from damage and wear during construction operation.

   1. Cover flooring with kraft type paper.

   2. Optional 6 mm (1/4 inch) thick hardboard, plywood, or particle board where area is in foot or vehicle traffic pattern, rolling or fixed scaffolding and overhead work occurs.

D. Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

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SECTION 09 68 00

CARPETING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section specifies carpet, edge strips, adhesives, and other items required for complete installation.

1.2 RELATED WORK

A. Color and texture of carpet and edge strip: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Resilient wall base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

1.3 QUALITY ASSURANCE

A. Carpet installed by mechanics certified by the Floor Covering Installation Board.

B. Certify and label the carpet that it has been tested and meets criteria of CRI IAQ Carpet Testing Program for indoor air quality.

1.4 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Provide manufacturer documentation that the carpet tiles and adhesives shall meet or exceed all criteria of the following:

   a. Installed carpet and carpet tiles meet Green Label Plus Indoor Air Quality Test Program established by the Carpet and Rug Institute (CRI).

   b. Installed carpet pads/cushions meet Green Label Indoor Air Quality Test Program established by the Carpet and Rug Institute (CRI).

   c. The Volatile Organic Compound (VOC) content of any field applied interior Floor Adhesive, shall not exceed 50 grams per liter (50g/l).

4. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

5. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Product Data:

1. Manufacturer™s catalog data and printed documentation stating physical characteristics, durability, resistance to fading and flame resistance characteristics for each type of carpet material and installation accessory.

2. Manufacturer™s printed installation instructions for the carpet, including preparation of installation substrate, seaming techniques and recommended adhesives and tapes.

3. Manufacturer™s certificate verifying carpet containing recycled materials include percentage of recycled materials as specified.

D. Samples:

1. Carpet: "Production Quality" samples 300 x 300 mm (12 x 12 inches) of carpets, showing quality, pattern and color specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2. Floor Edge Strip (Molding): 150 mm (6 inches) long of each color and type specified.

3. Base Edge Strip (Molding): 150 mm (6 inches) long of each color specified.

E. Shop Drawings: Installers layout plan showing seams and cuts for sheet carpet and carpet module.

F. Maintenance Data: Carpet manufacturer™s maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods and cleaning cycles.

1.5 DELIVERY AND STORAGE

A. Deliver carpet in manufacturer’s original wrappings and packages clearly labeled with manufacturer’s name, brand, name, size, dye lot number and related information.

B. Deliver adhesives in containers clearly labeled with manufacturer's name, brand name, number, installation instructions, safety instructions and flash points.

C. Store in a clean, dry, well ventilated area, protected from damage and soiling. Maintain storage space at a temperature above 16 degrees C (60 degrees F) for 2 days prior to installation.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Areas in which carpeting is to be installed shall be maintained at a temperature above 16 degrees C (60 degrees F) for 2 days before installation, during installation and for 2 days after installation. A minimum temperature of 13 degrees C (55 degrees F) shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

1.7 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements

1. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
2. The Volatile Organic Compound (VOC) content of any field applied interior Carpet Pad Adhesive shall not exceed 50 grams per liter (50g/l).
3. Carpet and Carpet tiles shall meet or exceed all criteria of the ‘Green Label Plus” Indoor Air Quality Test Program established by the Carpet and Rug Institute (CRI).
4. Carpet Cushion shall meet or exceed all criteria of the ‘Green Label” Indoor Air Quality Test Program established by the Carpet and Rug Institute (CRI).
5. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
6. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.8 WARRANTY

A. Carpet and installation subject to terms of "Warranty of Construction" FAR clause 52.246-21, except that warranty period is extended to two years.

1.9 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American National Standards Institute (ANSI):

1. ANSI/NSF 140-10 Sustainable Carpet Assessment Standard

C. American Association of Textile Chemists and Colorists (AATCC):

1. AATCC 16-04 Colorfastness to Light
2. AATCC 129-10 Colorfastness to Ozone in the Atmosphere under High Humidities
3. AATCC 134-11 Electric Static Propensity of Carpets
4. AATCC 165-08 Colorfastness to Crocking: Textile Floor

Conerings-AATCC Crockmeter Method

D. American Society for Testing and Materials (ASTM):

1. ASTM D1335-05 Tuft Bind of Pile Yarn Floor Coverings
2. ASTM D3278-96 (R2004) Flash Point of Liquids by Small Scale Closed-Cup Apparatus
3. ASTM D5116-10 Determinations of Organic Emissions from Indoor Materials/Products
4. ASTM D5252-05 Operation of the Hexapod Tumble Drum Tester
5. ASTM D5417-05 Operation of the Vettermann Drum Tester
6. ASTM E648-10 Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

E. The Carpet and Rug Institute (CRI):

1. CRI 104-11 Installation of Commercial Carpet

PART 2 - PRODUCTS

2.1 CARPET

A. Physical Characteristics:

1. Carpet free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains and other physical and manufacturing defects.
2. Manufacturers standard construction commercial carpet:

   a. Modular Tile: 660 mm (24 inches) square tile.

3. Provide static control to permanently control static build up to less than 2.0 kV when tested at 20 percent relative humidity and 21 degrees C (70 degrees F) in accordance with AATCC 134.
4. Pile Height: Maximum 3.25 mm (0.10 inch).
5. Pile Fiber: Nylon with recycled content 25 percent minimum branded (federally registered trademark).
6. Pile Type: Level Loop.
7. Backing materials: Manufacturer™s unitary backing designed for glue-down installation using recovered materials.
8. Appearance Retention Rating (ARR): Carpet shall be tested and have the minimum 3.5-4.0 Severe ARR when tested in accordance with either the ASTM D 5252 (Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.
9. Tuft Bind: Minimum force of 40 N (10 lb) required to pull a tuft or loop free from carpet backing. Test per ASTM D1335.
10. Colorfastness to Crocking: Dry and wet crocking and water bleed, comply with AATCC 165 Color Transference Chart for colors, minimum class 4 rating.
11. Colorfastness to Ozone: Comply with AATCC 129, minimum rating of 4 on the AATCC color transfer chart.
12. Delamination Strength: Minimum of 440 N/m (2.5 lb/inch) between

secondary backing.

13. Flammability and Critical Radiant Flux Requirements:
    a. Test Carpet in accordance with ASTM E 648.
    b. Class I: Not less than 0.45 watts per square centimeter.
    c. Class II: Not less than 0.22 watts per square centimeter.
    d. Carpet in corridors, exits and Medical Facilities: Class I.
14. Density: Average Pile Yarn Density (APYD):
    a. Corridors, lobbies, entrances, common areas or multipurpose rooms, open offices, waiting areas and dining areas: Minimum APYD 6000.
    b. Other areas: Minimum APYD 4000.
15. VOC Limits: Use carpet and carpet adhesive that comply with the following limits for VOC content when tested according to ASTM D 5116:
    a. Carpet, Total VOCs: 0.5 mg/sq.m x hr.
    b. Carpet, 4-PC (4-Phenylcyclohexene): 0.05 mg/sq.m x hr.
    c. Carpet, Formaldehyde: 0.05 mg/sq.m x hr.
    d. Carpet, Styrene: 0.4 mg/sq.m x hr.
    e. Adhesive, Total VOCs: 10.00 mg/sq.m x hr.
    f. Adhesive, Formaldehyde: 0.05 mg/sq.m x hr.
    g. Adhesive, 2-Ethyl-1-Hexanol: 3.00 mg/sq.m x hr.

B. Shall meet platinum level of ANSI/NSF 140.

C. Color, Texture, and Pattern: As specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2.2 ADHESIVE AND CONCRETE PRIMER

A. Waterproof, resistant to cleaning solutions, steam and water, nonflammable, complies with air-quality standards as specified. Adhesives flashpoint minimum 60 degrees C (140 degrees F), complies with ASTM D 3278.

B. Seam Adhesives: Waterproof, non-flammable and non-staining.

2.3 SEAMING TAPE

A. Permanently resistant to carpet cleaning solutions, steam, and water.

B. Recommended by carpet manufacturer.

2.4 EDGE STRIPS (MOLDING)

A. Metal:
    1. Hammered surface aluminum, pinless, clamp down type designed for the carpet being installed.
    2. Floor flange not less than 38 mm (1-/2 inches) wide, face not less than 16 mm (5/8 inch) wide.
    3. Finish: Clear anodic coating unless specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.

B. Vinyl Edge Strip:

1. Beveled floor flange minimum 50 mm (2 inches) wide.
2. Beveled surface to finish flush with carpet for tight joint and other side to floor finish.
3. Color as specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2.5 LEVELING COMPOUND (FOR CONCRETE FLOORS)

A. Determine the type of underlayment selected for use by condition to be corrected.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Examine surfaces on which carpeting is to be installed.

B. Clean floor of oil, waxy films, paint, dust and deleterious substances that prevent adhesion, leave floor dry and cured, free of residue from curing or cleaning agents.

C. Correct conditions which will impair proper installation, including trowel marks, pits, dents, protrusions, cracks or joints.

D. Fill cracks, joints depressions, and other irregularities in concrete with leveling compound.

1. Do not use adhesive for filling or leveling purposes.
2. Do not use leveling compound to correct imperfections which can be corrected by spot grinding.
3. Trowel to smooth surface free of trowel marks, pits, dents, protrusions, cracks or joint lines.

E. Test new concrete subfloor prior to adhesive application for moisture and surface alkalinity per CRI 104 Section 6.3.1 or per ASTM E1907.

3.2 CARPET INSTALLATION

A. Do not install carpet until work of other trades including painting is complete and dry.

B. Install in accordance with CRI 104 direct glue down installation.

1. Relax carpet in accordance with Section 6.4.
2. Comply with indoor air quality recommendations noted in Section 6.5.
3. Maintain temperature in accordance with Section 15.3.

C. Secure carpet to subfloor of spaces with adhesive applied as recommended by carpet manufacturer.

D. Follow carpet manufacturer's recommendations for matching pattern and texture directions.

E. Cut openings in carpet where required for installing equipment, pipes, outlets, and penetrations.

1. Bind or seal cut edge of sheet carpet and replace flanges or plates.
2. Use additional adhesive to secure carpets around pipes and other vertical projections.

F. Broadloom Carpet:

1. Install per CRI 104, Section 8.
2. Lay broadloom carpet lengthwise in longest dimension of space, with minimum seams, uniformly spaced to provide a tight smooth finish, free from movement when subjected to traffic.
3. Use tape-seaming method to join sheet carpet edges. Do not leave visible seams.

G. Carpet Modules:

1. Install per CRI 104, Section 13, Adhesive Application.
2. Lay carpet modules with pile in same direction unless specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
3. Install carpet modules so that cleaning methods and solutions do not cause dislocation of modules.
4. Lay carpet modules uniformly to provide tight flush joints free from movement when subject to traffic.

3.3 EDGE STRIPS INSTALLATION

A. Install edge strips over exposed carpet edges adjacent to uncarpeted finish flooring.

B. Anchor metal strips to floor with suitable fasteners. Apply adhesive to edge strips, insert carpet into lip and press it down over carpet.

C. Anchor vinyl edge strip to floor with adhesive apply adhesive to edge strip and insert carpet into lip and press lip down over carpet.

D. Carpet Base Top Edge Strip Installation:

1. Place carpet molding at top edge of carpet where turned up as base.
2. Install molding in accordance with manufacturer's instructions.

3.4 PROTECTION AND CLEANING

A. Remove waste, fasteners and other cuttings from carpet floors.

B. Vacuum carpet and provide suitable protection. Do not use polyethylene film.

C. Do not permit traffic on carpeted surfaces for at least 48 hours after installation. Protect the carpet in accordance with CRI 104.

D. Do not move furniture or equipment on unprotected carpeted surfaces.

E. Just before final acceptance of work, remove protection and vacuum carpet clean.

- - - E N D - - -

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section specifies field painting.

B. Section specifies prime coats which may be applied in shop under other sections.

C. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.

1.2 RELATED WORK

A. Shop prime painting of steel and ferrous metals: Division 05 - METALS, Division 08 - OPENINGS, Division 10 - SPECIALTIES, Division 11 - EQUIPMENT, Division 12 - FUNISHINGS, Division 13 – SPECIAL CONSTRUCTION, Division 14 – CONVEYING EQUIPMENT, Division 21 – FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 – HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 – ELECTRONIC SAFETY AND SECURITY sections.

B. Contractor option: Prefinished flush doors with transparent finishes: Section 08 14 00, WOOD DOORS.

C. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.

D. Glazed wall surfacing or tile like coatings: Section 09 96 59, HIGH-BUILD GLAZED COATINGS.

E. Multi-color Textured Wall Finish: Section 09 94 19, MULTICOLOR INTERIOR FINISHING.

F. Asphalt and concrete pavement marking: Section 32 17 23, PAVEMENT MARKINGS.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.
3. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content)

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's Literature and Data:

1. Before work is started, or sample panels are prepared, submit manufacturer's literature, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of Contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one list may be used for the entire Contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.

D. Sample Panels:

1. After painters' materials have been approved and before work is started submit sample panels showing each type of finish and color specified.
2. Panels to show color: Composition board, 100 by 250 by 3 mm (4 inch by 10 inch by 1/8 inch).
3. Panel to show transparent finishes: Wood of same species and grain pattern as wood approved for use, 100 by 250 by 3 mm (4 inch by 10 inch face by 1/4 inch) thick minimum, and where both flat and edge grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 by 50 mm (2 by 2 inch) minimum or actual wood member to show complete finish.
4. Attach labels to panel stating the following:
   a. Federal Specification Number or manufacturers name and product number of paints used.
   b. Specification code number specified in Section 09 06 00, SCHEDULE FOR FINISHES.
   c. Product type and color.
   d. Name of project.
5. Strips showing not less than 50 mm (2 inch) wide strips of undercoats and 100 mm (4 inch) wide strip of finish coat.

E. Sample of identity markers if used.

F. Manufacturers' Certificates indicating compliance with specified

requirements:

1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
2. High temperature aluminum paint.
3. Epoxy coating.
4. Intumescent clear coating or fire retardant paint.
5. Plastic floor coating.

1.4 QUALITY ASSURANCE

A. LEED Building Performance Requirements:

1. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.
2. Volatile Organic Compounds: the VOC concentrations (in grams per liter) of the product shall not exceed those listed below as determined by U. S. Environmental Protection Agency (EPA) Reference Test Method 24.

Interior Paints and Primers:

Non-flat:	150 g/l
Flat:	50 g/l

Anti-Corrosive Paints (if used in interior applications):

Gloss	250 g/l
Semi-gloss	250 g/l
Flat	250 g/l

a. The calculation of VOC shall exclude water and tinting color added at the point of sale.

3. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.5 DELIVERY AND STORAGE

A. Deliver materials to site in manufacturer's sealed container marked to show following:

1. Name of manufacturer.
2. Product type.
3. Batch number.
4. Instructions for use.
5. Safety precautions.

B. In addition to manufacturer's label, provide a label legibly printed as following:

1. Federal Specification Number, where applicable, and name of material.
2. Surface upon which material is to be applied.
3. If paint or other coating, state coat types; prime, body or finish.

C. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.

D. Store materials at site at least 24 hours before using, at a temperature between 18 and 30 degrees C (65 and 85 degrees F).

1.6 MOCK-UP PANEL

A. Before starting application of water paint mixtures, cementitious paint , apply paint as specified to an area, not to exceed 9 m2 (100 ft2), selected by Resident Engineer.

B. Finish and texture approved by Resident Engineer will be used as a standard of quality for remainder of work.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. American Conference of Governmental Industrial Hygienists (ACGIH):

1. ACGIH TLV-BKLT-2008 Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
2. ACGIH TLV-DOC-2008 Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)

C. American National Standards Institute (ANSI):

1. A13.1-07 Scheme for the Identification of Piping Systems

D. American Society for Testing and Materials (ASTM):

1. D260-86 Boiled Linseed Oil

E. Commercial Item Description (CID):

1. A-A-1555 Water Paint, Powder (Cementitious, White and Colors) (WPC) (cancelled)
2. A-A-3120 Paint, For Swimming Pools (RF) (cancelled)

F. Federal Specifications (Fed Spec):

1. TT-P-1411A Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)

G. Master Painters Institute (MPI):

1. 1-07 Aluminum Paint (AP)
2. 4-07 Interior/ Exterior Latex Block Filler
3. 5-07 Exterior Alkyd Wood Primer
4. 7-07 Exterior Oil Wood Primer
5. 8-07 Exterior Alkyd, Flat MPI Gloss Level 1 (EO)

6. 9-07 Exterior Alkyd, Enamel MPI Gloss Level 6 (EO)
7. 10-07 Exterior Latex, Flat (AE)
8. 11-07 Exterior Latex, Semi-Gloss (AE)
9. 18-07 Organic Zinc Rich Primer
10. 22-07 Aluminum Paint, High Heat (up to 590% - 1100F) (HR)
11. 26-07 Cementitious Galvanized Metal Primer
12. 27-07 Exterior / Interior Alkyd Floor Enamel, Gloss (FE)
13. 31-07 Polyurethane, Moisture Cured, Clear Gloss (PV)
14. 36-07 Knot Sealer
15. 43-07 Interior Satin Latex, MPI Gloss Level 4
16. 44-07 Interior Low Sheen Latex, MPI Gloss Level 2
17. 45-07 Interior Primer Sealer
18. 46-07 Interior Enamel Undercoat
19. 47-07 Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 (AK)
20. 48-07 Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)
21. 49-07 Interior Alkyd, Flat, MPI Gloss Level 1 (AK)
22. 50-07 Interior Latex Primer Sealer
23. 51-07 Interior Alkyd, Eggshell, MPI Gloss Level 3
24. 52-07 Interior Latex, MPI Gloss Level 3 (LE)
25. 53-07 Interior Latex, Flat, MPI Gloss Level 1 (LE)
26. 54-07 Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)
27. 59-07 Interior/Exterior Alkyd Porch & Floor Enamel, Low Gloss (FE)
28. 60-07 Interior/Exterior Latex Porch & Floor Paint, Low Gloss
29. 66-07 Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved) (FC)
30. 67-07 Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR)
31. 68-07 Interior/ Exterior Latex Porch & Floor Paint, Gloss
32. 71-07 Polyurethane, Moisture Cured, Clear, Flat (PV)
33. 74-07 Interior Alkyd Varnish, Semi-Gloss
34. 77-07 Epoxy Cold Cured, Gloss (EC)
35. 79-07 Marine Alkyd Metal Primer
36. 90-07 Interior Wood Stain, Semi-Transparent (WS)
37. 91-07 Wood Filler Paste
38. 94-07 Exterior Alkyd, Semi-Gloss (EO)
39. 95-07 Fast Drying Metal Primer
40. 98-07 High Build Epoxy Coating
41. 101-07 Epoxy Anti-Corrosive Metal Primer

42. 108-07 High Build Epoxy Coating, Low Gloss (EC)
43. 114-07 Interior Latex, Gloss (LE) and (LG)
44. 119-07 Exterior Latex, High Gloss (acrylic) (AE)
45. 135-07 Non-Cementitious Galvanized Primer
46. 138-07 Interior High Performance Latex, MPI Gloss Level 2 (LF)
47. 139-07 Interior High Performance Latex, MPI Gloss Level 3 (LL)
48. 140-07 Interior High Performance Latex, MPI Gloss Level 4
49. 141-07 Interior High Performance Latex (SG) MPI Gloss Level 5

H. Steel Structures Painting Council (SSPC):
1. SSPC SP 1-04 (R2004) Solvent Cleaning
2. SSPC SP 2-04 (R2004) Hand Tool Cleaning
3. SSPC SP 3-04 (R2004) Power Tool Cleaning

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cementitious Paint (CEP): TT-P-1411A Paint, Copolymer-Resin, Cementitious (CEP), Type 1 for exterior use, Type II for interior use.

B. Wood Sealer: MPI 31 (gloss) or MPI 71 (flat) thinned with thinner recommended by manufacturer at rate of about one part of thinner to four parts of varnish.

C. Aluminum Paint (AP): MPI 1.

D. Interior/Exterior Latex Block Filler: MPI 4.

E. Interior Primer Sealer: MPI 45.

F. Interior Latex Primer Sealer: MPI 50.

G. Interior / Exterior Alkyd Porch & Floor Enamel, Low Gloss (FE): MPI 59.

H. Interior/ Exterior Latex Porch & Floor Paint, Low Gloss: MPI 60.

I. Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved) (FC): MPI 66.

J. Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR): MPI 67.

K. Interior/ Exterior Latex Porch & Floor Paint, gloss: MPI 68.

L. Epoxy Cold Cured, Gloss (EC): MPI 77.

M. Interior Wood Stain, Semi-Transparent (WS): MPI 90.

N. Interior High Performance Latex, MPI Gloss Level 2(LF): MPI 138.

O. Interior High Performance Latex, MPI Gloss Level 3 (LL): MPI 139.

P. Interior High Performance Latex (SG), MPI Gloss Level 5: MPI 141.

Q. Interior High Performace Latex (SG, MPI Gloss Level 5: MPI 141.

2.2 PAINT PROPERTIES

A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.

B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

2.3 REGULATORY REQUIREMENTS/QUALITY ASSURANCE

A. Paint materials shall conform to the restrictions of the local Environmental and Toxic Control jurisdiction.

1. Volatile Organic Compounds (VOC): VOC content of paint materials shall not exceed 10g/l for interior latex paints/primers and 50g/l for exterior latex paints and primers.

2. Asbestos: Materials shall not contain asbestos.

3. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.

4. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.

5. Use high performance acrylic paints in place of alkyd paints, where possible.

6. VOC content for solvent-based paints shall not exceed 250g/l and shall not be formulated with more than one percent aromatic hydro carbons by weight.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.

1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.

2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each days work.

B. Atmospheric and Surface Conditions:

1. Do not apply coating when air or substrate conditions are:

a. Less than 3 degrees C (5 degrees F) above dew point.

b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

2. Maintain interior temperatures until paint dries hard.

3. Do no exterior painting when it is windy and dusty.

4. Do not paint in direct sunlight or on surfaces that the sun will soon warm.

5. Apply only on clean, dry and frost free surfaces except as follows:

a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces where allowed by manufacturer's printed instructions.

b. Dampened with a fine mist of water on hot dry days concrete and masonry surfaces to which water thinned acrylic and cementitious paints are applied to prevent excessive suction and to cool surface.

6. Varnishing:

a. Apply in clean areas and in still air.

b. Before varnishing vacuum and dust area.

c. Immediately before varnishing wipe down surfaces with a tack rag.

3.2 SURFACE PREPARATION

A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.

B. General:

1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.

2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.

3. See other sections of specifications for specified surface conditions and prime coat.

4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.

C. Wood:

1. Sand to a smooth even surface and then dust off.

2. Sand surfaces showing raised grain smooth between each coat.

3. Wipe surface with a tack rag prior to applying finish.

4. Surface painted with an opaque finish:

a. Coat knots, sap and pitch streaks with MPI 36 (Knot Sealer) before applying paint.

b. Apply two coats of MPI 36 (Knot Sealer) over large knots.

5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand the surface to make smooth and finish flush with adjacent surface.

6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.

7. Fill open grained wood such as oak, walnut, ash and mahogany with MPI 91 (Wood Filler Paste), colored to match wood color.

a. Thin filler in accordance with manufacturer's instructions for

application.

b. Remove excess filler, wipe as clean as possible, dry, and sand as specified.

D. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).

2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning). Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.

3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two- Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.

   a. This includes flat head countersunk screws used for permanent anchors.

   b. Do not fill screws of item intended for removal such as glazing beads.

4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.

5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.

E. Zinc-Coated (Galvanized) Metal Aluminum, Surfaces Specified Painted:

1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion in accordance with SSPC-SP 1 (Solvent Cleaning).

2. Spot coat abraded and damaged areas of zinc-coating which expose base metal on hot-dip zinc-coated items with MPI 18 (Organic Zinc Rich Coating). Prime or spot prime with MPI 134 (Waterborne Galvanized Primer) or MPI 135 (Non- Cementitious Galvanized Primer) depending on finish coat compatibility.

F. Masonry, Concrete, and Cement Board:

1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.

2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.

3. Remove loose mortar in masonry work.

4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar specified in Section 04 05 13, MASONRY MORTARING Section 04 05 16, MASONRY GROUTING. Do not fill weep holes. Finish to match adjacent surfaces.

5. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three days and brush thoroughly free of crystals.

6. Repair broken and spalled concrete edges with concrete patching compound

to match adjacent surfaces as specified in CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

G. Gypsum Board:

1. Remove efflorescence, loose and chalking plaster or finishing materials.
2. Remove dust, dirt, and other deterrents to paint adhesion.
3. Fill holes, cracks, and other depressions with CID-A-A-1272A Gypsum (Spackling Compound) finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.3 PAINT PREPARATION

A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.

B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.

C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.

D. Mix two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.

E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.4 APPLICATION

A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.

B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.

C. Apply each coat evenly and cover substrate completely.

D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by Resident Engineer.

E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.

F. Apply by brush, roller or spray, except as otherwise specified.

G. Do not spray paint in existing occupied spaces unless approved by Resident Engineer, except in spaces sealed from existing occupied spaces.

1. Apply painting materials specifically required by manufacturer to be applied by spraying.
2. In areas, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in WORK NOT PAINTED, motors, controls, telephone, and electrical equipment, fronts of

sterilizes and other recessed equipment and similar prefinished items.

H. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.5 PRIME PAINTING

A. After surface preparation prime surfaces before application of body and finish coats, except as otherwise specified.

B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.

C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.

D. Prime rebates for stop and face glazing of wood, and for face glazing of steel.

E. Wood and Wood Particleboard:

1. Use same kind of primer specified for exposed face surface.

a. Exterior wood: MPI 7 (Exterior Oil Wood Primer) for new construction and MPI 5(Exterior Alkyd Wood Primer) for repainting bare wood primer except where MPI 90 (Interior Wood Stain, Semi-Transparent (WS) is scheduled.

b. Interior wood except for transparent finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.

c. Transparent finishes as specified under Transparent Finishes on Wood except Floors.

2. Apply two coats of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) to surfaces of wood doors, including top and bottom edges, which are cut for fitting or for other reason.

3. Apply one coat of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) as soon as delivered to site to surfaces of unfinished woodwork, except concealed surfaces of shop fabricated or assembled millwork and surfaces specified to have varnish, stain or natural finish.

4. Back prime and seal ends of exterior woodwork, and edges of exterior plywood specified to be finished.

5. Apply MPI 67 (Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR)) to wood for fire retardant finish.

F. Metals except boilers, incinerator stacks, and engine exhaust pipes:

1. Steel and iron: MPI 79 (Marine Alkyd Metal Primer), MPI 95 (Fast Drying Metal Primer) MPI 108 (High Build Epoxy Marine Coating (EC)) finish is specified.

2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer) .

3. Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
4. Terne Metal: MPI 79 (Marine Alkyd Metal Primer), MPI 95 (Fast Drying Metal Primer).
5. Copper and copper alloys scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
6. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel (EO)).
7. Asphalt coated metal: MPI 1 (Aluminum Paint (AP)).
8. Metal over 94 degrees C. (200 degrees F), Boilers, Incinerator Stacks, and Engine Exhaust Pipes: MPI 22 (High Heat Resistant Coating (HR)).

G. Gypsum Board:

1. Surfaces scheduled to have MPI 11 (Exterior Latex, Latex, Semi-Gloss (AEMPI 52 (Interior Latex, MPI Gloss Level 3 (LE)) MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)), MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)) MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)) MPI 114 (Interior Latex, Gloss (LE) and (LG) respectively .
2. Primer: MPI 50(Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer) in shower and bathrooms.
3. Use MPI 101 (Cold Curing Epoxy Primer) for surfaces scheduled to receive MPI 77 (Epoxy Cold Cured, Gloss (EC MPI 108 (High Build Epoxy Marine Coating (EC)) finish.

H. Gypsum Plaster and Veneer Plaster:

1. Surfaces scheduled to receive vinyl coated fabric wallcovering: Use MPI 45 (Interior Primer Sealer).
2. MPI 45 (Interior Primer Sealer), except use MPI 50 (Interior Latex Primer Sealer) when an alkyd flat finish is specified.
3. Surfaces scheduled to have MPI 10 (Exterior Latex, Flat (AE)) respectively.
4. Use MPI 101 (Cold Curing Epoxy Primer) for surfaces scheduled to receive finish.

I. Concrete Masonry Units except glazed or integrally colored and decorative units:

1. MPI 4 (Block Filler) on interior surfaces.
2. Prime exterior surface as specified for exterior finishes.

J. Cement Plaster or stucco Concrete Masonry, Brick Masonry and Cement board Interior Surfaces of Ceilings and Walls:

1. MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 LE),MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)),[MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE))]except use two coats where substrate has aged less than six months.
2. Use MPI 138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)) , MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)) MPI 140 (Interior High Performance latex, MPI Gloss Level 4) MPI 141 (Interior High Performance Latex (SG) MPI Gloss Level 5) as scheduled.

K. Concrete Floors: MPI 60 (Interior/ Exterior Latex Porch & Floor Paint, Low

Gloss) .

3.6 EXTERIOR FINISHES

A. Apply following finish coats where specified in Section 09 06 00, SCHEDULE FOR FINISHES.

B. Wood:

1. Do not apply finish coats on surfaces concealed after installation, top and bottom edges of wood doors and sash, or on edges of wood framed insect screens.

2. Portion of sash runs of double hung wood windows, concealed by sash when in a closed position: Apply two coats of ASTM D260 mixed with not more than 0.12L (1/4 pint) of dryer per 3.89L (gallon).

3. Two coats of MPI 10 Exterior Latex, Flat (AE)), MPI 11 (Exterior Latex, Semi- Gloss on exposed surfaces, except where transparent finish is specified.

4. Two coats of MPI 31 (Polyurethane, Moisture Cured, Clear Gloss (PV)) MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV))for transparent finish.

C. Steel and Ferrous Metal:

1. Two coats of MPI 8 (Exterior Alkyd, Flat (EO)) MPI 9 (Exterior Alkyd Enamel (EO)) MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F).

D. Machinery without factory finish except for primer: One coat MPI 8 (Exterior Alkyd, Flat (EO)) MPI 9 (Exterior Alkyd Enamel (EO)) MPI 94 (Exterior Alkyd, Semi-Gloss (EO)).

E. Concrete Masonry Units:

a. Where specified in Section 09 06 00, SCHEDULE FOR FINISHES or shown.

b. Mix as specified in manufacturer's printed directions.

c. Do not mix more paint at one time than can be used within four hours after mixing. Discard paint that has started to set.

d. Dampen warm surfaces above 24 degrees C (75 degrees F) with fine mist of water before application of paint. Do not leave free water on surface.

e. Cure paint with a fine mist of water as specified in manufacturer's printed instructions.

2. Use two coats of TT-P-1411 (Paint, Co-polymer-Resin, Cementitious (CEP)), unless specified otherwise.

3.7 INTERIOR FINISHES

A. Apply following finish coats over prime coats in spaces or on surfaces specified in Section 09 06 00, SCHEDULE FOR FINISHES.

B. Metal Work:

1. Apply to exposed surfaces.

2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
   a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK) unless specified otherwise.
   b. Two coats of MPI 51 (Interior Alkyd, Eggshell (AK0).
   c. One coat of MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) on exposed interior surfaces of alkyd-amine enamel prime finished windows.
   d. Two coats of CID-A-A3120 Type E (RP) on exposed surfaces in battery rooms .
   e. Machinery: One coat MPI 9 (Exterior Alkyd Enamel (EO)).
   f. Asphalt Coated Metal: One coat MPI 1 (Aluminum Paint (AP)).
   g. Ferrous Metal over 94 degrees K (200 degrees F): Boilers, Incinerator Stacks, and Engine Exhaust Pipes: One coat MPI 22 (High Heat Resistant Coating (HR)).

C. Gypsum Board:
1. One coat of MPI 45 (Interior Primer Sealer) plus one coat of MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)).
2. Two coats of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)).
3. One coat of MPI 45 (Interior Primer Sealer) plus one coat of MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE) or MPI 114 (Interior Latex, Gloss (LE) and (LG)).
4. One coat of MPI 45 (Interior Primer Sealer) plus one coat of MPI 48 (Interior Alkyd Gloss (AK)).

D. Masonry and Concrete Walls:
1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.
2. Two coats of MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)).
3. Two coats of MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)).

E. Wood:
1. Sanding:
   a. Use 220-grit sandpaper.
   b. Sand sealers and varnish between coats.
   c. Sand enough to scarify surface to assure good adhesion of subsequent coats, to level roughly applied sealer and varnish, and to knock off "whiskers" of any raised grain as well as dust particles.
2. Sealers:
   a. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.
   b. Allow manufacturer's recommended drying time before sanding, but not

less than 24 hours or 36 hours in damp or muggy weather.

c. Sand as specified.

3. Paint Finish:

a. One coat of MPI 45 (Interior Primer Sealer) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss (AK) (SG)).

b. One coat MPI 66 (Interior Alkyd Fire retardant, Clear Top-Coat (ULC Approved) (FC) MPI 67 (Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR)), intumescent type (FR), on exposed wood in attics with floors used for mechanical equipment and above ceilings where shown.

c. One coat of MPI 45 Interior Primer Sealer) MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 48 (Interior Alkyd Gloss (AK)).

d. Two coats of MPI 51 (Interior Alkyd, Eggshell (AK)).

4. Transparent Finishes on Wood Except Floors.

a. Natural Finish:

1) One coat of sealer as written in 2.1 E.

2) Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV)).

b. Stain Finish:

1) One coat of MPI 90 (Interior Wood Stain, Semi-Transparent (WS).

2) Use wood stain of type and color required to achieve finish specified. Do not use varnish type stains.

3) One coat of sealer as written in 2.1 E.

4) Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV) .

F. Cement Board: One coat of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)) MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)) MPI 140 (Interior High Performance Latex MPI Gloss level 4) MPI 141 (Interior High Performance Latex (SG)) MPI Gloss Level 5]MPI 114 (Interior Latex, Gloss (LE) and (LG)).

G. Concrete Floors: One coat of MPI 68 (Interior/ Exterior Latex Porch & Floor Paint, Gloss (FE)).

H. Miscellaneous:

1. Apply where specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2. MPI 1 (Aluminum Paint): Two coats of aluminum paint.

3.8 PAINT COLOR

A. Color and gloss of finish coats is specified in Section 09 06 00, SCHEDULE FOR FINISHES.

B. For additional requirements regarding color see Articles, REFINISHING EXISTING PAINTED SURFACE and MECHANICAL AND ELECTRICAL FIELD PAINTING SCHEDULE.

C. Coat Colors:

1. Color of priming coat: Lighter than body coat.
2. Color of body coat: Lighter than finish coat.
3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.

D. Painting, Caulking, Closures, and Fillers Adjacent to Casework:

1. Paint to match color of casework where casework has a paint finish.
2. Paint to match color of wall where casework is stainless steel, plastic laminate, or varnished wood.

3.9 MECHANICAL AND ELECTRICAL WORK FIELD PAINTING SCHEDULE

A. Field painting of mechanical and electrical consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment if not factory finished in space scheduled to be finished.

B. In spaces not scheduled to be finish painted in Section 09 06 00, SCHEDULE FOR FINISHES paint as specified under paragraph H, colors.

C. Paint various systems specified in Division 02 – EXISTING CONDITIONS, Division 21 – FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 – HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 – ELECTRONIC SAFETY AND SECURITY.

D. Paint after tests have been completed.

E. Omit prime coat from factory prime-coated items.

F. Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces except on electrical conduit containing feeders 600 volts or more.

G. Omit field painting of items specified in paragraph, Building and Structural WORK NOT PAINTED.

H. Color:

1. Paint items having no color specified in Section 09 06 00, SCHEDULE FOR FINISHES to match surrounding surfaces.
2. Paint colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES except for following:
   a. White: Exterior unfinished surfaces of enameled plumbing fixtures. Insulation coverings on breeching and uptake inside boiler house, drums and drum-heads, oil heaters, condensate tanks and condensate piping.
   b. Gray: Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.
   c. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping,

fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).

d. Federal Safety Red: Exposed fire protection piping hydrants, post indicators, electrical conducts containing fire alarm control wiring, and fire alarm equipment.

e. Federal Safety Orange: Entire lengths of electrical conduits containing feeders 600 volts or more.

f. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.

I. Apply paint systems on properly prepared and primed surface as follows:

1. Exterior Locations:

a. Apply two coats of MPI 8 (Exterior Alkyd, Flat (EO)) MPI 94 (Exterior Alkyd, Semi-gloss (EO)) MPI 9 (Exterior Alkyd Enamel (EO)) to the following ferrous metal items: Vent and exhaust pipes with temperatures under 94 degrees C (200 degrees F), roof drains, fire hydrants, post indicators, yard hydrants, exposed piping and similar items.

b. Apply two coats of MPI 10 (Exterior Latex, Flat (AE)) MPI 11 (Exterior Latex, Semi Gloss (AE)) MPI 119 (Exterior Latex, High Gloss (acrylic) (AE)) to the following metal items: Galvanized and zinc-copper alloy metal.

c. Apply one coat of MPI 22 (High Heat Resistant Coating (HR)), 650 degrees C (1200 degrees F) to incinerator stacks, boiler stacks, and engine generator exhaust.

2. Interior Locations:

a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) to following items:

1) Metal under 94 degrees C (200 degrees F) of items such as bare piping, fittings, hangers and supports.

2) Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.

3) Heating, ventilating, air conditioning, plumbing equipment, and machinery having shop prime coat and not factory finished.

b. Ferrous metal exposed in hydrotherapy equipment room and chlorinator room of water and sewerage treatment plants: One coat of MPI 101 (Cold Curing Epoxy Primer) and one coat of MPI 77 (Epoxy Cold Cured, Gloss (EC)) MPI 98 (High Build Epoxy Coating) MPI 108 (High Build Epoxy Marine coating (EC))].

c. Apply one coat of MPI 50 (Interior Latex Primer Sealer) and one coat of[MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 (LE)) MPI 44 (Interior Low Sheen Latex) MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)) MPI 43 (Interior Satin Latex) MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)) MPI 114 (Interior Latex, Gloss (LE) and (LG)) on finish of insulation on boiler breeching and uptakes inside boiler house, drums, drumheads, oil heaters, feed water

heaters, tanks and piping.

d. Apply two coats of MPI 22 (High Heat Resistant Coating (HR)) to ferrous metal surface over 94 degrees K (200 degrees F) of following items:

1) Garbage and trash incinerator.

2) Medical waste incinerator.

3) Exterior of boilers and ferrous metal in connection with boiler settings including supporting members, doors and door frames and fuel oil burning equipment.

4) Steam line flanges, bare pipe, fittings, valves, hangers and supports over 94 degrees K (200 degrees F).

5) Engine generator exhaust piping and muffler.

e. Paint electrical conduits containing cables rated 600 volts or more using two coats of MPI 9 (Exterior Alkyd Enamel (EO) MPI 8(Exterior Alkyd, Flat (EO) MPI 94 (Exterior Alkyd, Semi-gloss (EO)] in the Federal Safety Orange color in exposed and concealed spaces full length of conduit.

3. Other exposed locations:

a. Metal surfaces, except aluminum, of cooling towers exposed to view, including connected pipes, rails, and ladders: Two coats of MPI 1 (Aluminum Paint (AP)).

b. Cloth jackets of insulation of ducts and pipes in connection with plumbing, air conditioning, ventilating refrigeration and heating systems: One coat of MPI 50 (Interior Latex Primer Sealer) and one coat of MPI 10 (Exterior Latex, Flat MPI 11 (Exterior Latex Semi-Gloss (AE)) MPI 119 (Exterior Latex, High Gloss (acrylic)(AE)).

3.10 BUILDING AND STRUCTURAL WORK FIELD PAINTING

A. Painting and finishing of interior and exterior work except as specified under paragraph 3.11 B.

1. Painting and finishing of new work including colors and gloss of finish selected is specified in Finish Schedule, Section 09 06 00, SCHEDULE FOR FINISHES.

2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.

3. Painting of ferrous metal and galvanized metal.

4. Painting of wood with fire retardant paint exposed in attics, when used as mechanical equipment space except shingles.

5. Identity painting and safety painting.

B. Building and Structural Work not Painted:

1. Prefinished items:

a. Casework, doors, elevator entrances and cabs, metal panels, wall covering, and similar items specified factory finished under other sections.

b. Factory finished equipment and pre-engineered metal building

components such as metal roof and wall panels.

2. Finished surfaces:
   a. Hardware except ferrous metal.
   b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
   c. Signs, fixtures, and other similar items integrally finished.
3. Concealed surfaces:
   a. Inside dumbwaiter, elevator and duct shafts, interstitial spaces, pipe basements, crawl spaces, pipe tunnels, above ceilings, attics, except as otherwise specified.
   b. Inside walls or other spaces behind access doors or panels.
   c. Surfaces concealed behind permanently installed casework and equipment.
4. Moving and operating parts:
   a. Shafts, chains, gears, mechanical and electrical operators, linkages, and sprinkler heads, and sensing devices.
   b. Tracks for overhead or coiling doors, shutters, and grilles.
5. Labels:
   a. Code required label, such as Underwriters Laboratories Inc., Inchcape Testing Services, Inc., or Factory Mutual Research Corporation.
   b. Identification plates, instruction plates, performance rating, and nomenclature.
6. Galvanized metal:
   a. Exterior chain link fence and gates, corrugated metal areaways, and gratings.
   b. Gas Storage Racks.
   c. Except where specifically specified to be painted.
7. Metal safety treads and nosings.
8. Gaskets.
9. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundation walls and interior walls in pipe basements.
10. Face brick.
11. Structural steel encased in concrete, masonry, or other enclosure.
12. Structural steel to receive sprayed-on fire proofing.
13. Ceilings, walls, columns in interstitial spaces.
14. Ceilings, walls, and columns in pipe basements.
15. Wood Shingles.

3.11 IDENTITY PAINTING SCHEDULE

A. Identify designated service in accordance with ANSI A13.1, unless specified

otherwise, on exposed piping, piping above removable ceilings, piping in accessible pipe spaces, interstitial spaces, and piping behind access panels.

1. Legend may be identified using 2.1 G options or by stencil applications.
2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12000 mm (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.
3. Locate Legends clearly visible from operating position.
4. Use arrow to indicate direction of flow.
5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on drawings where asterisk appears for High, Medium, and Low Pressure designations as follows:
   a. High Pressure - 414 kPa (60 psig) and above.
   b. Medium Pressure - 104 to 413 kPa (15 to 59 psig).
   c. Low Pressure - 103 kPa (14 psig) and below.
   d. Add Fuel oil grade numbers.
6. Legend name in full or in abbreviated form as follows:

PIPING	COLOR OF EXPOSED PIPING	COLOR OF BACK-GROUND	COLOR OF LETTERS	LEGEND ABBREVIATIONS
Blow-off		Yellow	Black	Blow-off
Boiler Feedwater		Yellow	Black	Blr Feed
A/C Condenser Water Supply		Green	White	A/C Cond Wtr Sup
A/C Condenser Water Return		Green	White	A/C Cond Wtr Ret
Chilled Water Supply		Green	White	Ch. Wtr Sup
Chilled Water Return		Green	White	Ch. Wtr Ret
Shop Compressed Air		Yellow	Black	Shop Air
Air-Instrument Controls		Green	White	Air-Inst Cont
Drain Line		Green	White	Drain
Emergency Shower		Green	White	Emg Shower
High Pressure Steam		Yellow	Black	H.P. _____*
High Pressure Condensate Return		Yellow	Black	H.P. Ret ____*
Medium Pressure Steam		Yellow	Black	M. P. Stm ____*
Medium Pressure Condensate Return		Yellow	Black	M.P. Ret _____*
Low Pressure Steam		Yellow	Black	L.P. Stm _____*
Low Pressure Condensate Return		Yellow	Black	L.P. Ret _____*
High Temperature Water Supply		Yellow	Black	H. Temp Wtr Sup
High Temperature Water Return		Yellow	Black	H. Temp Wtr Ret
Hot Water Heating Supply		Yellow	Black	H. W. Htg Sup
Hot Water Heating Return		Yellow	Black	H. W. Htg Ret
Gravity Condensate Return		Yellow	Black	Gravity Cond Ret
Pumped Condensate Return		Yellow	Black	Pumped Cond Ret
Vacuum Condensate Return		Yellow	Black	Vac Cond Ret

Fuel Oil - Grade		Green	White	Fuel Oil-Grade __*
Boiler Water Sampling		Yellow	Black	Sample
Chemical Feed		Yellow	Black	Chem Feed
Continuous Blow-Down		Yellow	Black	Cont. B D
Pumped Condensate			Black	Pump Cond
Pump Recirculating		Yellow	Black	Pump-Recirc.
Vent Line		Yellow	Black	Vent
Alkali				
		Bleach	Yellow	Black Bleach
Detergent		Yellow	Black	Det
Liquid Supply		Yellow	Black	Liq Sup
Reuse Water		Yellow	Black	Reuse Wtr
Cold Water (Domestic)	White	Green	White	C.W. Dom
Hot Water (Domestic)				
Supply	White	Yellow	Black	H.W. Dom
Return	White	Yellow	Black	H.W. Dom Ret
Tempered Water	White	Yellow	Black	Temp. Wtr
Ice Water				
Supply	White	Green	White	Ice Wtr
Return	White	Green	White	Ice Wtr Ret
Reagent Grade Water		Green	White	RG
Reverse Osmosis		Green	White	RO
Sanitary Waste		Green	White	San Waste
Sanitary Vent		Green	White	San Vent
Storm Drainage		Green	White	St Drain
Pump Drainage		Green	White	Pump Disch
Chemical Resistant Pipe				
Waste		Yellow	Black	Acid Waste
Vent		Yellow	Black	Acid Vent
Atmospheric Vent		Green	White	ATV
Silver Recovery		Green	White	Silver Rec
Oral Evacuation		Green	White	Oral Evac
Fuel Gas		Yellow	Black	Gas
Fire Protection Water				
Sprinkler		Red	White	Auto Spr
Standpipe		Red	White	Stand
Sprinkler		Red	White	Drain
Hot Water Supply Domestic/Solar Water		H.W. Sup Dom/SW		
Hot Water Return Domestic/Solar Water		H.W. Ret Dom/SW		

7. Electrical Conduits containing feeders over 600 volts, paint legends using 50 mm (2 inch) high black numbers and letters, showing the voltage class rating. Provide legends where conduits pass through walls and floors and at maximum 6100 mm (20 foot) intervals in between. Use labels with yellow background with black border and words Danger High Voltage Class,[**5000**][**15000**][**25000**].

8. See Sections for methods of identification, legends, and abbreviations of the following:

   a. Regular compressed air lines: Section 22 15 00, GENERAL SERVICE COMPRESSED-AIR SYSTEMS.

   b. Conduits containing high voltage feeders over 600 volts: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS / Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS / Section 28 05 33,

RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY.

B. Fire and Smoke Partitions:

1. Identify partitions above ceilings on both sides of partitions except within shafts in letters not less than 64 mm (2 1/2 inches) high.
2. Stenciled message: "SMOKE BARRIER" or, "FIRE BARRIER" as applicable.
3. Locate not more than 6100 mm (20 feet) on center on corridor sides of partitions, and with a least one message per room on room side of partition.
4. Use semigloss paint of color that contrasts with color of substrate.

C. Identify columns in pipe basements and interstitial space:

1. Apply stenciled number and letters to correspond with grid numbering and lettering shown.
2. Paint numbers and letters 100 mm (4 inches) high, locate 450 mm (18 inches) below overhead structural slab.
3. Apply on four sides of interior columns and on inside face only of exterior wall columns.
4. Color:
   a. Use black on concrete columns.
   b. Use white or contrasting color on steel columns.

3.12 PROTECTION CLEAN UP, AND TOUCH-UP

A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.

B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.

C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

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APPENDIX

Paint or coating	Abbreviation
Acrylic Emulsion	AE (MPI 10 – flat/MPI 11 – semigloss/MPI 119 - gloss)
Alkyd Flat	Ak (MPI 49)
Alkyd Gloss Enamel	G (MPI 48)
Alkyd Semigloss Enamel	SG (MPI 47)
Aluminum Paint	AP (MPI 1)
Cementitious Paint	CEP (TT-P-1411)
Exterior Latex	EL??(MPI 10 / 11 / 119)??
Exterior Oil	EO (MPI 9 – gloss/MPI 8 – flat/MPI 94 – semigloss)
Epoxy Coating	EC (MPI 77 – walls, floors/MPI 108 – CMU, concrete)
Fire Retardant Paint	FR (MPI 67)
Fire Retardant Coating (Clear)	FC (MPI 66, intumescent type)
Floor Enamel	FE (MPI 27 – gloss/MPI 59 – eggshell)
Heat Resistant Paint	HR (MPI 22)

Latex Emulsion	LE (MPI 53, flat/MPI 52, eggshell/MPI 54, Latex Flat LF (MPI 138)
Latex Gloss	LG (MPI 114)
Latex Semigloss	SG (MPI 141)
Latex Low Luster	LL (MPI 139)
Plastic Floor Coating	PL
Polyurethane Varnish	PV (MPI 31 – gloss/MPI 71 - flat)
Rubber Paint	RF (CID-A-A-3120 - Paint for Swimming Pools (RF).
Water Paint, Cement	WPC (CID-A-A-1555 - Water Paint, Powder).
Wood Stain	WS (MPI 90)

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SECTION 10 11 13

CHALKBOARDS AND MARKERBOARDS (N.I.C - By Owner)

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies chalkboards, marker boards and related items.

B. Boards may be either factory or field assembled.

C. Where shown, assemble either chalkboards or marker boards with tack boards into a single unit.

1.2 RELATED WORK

A. Color of chalkboard and marker board writing surface: Section 09 06 00, SCHEDULE FOR FINISHES

1.3 QUALITY ASSURANCE

A. Boards shall be the products of one manufacturer.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Shop Drawings: Identifying all parts by name and material and showing design, construction, installation, anchorage and relation to adjacent construction.

C. Manufacturer's Literature and Data:

1. Marker board

D. Samples:

1. Chalkboard and marker board writing surface, 300 by 300 mm (six by six inches), each color, mounted on backing.
2. Integrally colored anodized aluminum, 300 mm (six inch) length.
3. Each accessory (after approval, may be used in the work).

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 500 Series Metal Finishes Manual
2. AMP 501 Finishes for Aluminum

C. American National Standards (ANSI):

1. Z97.1-04 Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

D. American Society for Testing and Materials (ASTM):

1. B221/B221M-06 Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
2. C1036-06 Flat Glass
3. C1048-04 Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass
4. F104-03 Nonmetallic Gasket Materials

E. Composite Panel Association (CPA):

1. A208.1-06 Particleboard
2. A135.4-04 Basic Hardboard

PART 2 - PRODUCTS

2.1 CHALKBOARD AND MARKERBOARD

A. Chalkboards and marker boards shall consist of a writing surface, snap on aluminum frame, chalk trough, mullions, display rail and accessories, grounds and other items specified and shown.

2.2 FABRICATION

A. Materials:

1. Aluminum, extruded: ASTM B221.
2. Backing: Hardboard, AHBA A135.4 or particleboard, CPA A208.1.

B. Components:

1. Writing Surface: Factory assembly consisting of face sheet of 24 gauge sheet steel with porcelain enamel board texture finish conforming to PEI S-100, laminated to a hardboard or particleboard backing, 9 mm to 13 mm (3/8 to 1/2-inch) thick, and a 0.13 mm (0.005-inch) thick aluminum foil back sheet laminated to back-face.
2. Frames (Trim): Extruded aluminum, 1.5 mm (0.060-inch) thick, snap-on type, approximate face width 44 mm (1-3/4 inch), depth and configuration as required to return to wall and engage clips.
3. Trough: Extruded aluminum, 2.34 mm (0.092-inch) thick, not less than 75 mm (3-inch) projection from writing surface with grooved top surface, closed ends and return to wall surface at underside. Design to be snap-on type with concealed fasteners.
4. Accessories: Fabricate from aluminum with holders from spring steel. Design to suit display rail. Furnish accessories as follows:
5. Mullions: Snap-on type, same material and face width as frames, designed to finish flush with frame.
6. Grounds: Continuous zinc-coated (galvanized) steel or extruded aluminum members designed to support the board writing surface and clips for snap-on frames, map rail and chalk tray.

7. Clips: Manufacturer's standard as required to support frame, mullions, display rail, and trough.

C. Boards 3660 mm (12 feet) or less in length shall be in one piece. Larger units shall have one joint at center. Joints shall have metal spline, with faces in same plane and edges shall touch along entire length.

D. Finish exposed aluminum surfaces as follows:

1. AA 45 chemically etched medium matte, with clear anodic coating Class II Architectural, 0.4 mils thick (AA-M12C22A32).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install units in accordance with the manufacturer's installation instructions, use concealed fasteners.

B. Inspect surfaces and related construction to receive units. Partitions shall have reinforcing to receive fasteners. Verify type and placement of reinforcement.

C. Do not proceed with the installation until reinforcement is in place and surfaces are flat.

D. Assemble units as specified by the manufacturer.

3.2 INSTALLATION OF CHALKBOARD and marker board

A. Mount board with adhesive and blocking pads spaced 16 inches on center each way.

B. Grounds designed to receive clips for snap-on trim shall be continuous and be secured 300 mm (12 inches) on center. Space clips 300 mm (12 inches) on center.

C. Miter trim at corners, conceal fasteners. Modify trim as required to conform to surrounding construction details.

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SECTION 10 11 23

TACKBOARDS (N.I.C - By Owner)

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies tackboards (bulletin boards) and glass door bulletin boards and related items.

B. Boards may be either factory or field assembled.

C. Where shown, assemble both chalkboards and tackboards into a single unit.

1.2 RELATED WORK

A. Color of tackboard: Section 09 06 00, SCHEDULE FOR FINISHES

1.3 QUALITY ASSURANCE

A. Boards shall be the products of one manufacturer.

B. LEED Building Performance Requirements:

1. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

2. Adhesives, sealants, paints or coatings used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

3. Adhesives used for work in this section including plastic laminating adhesives shall contain no added Urea Formaldehyde.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Shop Drawings: Identifying all parts by name and material and showing design, construction, installation, anchorage and relation to adjacent construction.

C. Manufacturer's Literature and Data:

1. Bulletin board.

D. Samples:

1. Tackboard, 300 by 300 mm (six by six inches), each color, mounted on backing.

2. Integrally colored anodized aluminum, 300 mm (six inch) length.

3. Each accessory (after approval, may be used in the work).

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 500 Series Metal Finishes Manual
2. AMP 501 Finishes for Aluminum

C. American National Standards (ANSI):

1. Z97.1-04 Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

D. American Society for Testing and Materials (ASTM):

1. B221/B221M-06 Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
2. C1036-06 Flat Glass
3. C1048-04 Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass
4. F104-03 Nonmetallic Gasket Materials

E. Composite Panel Association (CPA):

1. A208.1-06 Particleboard
2. A135.4-04 Basic Hardboard

PART 2 - PRODUCTS

2.1 BULLETIN BOARD

A. Bulletin board shall consist of a tackboard, snap on aluminum frame, grounds and other items specified and shown.

2.2 FABRICATION

A. Materials:

1. Aluminum, extruded: ASTM B221.
2. Cork: ASTM F104, Type II, mildew resistant, Class 2.
3. Backing: Hardboard, AHBA A135.4 or particleboard, CPA A208.1.

B. Components:

1. Tackboard: Cork face, 6 mm (1/4-inch) thick factory laminated to a hardboard or particleboard backing of thickness required so that the face of the cork will be in the same plane as the face of the chalkboard writing surface, 6 mm to 9 mm (1/4 to 3/8-inch) thick.
2. Frames (Trim): Extruded aluminum, 1.5 mm (0.060-inch) thick, snap-on type, approximate face width 44 mm (1-3/4 inch), depth and configuration as required to return to wall and engage clips.
3. Display Rail: Snap-on type, same materials as frames, approximate face width one inch with 6 mm (1/4-inch) thick cork insert.
4. Mullions: Snap-on type, same material and face width as frames, designed to finish flush with frame.
5. Grounds: Continuous zinc-coated (galvanized) steel or extruded aluminum members designed to support the tackboard and clips for snap-on frames, and map rail

6. Clips: Manufacturer's standard as required to support frame, mullions, and display rail,

7. Tubular Frame (For glass door bulletin board): Extruded aluminum, 2.34 mm (0.092 inches) thick; tubular or open back in section, with flanges for concealed attachment, designed to support door hardware and tackboard.

C. Bulletin boards 3660 mm (12 feet) or less in length shall be in one piece. Larger units shall have one joint at center.

D. Finish exposed aluminum surfaces as follows:

1. AA 45 chemically etched medium matte, with clear anodic coating Class II Architectural, 0.4 mils thick (AA-M12C22A32).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install units in accordance with the manufacturer's installation instructions, use concealed fasteners.

B. Inspect surfaces and related construction to receive units. Partitions shall have reinforcing to receive fasteners. Verify type and placement of reinforcement.

C. Do not proceed with the installation until reinforcement is in place and surfaces are flat.

D. Assemble units as specified by the manufacturer.

3.2 INSTALLATION OF BULLETIN BOARD:

A. (Except glass door bulletin boards):

1. Mount bulletin boards with adhesive and blocking pads spaced 16 inches on center each way.

2. Grounds designed to receive clips for snap-on trim shall be continuous and be secured 300 mm (12 inches) on center. Space clips 300 mm (12 inches) on center.

3. Miter trim at corners, conceal fasteners. Modify trim as required to conform to surrounding construction details.

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SECTION 10 21 13

TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies solid phenolic toilet partitions, and urinal screens.

1.2 RELATED WORK

A. Overhead structural steel supports for ceiling hung pilasters: Section 05 50 00, METAL FABRICATIONS.

B. Color of finish: Section 09 06 00, SCHEDULE FOR FINISHES.

C. Grab bars and toilet tissue holders: Section 10 28 00, TOILET, BATH, AND LAUNDRY ACCESSORIES.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's Literature and Data: Specified items indicating all hardware and fittings, material, finish, and latching.

D. Shop Drawings: Construction details at 1/2 scale, showing installation details, anchoring and leveling devices.

1.4 QUALITY ASSURANCE

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):

1. FF-B-575C Bolt, Hexagon and Square

C. Code of Federal Regulations (CFR):

1. 40 CFR 247 Comprehensive Procurement Guidelines for Products Containing Recovered Materials

D. Commercial Item Descriptions (CID):

1. A-A-1925 Shield, Expansion (Nail Anchors)

2. A-A-60003 Partitions, Toilet, Complete

PART 2 - PRODUCTS

2.1 FABRICATION

A. Solid phenolic: water resistant; graffiti resistant; non- absorbent; contain a minimum 30 percent post consumer recycled plastic; Class C flame spread rating.

B. Conform to Fed. CID A-A-60003, except as modified herein.

C. Fabricate to dimensions shown or specified.

D. Toilet Enclosures:

1. Type 1, Style B (Ceiling hung) A (Floor supported).

2. Reinforce panels shown to receive toilet tissue holders or grab bars.

3. Upper pivots and lower hinges adjustable to hold doors open 30 degrees.

4. Latching devices and hinges for handicap compartments shall comply with ADA requirements.

5. Keeper:
   a. U-slot to engage bar of throw latch.
6. Wheelchair Toilets:
   a. Upper pivots and lower hinges to hold out swinging doors in closed position.
   b. Provide U-type doors pulls, approximately 100 mm (four inches) long on pull side.
7. Finish:
   a. Finish 1 (solid phenolic) doors, pilasters, and enclosure panels as specified.

E. Urinal Screens:
1. Type III, Style D (wall hung).
   a. With integral flanges and continuous, full height wall anchor plate.
   b. Option: Full height U-Type bracket.
   c. Wall anchor plate drilled for 4 anchors on both sides of screen.
2. Screen 600 mm (24 inches) wide and Full Height.

2.2 FASTENERS

A. Partition Fasteners: CID A-A-60003.

B. Use toggle bolts, CID A-A-60003, for anchoring to hollow masonry or stud framed walls.

C. Use steel bolts FS-B-575, for anchoring pilasters to overhead steel supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install in rigid manner, straight, plumb and with all horizontal lines level.
2. Conceal evidence of drilling, cutting and fitting in finish work.
3. Use hex-bolts for through-bolting.
4. Adjust hardware and leave in freely working order.
5. Clean finished surfaces and leave free of imperfections.

B. Panels and Pilasters:
1. Support panels, except urinal screens, and pilaster abutting building walls near top and bottom by stirrup supports secured to partitions with through-bolts.
2. Secure stirrups to walls with two suitable anchoring devices for each stirrup.
3. Secure panels to faces of pilaster near top and bottom with stirrup supports, through-bolted to panels and machine screwed to each pilaster.

4. Secure edges of panels to edges of pilasters near top and bottom with "U" shaped brackets.
5. Where overhead braced, secure pilasters to building walls by headrails clamped on or set into top of each pilaster.
   a. Secure clamps to pilasters with two through-bolts to each clamp.
   b. When headrails are set into pilasters, through-bolt them to the pilasters.
   c. Support headrails on wall flange fittings secured to building walls with minimum of two anchor bolts to each flange fitting.

C. Urinal Screens:

1. Anchor urinal screen flange to walls with minimum of four bolts both side of panel.
2. Space anchors at top and bottom and equally in between.

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SECTION 10 26 00

WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies wall guards (corner guards).

1.2 RELATED WORK

A. Structural steel corner guards: Section 05 50 00, METAL FABRICATIONS.

B. Color and texture of aluminum and wood material: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items;

1. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Shop Drawings: show design and installation details.

D. Manufacturer's Literature and Data:

1. Corner Guards.

E. Test Report: Showing that resilient material complies with specified fire and safety code requirements.

1.4 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.5 DELIVERY AND STORAGE

A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer.

B. Protect from damage from handling and construction operations before, during and after installation.

C. Store in a dry environment of approximately 21° C (70 degrees F) for at least 48 hours prior to installation.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Society for Testing and Materials (ASTM):

1. A167-99(R2009) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

2. B221-08 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

3. D256-06 Impact Resistance of Plastics

4. D635-06 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

5. E84-09 Surface Burning Characteristics of Building Materials

C. The National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 500-06 Metal Finishes Manual

D. National Fire Protection Association (NFPA):

1. 80-10 Standard for Fire Doors and Windows

E. Society of American Automotive Engineers (SAE):

1. J 1545-05 Instrumental Color Difference Measurement for Exterior Finishes.

F. Underwriters Laboratories Inc. (UL):

1. Annual Issue Building Materials Directory

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A167, Type 304 with a #4 satin finish.

B. Solid Wood Components: Shall be manufactured from plain sawn, FAS grade hardwood, kiln dried to a moisture content of 6% to 10%. All wood components shall be factory finished. Wood components to be final coated with catalyzed, high solids, clear conversion varnish using a two coat process. Finish shall be in accordance with specified AWI finish system. Coverage shall be a minimum of 3-5 mils. Gloss shall be measured on 60° gloss meter as per ASTM D523.

   a. Material shall be labeled and tested by Underwriters Laboratories or other approved independent testing laboratory.

   b. Fasteners: All necessary fasteners to be supplied by the manufacturer.

2.2 CORNER GUARDS

A. Wood/Stainless Steel Corner Guards: Surface mounted wood corner guard with stainless steel facing to profile shown.

   1. Bullnose shaped wood corner guard with 2-3/4" (69.9mm) legs and recessed stainless steel cover. Provide factory fabricated end closure caps at top and bottom of surface mounted corner guards.

   2. Flush mounted corner guards installed on any fire rated wall shall maintain the fire rating of the wall. Provide fire test of proposed corner guard system to verify compliance.

      a. Where insulating materials are an integral part of the corner guard system, the insulating materials shall be provided by the manufacturer of the corner guard system.

      b. All exposed metal in fire rated assemblies shall have a paintable finish.

2.3 FABRICATION

A. General: Fabricate wall protection systems to comply with requirements indicated for designed, dimensions, detail, finish and member sizes. All based upon required field verified dimensions.

B. Fabricate components with wood joints lightly chamfered.

C. Provide surfaces free of chipping, dents and other imperfections.

2.4 FINISH

PART 3 - In accordance with NAAMM AMP 500 series INSTALLATION

3.1 EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

   1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer’s instructions.

3.3 INSTALLATION

A. Install corner guards on walls in accordance with manufacturer's instructions.

B. Use only approved mounting hardware, and locating all components firmly into position, level and plumb.

C. Temperature at the time of installation must be between 65°-75°F (18°-24°C) and be maintained for at least 48 hours after installation.

3.4 CLEANING

A. General: Immediately upon completion of installation, clean rails and accessories in accordance with manufacturer's recommended cleaning method.

B. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.

3.5 PROTECTION

A. Protect installed materials to prevent damage to other trades. Use materials that may be easily removed without leaving residue or permanent stains.

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SECTION 10 28 00

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies manufactured items usually used in dressing rooms, toilets, baths, locker rooms and at sinks in related spaces.

B. Items Specified:

1. Paper towel dispenser.
2. Combination paper towel dispenser and disposal unit.
3. Toilet tissue dispenser.
4. Grab Bars: (10800-1.DWG).
5. Shower curtain rods: (10800-2.DWG) and (10800-3.DWG).
6. Towel bars.
7. Metal framed mirror: (10800-7.DWG).
8. Deck mounted soap dispenser.
9. Mop racks.
10. Stainless steel shelves, Type 45C. (10801-1.DWG)

C. This section also specifies custom fabricated items used in toilets and related spaces.

1.2 RELATED WORK

A. Color of finishes: Section 09 06 00, SCHEDULE FOR FINISHES

B. Ceramic toilet and bath accessories: Section 09 30 13, CERAMIC TILING

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:
   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).
2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.
3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.
4. Material Safety Data Sheets (MSDS), for all applicable products.

Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Shop Drawings:

1. Each product specified.
2. Paper towel dispenser and combination dispenser and disposal units.
3. Metal framed mirrors, showing shelf where required, fillers, and design and installation of units when installed on ceramic tile wainscots and offset surfaces.
4. Shower Curtain rods, showing required length for each location.
5. Grab bars, showing design and each different type of anchorage.
6. Show material and finish, size of members, and details of construction, installation and anchorage of mop racks.

D. Samples:

1. One of each type of accessory specified.
2. After approval, samples may be used in the work.

E. Manufacturer's Literature and Data:

1. All accessories specified.
2. Show type of material, gages or metal thickness in inches, finishes, and when required, capacity of accessories.
3. Show working operations of spindle for toilet tissue dispensers.
4. Mop racks.

F. Manufacturer's Certificates:

1. Attesting that soap dispensers are fabricated of material that will not be affected by liquid soap or aseptic detergents, Phisohex and solutions containing hexachlorophene.
2. Anodized finish as specified.

1.4 QUALITY ASSURANCE

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable.
2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building

Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

B. Each product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.

C. Each accessory type shall be the same and be made by the same manufacturer.

D. Each accessory shall be assembled to the greatest extent possible before delivery to the site.

E. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

1.5 PACKAGING AND DELIVERY

A. Pack accessories individually to protect finish.

B. Deliver accessories to the project only when installation work in rooms is ready to receive them.

C. Deliver inserts and rough-in frames to site at appropriate time for building-in.

D. Deliver products to site in sealed packages of containers; labeled for identification with manufacturer's name, brand, and contents.

1.6 STORAGE

A. Store products in weathertight and dry storage facility.

B. Protect from damage from handling, weather and construction operations before, during and after installation in accordance with manufacturer's instructions.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

1. A167-99(R2009) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

2. A176-99(R2009) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip

3. A269-10 Seamless and Welded Austenitic Stainless Steel Tubing for General Service

4. A312/A312M-09 Seamless and Welded Austenitic Stainless Steel Pipes

5. A653/A653M-10 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

6. B221-08 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

7. B456-03 (R2009) Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
8. C1036-06 Flat Glass
9. C1048-04 Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass
10. D635-10 Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position
11. F446-85 (R2009) Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area.

C. The National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 500 Series Metal Finishes Manual

D. American Welding Society (AWS):

1. D10.4-86 (R2000) Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing

E. Federal Specifications (Fed. Specs.):

1. A-A-3002 Mirrors, Glass
2. FF-S-107C (2) Screw, Tapping and Drive
3. FF-S-107C Screw, Tapping and Drive.
4. WW-P-541E(1) Plumbing Fixtures (Accessories, Land Use) Detail Specification

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: ASTM B221, alloy 6063-T5 and alloy 6463-T5.

B. Stainless Steel:

1. Plate or sheet: ASTM A167, Type 302, 304, or 304L, except ASTM A176 where Type 430 is specified, 0.0299-inch thick unless otherwise specified.
2. Tube: ASTM A269, Alloy Type 302, 304, or 304L.

C. Stainless Steel Tubing: ASTM A269, Grade 304 or 304L, seamless or welded.

D. Stainless Steel Pipe: ASTM A312; Grade TP 304 or TP 304L.

E. Steel Sheet: ASTM A653, zinc-coated (galvanized) coating designation G90.

F. Glass:

1. ASTM C1036, Type 1, Class 1, Quality q2, for mirrors, and for mirror doors in medicine cabinets.
2. ASTM C1048, Kind FT, Condition A, Type 1, Class 1 (use in Mental Health and Behavior Nursing Unit Psychiatric Patient Areas and Security Examination Rooms where mirrors and glass are specified).

G. Vinyl Covering: ASTM D3690, Vinyl coated fabric, Class A.

H. Plywood: PS1, Grade CD.

2.2 FASTENERS

A. Concealed Fasteners: Steel, hot-dip galvanized (except in high moisture areas such as showers or bath tubs use stainless steel).

B. Toggle Bolts: For use in hollow masonry or frame construction.

C. Hex bolts: For through bolting on thin panels.

D. Expansion Shields: Lead or plastic as recommended by accessory manufacturer for component and substrate for use in solid masonry or concrete.

E. Screws:

1. ASME B18.6.4.

2. Fed Spec. FF-S-107, Stainless steel Type A.

F. Adhesive: As recommended by manufacturer for products to be joined.

2.3 FINISH

A. In accordance with NAAMM AMP 500 series.

B. AA-M32 Mechanical finish, medium satin.

1. Stainless Steel: NAAMM AMP 503, finish number 4.

2. Ferrous Metal:

a. Shop Prime: Clean, pre-treat and apply one coat of primer and bake.

b. Finish: Over primer apply two coats of alkyd or phenolic resin enamel, and bake.

2.4 FABRICATION - GENERAL

A. Welding, AWS D10.4.

B. Grind dress, and finish welded joints to match finish of adjacent surface.

C. Form exposed surfaces from one sheet of stock, free of joints.

D. Provide steel anchors and components required for secure installation.

E. Form flat surfaces without distortion. Keep exposed surfaces free from scratches and dents. Reinforce doors to prevent warp or twist.

F. Isolate aluminum from dissimilar metals and from contact with building materials as required to prevent electrolysis and corrosion.

G. Hot-dip galvanized steel, except stainless steel, anchors and fastening devices.

H. Shop assemble accessories and package with all components, anchors, fittings, fasteners and keys.

I. Key items alike.

J. Provide templates and rough-in measurements as required.

K. Round and deburr edges of sheets to remove sharp edges.

2.5 PAPER TOWEL DISPENSERS

A. Surface mounted type with sloping top.

B. Dispensing capacity for 300 sheets of any type of paper toweling.

C. Fabricate of stainless steel.

D. Provide door with continuous hinge at bottom, and either spring tension cam lock or tumbler lock, keyed alike, at top and a refill sight slot in front.

2.6 COMBINATION PAPER TOWEL DISPENSER AND DISPOSAL UNITS

A. Recessed type.

B. Dispensing capacity for 400 sheets of any type of paper toweling.

C. Fabricate of stainless steel.

D. Form face frames, from one piece.

E. Provide each door with continuous stainless steel piano hinge and tumbler lock, keyed alike.

F. Provide removable waste receptacle approximately 40 liter (10.5 gallon) capacity, fabricated of 0.45 mm (0.018-inch) thick stainless steel.

2.7 TOILET TISSUE DISPENSERS

A. Double roll surface mounted type.

B. Mount on continuous backplate.

C. Removable spindle ABS plastic or chrome plated plastic.

D. Wood rollers are not acceptable.

2.8 GRAB BARS

A. Fed. Spec WW-P-541/8B, Type IV, bars, surface mounted, Class 2, grab bars and ASTM F446.

B. Fabricate of either stainless steel or nylon coated steel, except use only one type throughout the project:

1. Stainless steel: Grab bars, flanges, mounting plates, supports, screws, bolts, and exposed nuts and washers.

C. Concealed mount, except grab bars mounted at floor, swing up and on metal toilet shower partitions.

D. Bars:

1. Fabricate from 38 mm (1-1/2 inch) outside diameter tubing.

a. Stainless steel, minimum 1.2 mm (0.0478 inch) thick.

2. Fabricate in one continuous piece with ends turned toward walls, except swing up and where grab bars are shown continuous around three sides of showers, bars may be fabricated in two sections, with concealed slip joint between.

3. Continuous weld intermediate support to the grab bar.

4. Swing up bars manually operated. Designed to prevent bar from falling when in raised position.

E. Flange for Concealed Mounting:

1. Minimum of 2.65 mm (0.1046 inch) thick, approximately 75 mm (3 inch) diameter by 13 mm (1/2 inch) deep, with provisions for not less than three set screws for securing flange to back plate.

2. Insert grab bar through center of the flange and continuously weld perimeter of grab bar flush to back side of flange.

F. Back Plates:

1. Minimum 2.65 mm (0.1046 inch) thick metal.
2. Fabricate in one piece, approximately 6 mm (1/4 inch) deep, with diameter sized to fit flange. Provide slotted holes to accommodate anchor bolts.
3. Furnish spreaders, through bolt fasteners, and cap nuts, where grab bars are mounted on solid phenolic partitions.

2.9 SHOWER CURTAIN RODS

A. Stainless steel tubing, ASTM A569, minimum 1.27 mm (0.050 inch) wall thickness, 32 mm (1 1/4 inch) outside diameter.

B. Flanges, stainless steel rings, 66 mm (2 5/8 inch) minimum outside diameter, with 2 holes opposite each other for 6 mm (1/4 inch) stainless steel fastening bolts. Provide a set screw within the curvature of each flange for securing the rod.

C. Shower curtain rods in Mental Health and Behavioral Units:

1. Chrome plated plastic rods capable of supporting 22.6 Kg (50 pounds) before pulling free of wall flanges.

2.10 TOWEL BARS

A. Fed. Spec. WW-P-541/8B, Type IV, Bar, Surface mounted; Class 1, towel.

B. Either stainless steel, or chromium plated copper alloy.

C. Bar Length: 450 and 600 mm (18 and 24 inches) as shown.

D. Finish of brackets or supports same as bar.

2.11 METAL FRAMED MIRRORS

A. Spec. A-A-3002 metal frame; stainless steel, type 302 or 304.

B. Mirror Glass:

1. Minimum 6 mm (1/4 inch) thick.
2. Set mirror in a protective vinyl glazing tape.
3. Use tempered glass for mirrors in Mental Health and Behavioral Nursing units.

C. Frames:

1. Channel or angle shaped section with face of frame not less than 9 mm (3/8 inch) wide. Fabricate with square corners.
2. Use either 0.9 mm (0.0359 inch) thick stainless steel, chrome finished steel, or extruded aluminum, with clear anodized finish 0.4 mils thick.
3. Filler:

a. Where mirrors are mounted on walls having ceramic tile wainscots not flush with wall above, provide fillers at void between back of mirror and wall surface.

b. Fabricate fillers from same material and finish as the mirror frame,

contoured to conceal the void behind the mirror at sides and top.

D. Back Plate:

1. Fabricate backplate for concealed wall hanging of either zinc-coated, or cadmium plated 0.9 mm (0.036 inch) thick sheet steel, die cut to fit face of mirror frame, and furnish with theft resistant concealed wall fastenings.

2. Use set screw type theft resistant concealed fastening system for mounting mirrors.

E. Mounting Bracket:

1. Designed to support mirror tight to wall.

2. Designed to retain mirror with concealed set screw fastenings.

2.12 **DECK MOUNTED** SOAP DISPENSERS

A. Automatic Lavatory-Mounted Soap Dispenser.

B. Spout Cover Assembly – Bright Polished chrome plated plastic with LED light indicators. Red blinking LED indicates soap level is low, Yellow blinking LED indicates battery life is low. Equipped with integral plastic shank.

C. Motor Assembly – Water resistant, plastic construction, fits onto bottom of shank and top of soap refill.

D. Battery Pack – Water resistant, plastic material, holds 4 Alkaline "D" Cell Batteries.

E. Soap Refill – Translucent, shatter-resistant polyethylene bottle. Includes new supply tube and pump mechanism in each refill.

1. Soap Capacity - 54-fl oz.

2. Soap Dispensing Capacity - Controlled amount (0.8ml) of Hand Soap

2.13 MOP RACKS

A. Minimum 1.0M (40 inches) long with five holders.

B. Clamps:

1. Minimum of 1.3 mm (0.050-inch) thick stainless steel bracket retaining channel with a hard rubber serrated cam; pivot mounted to channel.

2. Clamps to hold handles from 13 mm (1/2-inch) minimum to 32 mm (1-1/4 inch) maximum diameter.

C. Support:

1. Minimum of 1 mm (0.0375 inch) thick stainless steel hat shape channel to hold clamps away from wall as shown.

2. Drill wall flange for 3 mm (1/8 inch) fasteners above and below clamp locations.

D. Secure clamps to support with oval head machine screws or rivets into continuous reinforcing back of clamps.

E. Finish on stainless Steel: AMP 503-No. 4.

2.14 STAINLESS STEEL SHELVES, TYPES 45C **.**

A. Fabricate shelves and brackets to design shown of 1.2 mm (0.0478-inch) thick stainless steel.

B. Round and finish smooth projecting corners of shelves and edge corners of brackets. Drill brackets for 6 mm (1/4-inch) anchor bolts.

C. Screw or weld brackets to shelves.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before starting work notify Resident Engineer in writing of any conflicts detrimental to installation or operation of units.

B. Verify with the Resident Engineer the exact location of accessories.

3.2 INSTALLATION

A. Set work accurately, in alignment and where shown. Items shall be plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.

B. Toggle bolt to steel anchorage plates in frame partitions or hollow masonry.

C. Install accessories in accordance with the manufacturer's printed instructions and ASTM F446.

D. Install accessories plumb and level and securely anchor to substrate.

E. Install accessories in a manner that will permit the accessory to function as designed and allow for servicing as required without hampering or hindering the performance of other devices.

F. Position and install dispensers, and other devices in countertops, clear of drawers, permitting ample clearance below countertop between devices, and ready access for maintenance as needed.

G. Align mirrors, dispensers and other accessories even and level, when installed in battery.

H. Install accessories to prevent striking by other moving, items or interference with accessibility.

I. Install wall mirrors in Mental Health and Behavioral Units with tamper resistant screws that are flush mounted so that they will not support a rope or material for hanging.

3.3 SCHEDULE OF ACCESSORIES

A. See drawings.

3.4 CLEANING

A. After installation, clean as recommended by the manufacturer and protect from damage until completion of the project.

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SECTION 10 44 13

FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers recessed fire extinguisher cabinets.

1.2 RELATED WORK

A. Acrylic glazing: Section 08 80 00, GLAZING.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

4. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's Literature and Data: Fire extinguisher cabinet including installation instruction and rough opening required.

1.4 QUALITY ASSURANCE

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.5 APPLICATION PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Testing and Materials (ASTM):

1. D4802-10 Poly (Methyl Methacrylate) Acrylic Plastic Sheet

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHER CABINET

A. Recessed type with flat trim of size and full clear acrylic door.

1. Inside box dimensions: 27 inch high, 12 inch wide, 8 inch deep.
2. Outside trim dimension: 30.5 inch high, 15.5 inch wide.

2.2 FABRICATION

A. Form body of cabinet from 0.9 mm (0.0359 inch) thick sheet steel.

B. Fabricate door and trim from 1.2 mm (0.0478 inch) thick sheet steel with all face joints fully welded and ground smooth.

1. Glaze doors with 6 mm (1/4 inch) thick ASTM D4802, clear acrylic sheet, Category B-1, Finish 1.
2. Design doors to open 180 degrees.
3. Provide continuous hinge, pull handle, and adjustable roller catch.

2.3 FINISH

A. Finish interior of cabinet body with baked-on semigloss white enamel.

B. Finish door, frame with manufacturer's standard baked-on prime coat suitable for field painting.

PART 3 - EXECUTION

A. Install fire extinguisher cabinets in prepared openings and secure in accordance with manufacturer's instructions.

B. Install cabinet so that bottom of cabinet is 975 mm (39 inches) above finished floor.

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SECTION 01 81 50

INTEGRATED PEST MANAGEMENT AND CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section is part of a comprehensive Integrated Pest Management And Control (IPM) program for the Federal premises listed herein. IPM is a process for achieving long-term, environmentally sound pest suppression and prevention through the use of a wide variety of technological and management practices. Control strategies in an IPM program include:

1. Structural and procedural modifications to reduce food, water, harborage, and access used by pests.

2. Pesticide compounds, formulations, and application methods that present the lowest potential hazard to humans and the environment.

3. Non-pesticide technologies such as trapping and monitoring devices.

4. Coordination among all facilities management programs that have a bearing on the pest control effort.

B. Contractor Service Requirements: The Contractor shall furnish all supervision, labor, materials, and equipment necessary to accomplish the monitoring, trapping, pesticide application, and pest removal components of the IPM program. The Contractor shall also provide detailed, site-specific recommendations for structural and procedural modifications to aid in pest prevention.

1.2 PESTS INCLUDED AND EXCLUDED:

1. The Contractor Shall Adequately Suppress the Following Pests :

   a. All rodents, insects, arachnids, and other arthropods found indoors, with the exception of the excluded pests specified below.

   b. Outdoor populations of commensal rodents that are within the property boundaries of the specified buildings

   c. Populations of mites on building exteriors that are invading inside the building.

   d. Nests of stinging insects within the property boundaries of the specified buildings.

   e. Individuals of all excluded pest populations that are incidental invaders inside the specified buildings, including winged termite swarmers emerging indoors.

2. Sorting and separating of waste materials.

3. Salvage of existing materials and items for reuse or resale.

4. Recycling of materials that cannot be reused or sold.

B. The Following Pests are Excluded From This Contract:

1. Outdoor populations of mosquitoes, birds, snakes, and all other vertebrates that are not commensal rodents.

2. Termites and other wood-destroying organisms.

3. Bats.

4. Bed bugs.

1.3 RELATED WORK

A. Section 02 41 16, STRUCTURAL DEMOLITION.

B. Section 02 41 00, DEMOLITION

C. Section 01 00 00, GENERAL REQUIREMENTS.

1.4 QUALITY ASSURANCE

A. INITIAL BUILDING INSPECTIONS:

1. The Contractor shall complete a thorough, initial inspection of each building(s) or site at least ten (10) working days prior to the starting date of the contract. The purpose of the initial inspections is for the Contractor to evaluate the pest control needs of all locations and to identity problem areas and any equipment, structural features, or management practices that are contributing to pest infestations. Access to building space shall be coordinated with the Contracting Officer's Representative (COTR). The COTR will inform the Contractor of any restrictions or areas requiring special scheduling..

B. PEST CONTROL PLAN. The Contractor shall submit to the COTR a Pest Control Plan at least five (5) working days prior to the starting date of the contract. Upon receipt of the Pest Control Plan, the COTR will render a decision regarding its acceptability within two (2) working days. If aspects of the Pest Control Plan are incomplete or disapproved, the Contractor shall have two (2) working days to submit revisions. The Contractor shall be on-site to perform the initial service visit for each building within the first five (5) working days of the contract.

1. The Pest Control Plan shall consist of five parts as follows:.

a. Proposed Materials and Equipment for Service: The Contractor shall provide current labels and Material Safety Data Sheets for all pesticides to be used, and brand names of pesticide application equipment, rodent bait boxes, insect and rodent trapping devices, pest monitoring devices, pest detection equipment, and any other pest control devices or equipment that may be used to provide service.

b. Proposed Methods for Monitoring and Detection: The Contractor shall describe methods and procedures to be used for identifying sites of pest harborage and access, and for making objective assessments of pest population levels throughout the term of the contract.

c. Service Schedule for Each Building or Site: The Contractor shall provide complete service schedules that include weekly or monthly frequency of Contractor visits, specific day(s) of the week of Contractor visits, and approximate duration of each visit.

d. Description of any Structural or Operational Changes That Would Facilitate the Pest Control Effort: The Contractor shall describe site-specific solutions for observed sources of pest food, water, harborage, and access.

e. Commercial Pesticide Applicator Certificates or Licenses: The Contractor shall provide: photocopies of Pennsylvania licenses issued Commercial Pesticide Applicator Certificates or Licenses for every Contractor employee who will be performing on-site service under this contract. Any of the above information that is contained in the Contractor's Proposal will be considered as part of the initial Pest Control Plan and need not be resubmitted to the COTR.

2. The Contractor shall be responsible for carrying out work according to the approved Pest Control Plan. The Contractor shall receive the concurrence of the COTR prior to implementing any subsequent changes to the approved Pest Control Plan, including additional or replacement pesticides and on-site service personnel

C. RECORD KEEPING

1. The Contractor shall be responsible for maintaining a pest control logbook or file for each building or site specified in this contract. These records shall be kept on-site and maintained on each visit by the Contractor. Each logbook or file shall contain at least the following items

a. Pest Control Plan: A copy of the Contractor's approved Pest Control Plan, including labels and MSDS sheets for all pesticides used in the building, brand names of all pest control devices and equipment used in the building, and the Contractor's service schedule for the building.

b. GSA Forms 3638: Field Office copies of GSA Form 3638, Pest Control Work and Inspection Report. These forms will be used by the Government to advise the Contractor of routine service requests and to document the performance of all work, including emergency work. Upon completion of a service visit to the building or site, the Contractor's employee performing the service shall complete, sign, and date the Form 3638, and return it to the logbook or file on the same or succeeding day of the services rendered.

c. Contractor's Service Report Forms: Customer copies of the Contractor's Service Report Form, documenting all information on pesticide application required by statute in the jurisdiction where service is actually performed. These forms shall not be mandatory if all required information on pesticide application is included on the GSA Pest Control Work and Inspection Report.

D. MANNER AND TIME TO CONDUCT SERVICE

1. Time Frame of Service Visits: The Contractor shall perform routine pest control services that do not adversely affect tenant health or productivity during the regular hours of operation in buildings. When it is necessary to perform work outside of the regularly scheduled service time set forth in the Pest Control Plan, the Contractor shall notify the COTR at least one (1) day in advance.

2. Safety and Health:

   a. The Contractor shall observe all safety precautions throughout the performance of this contract. All work shall be in strict accordance with all applicable Federal, state, and local safety and health requirements. Where there is a conflict between applicable regulations, the most stringent will apply

   b. The Contractor shall assume full responsibility and liability for compliance with all applicable regulations pertaining to the health and safety of personnel during the execution of work, and shall hold the Government harmless for any action on its part or that of its employees that results in illness, injury, or death.

3. Special Entrance: Certain areas within some buildings may require special instructions for persons entering them. Any restrictions associated with these special areas will be explained by the COTR. The Contractor shall adhere to these restrictions and incorporate them into the Pest Control Plan.

4. Uniforms and Protective Clothing: All Contractor personnel working in or around buildings specified in this contract shall wear distinctive uniform clothing. The Contractor shall determine the need for and provide any personal protective items required for the safe performance of work. Protective clothing, equipment, and devices shall, as a minimum, conform to U.S. Occupational Safety and Health Administration (OSHA) standards for the products being used.

5. Vehicles: Vehicles used by the Contractor shall be identified in accordance with state and local regulations.

E. SPECIAL REQUESTS AND EMERGENCY SERVICE

1. On occasion, the COTR may request that the Contractor perform corrective, special, or emergency service(s) that are beyond routine service requests. The Contractor shall respond to these exceptional circumstances and perform the necessary work within three (3) hours after receipt of the request

F. CONTRACTOR PERSONNEL

1. Pest Control Technicians

   a. Certification: Throughout the term of this contract, all Contractor personnel providing on-site pest control service must maintain certification as Commercial Pesticide Applicators in the category of Industrial, Institutional, Structural, and Health Related Pest Control. This certification must be in at least one of the following NCR jurisdictions: Pennsylvania. Uncertified individuals working under the supervision of a Certified Applicator will not be permitted to provide service under this contract.

   b. Minimum Number: Throughout the term of this contract, the Contractor shall have, as full-time employees, a minimum of five (5) certified technicians available to perform work under this contract

   c. Staff Entomologist: Throughout the term of this contract, the Contractor shall have, available as a full-time employee, a staff entomologist who has primary responsibility for the technical aspects of service delivery and who shall be available for routine and emergency consultation. The staff entomologist must provide a resume and meet the

following minimum requirements:

1) Bachelor's (4-year) or advanced degree in entomology from an accredited University, OR Bachelor's degree in biology, zoology, or other life science and registration as a Board Certified Entomologist (BCE) under the Entomological Society of America (ESA) Certification Program.

2) Certification in Pennsylvannia as a Commercial Pesticide Applicator in the category of Industrial, Institutional, Structural, and Health Related Pest Control.

PART 2 - PRODUCTS

2.1 MATERIALS – NOT USED

PART 3 - EXECUTION

3.1 USE OF PESTICIDES

A. The Contractor shall be responsible for application of pesticides according to the label. All pesticides used by the Contractor must be registered with the U.S. Environmental Protection Agency (EPA), state and/or local jurisdiction. Transport, handling, and use of all pesticides shall be in strict accordance with the manufacturer's label instructions and all applicable Federal, state, and local laws and regulations..

B. The Contractor shall adhere to the following rules for pesticide use:

1. Approved Products: The Contractor shall not apply any pesticide product that has not been included in the Pest Control Plan or approved in writing by the COTR.

2. Pesticide Storage: The Contractor shall not store any pesticide product on Government property.

3. Application by Need: Pesticide application shall be according to need and not by schedule. As a general rule, application of pesticides in any inside or outside area shall not occur unless visual inspection or monitoring devices indicate the presence of pests in that specific area. Requests for preventive pesticide treatments in areas where surveillance indicates a potential insect or rodent infestation will be evaluated by the COTR on a case-by-case basis. Written approval must be granted by the COTR prior to any preventive pesticide application

4. Minimization of Risk: When pesticide use is necessary, the Contractor shall employ the least hazardous material, most precise application technique, and minimum quantity of pesticide necessary to achieve control

3.2 INSECT CONTROL

A. Emphasis on Non-Pesticide Methods: The Contractor shall use non-pesticide methods of control wherever possible. For example, trapping devices rather than pesticide sprays shall be the standard method for indoor fly control.

B. Application of Insecticides to Cracks and Crevices: As a general rule, the

Contractor shall apply all insecticides as “crack and crevice” treatments only, defined in this contract as treatments in which the formulated insecticide is not visible to a bystander during or after the application process.

C. Application of Insecticides to Exposed Surfaces or as Space Sprays: Application of insecticides to exposed surfaces or as space sprays (“fogging”) shall be restricted to exceptional circumstances where no alternative measures are practical. The Contractor shall obtain approval by the COTR prior to any application of insecticide to an exposed surface or any space spray treatment. No surface application or space spray shall be made while tenant personnel are present. The Contractor shall take all necessary precautions to ensure tenant and employee safety, and all necessary steps to ensure the containment of the pesticide to the site of application.

D. Insecticide Bait Formulations: Bait formulations shall be the standard pesticide technology for cockroach and ant control, with alternate formulations restricted to unique situations where baits are not practical

3.3 RODENT CONTROL

A. Indoor Trapping: As a general rule, rodent control inside buildings shall be accomplished with trapping devices only. All such devices shall be concealed out of the general view and in protected areas so as not to be affected by routine cleaning and other operations. Traps shall be checked on a schedule approved by the COTR. The Contractor shall be responsible for disposing of all trapped rodents and all rodent carcasses in an appropriate manner.

B. Use of Rodenticides: In exceptional circumstances, when rodenticides are deemed essential for adequate rodent control inside buildings, the Contractor shall obtain approval of the COTR prior to making any interior rodenticide treatment. All rodenticides, regardless of packaging, shall be placed either in locations not accessible to children, pets, wildlife, and domestic animals, or in EPA-approved tamper-resistant bait boxes. As a general rule, rodenticide application outside buildings shall emphasize the direct treatment of rodent burrows wherever feasible.

C. Use of Bait Boxes: All bait boxes shall be maintained in accordance with EPA regulations, with an emphasis on the safety of non-target organisms. The Contractor shall adhere to the following five points:

1. All bait boxes shall be placed out of the general view, in locations where they will not be disturbed by routine operations.
2. The lids of all bait boxes shall be securely locked or fastened shut.
3. All bait boxes shall be securely attached or anchored to floor, ground, wall, or other immovable surface, so that the box cannot be picked up or moved.
4. Bait shall always be secured in the feeding chamber of the box and never placed in the runway or entryways of the box.
5. All bait boxes shall be labeled on the inside with the Contractor’s business name and address, and dated by the Contractor’s technician at the time of installation and each servicing

D. STRUCTURAL MODIFICATIONS AND RECOMMENDATIONS

1. Throughout the term of this contract, the Contractor shall be responsible for advising the COTR about any structural, sanitary, or procedural modifications that would reduce pest food, water, harborage, or access. The Contractor shall be responsible for adequately suppressing all pests included in this contract regardless of whether or not the Government implements suggested modifications. The Government will not hold the Contractor responsible for carrying out structural modifications as part of the pest control effort. However, minor applications of caulk and other sealing materials by the Contractor to eliminate pest harborage or access may be approved by the COTR on a case by case basis. The Contractor shall obtain the approval of the COTR prior to any application of sealing material or other structural modification.

E. PROGRAM EVALUATION

1. The COTR will continually evaluate the progress of this contract in terms of effectiveness and safety, and will require such changes as are necessary. The Contractor shall take prompt action to correct all identified deficiencies.

F. QUALITY CONTROL PROGRAM:

1. The Contractor shall establish a complete quality control program to assure the requirements of the contract are provided as specified. Within five (5) working days prior to the starting date of the contract, the Contractor shall submit a copy of his program to the Contracting Officer. The program shall include at least the following items:

   a. Inspection System: The Contractor’s quality control inspection system shall cover all the services stated in this contract. The purpose of the system is to detect and correct deficiencies in the quality of services before the level of performance becomes unacceptable and/or the COTR identifies the deficiencies

   b. Checklist: A quality control checklist shall be used in evaluating contract performance during regularly scheduled and unscheduled inspections. The checklist shall include every building or site serviced by the Contractor as well as every task required to be performed.

   c. File: A quality control file shall contain a record of all inspections conducted by the Contractor and any corrective actions taken. The file shall be maintained throughout the term of the contract and made available to the COTR upon request.

   d. Inspector(s): The Contractor shall state the name(s) of the individual(s) responsible for performing the quality control inspections.

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SECTION 12 24 00

WINDOW SHADES (N.I.C. By Owner)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Cloth shades, vertical blinds and venetian blinds are specified in this section. Window shades shall be furnished complete, including brackets, fittings and hardware.

1.2 RELATED WORK

A. Color of shade cloth : Section 09 06 00, SCHEDULE FOR FINISHES.

B. Lightproof Shades: Section 12 24 21, LIGHTPROOF SHADES.

1.3 QUALITY CONTROL

A. Manufacturer's Qualification: Bottom-Up and vertical blind manufacturer shall provide evidence that the manufacture of blinds are a major product, and that the blinds have performed satisfactorily on similar installations.

1.4 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

2. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Samples:

1. Shade cloth, each type, 600 mm (24 inch) square, including cord and ring, showing color, finish and texture.

D. Manufacturer's literature and data; showing details of construction and hardware for:

1. Cloth and window shades

1.5 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113

"Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings", where applicable.

2. Materials manufactured within a radius of 500 miles from the project site where all or a portion of the raw resources also originate within a radius of 500 miles shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

3. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced to in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):

1. AA-V-00200B Venetian Blinds, Shade, Roller, Window, Roller, Slat, Cord, and Accessories

C. American Society for Testing and Materials (ASTM):

1. A167-99 (R2004) Stainless and heat-Resisting Chromium- Nickel Steel Plate, Sheet and Strip

2. B221/B221M-07 Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

3. D635-06 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

4. D648-07 Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position

5. D1784 Rev.A-06 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

PART 2 - PRODUCTS

2.1 Manufacturers

A. Basis of Design Product: Lutron Sivoia QS with Hyperion or approved equal.

B. System Description:

1. Ultra-quiet, precision-controlled electronic drive unit housed inside roller tube, controlling shade movement.

2. Audible noise: Maximum 44 dBA measured 3 feet from electronic drive unit. No audible clicks when motor starts or stops.

3. Allow for maximum of 100 devices including roller shades, skylight shades, drapery tracks, keypads, lighting controls, and power supplies.

4. Allow for 100 zones including roller shades, skylight shades, drapery tracks, and lighting zones.

5. Operate independently, without use of external group controllers.

6. Control shade speed for tracking within plus or minus 0.0625 inch throughout entire travel.

7. Include 10 year power failure memory for preset stops, open and close

limits, shade grouping and subgrouping, and system configuration.

8. Integrate directly with skylight shades, roman shades and drapery tracks incorporating electronic drive units.
9. Systems with multiple electronic drive units electronically synchronized to start, stop and move in unison.

C. Grouping:

1. Keypads and contact closure inputs can control any electronic drive unit without separate group controller.
2. System groups and subgroups configured at point of control without rewiring and without access to electronic drive unit.
3. System may contain multiple electronic drive units.
4. Keypads and interfaces able to operate any group or subgroup of electronic drive units.

D. Integration:

1. Electronic drive units integrate with lighting controls by same manufacturer without interfaces.

E. System Controls:

1. Shades controlled by built-in shade columns on lighting control or by keypad.
2. Electronic drive units, keypads, and lighting controls contain microprocessors, allowing high level programming from any source.
3. System devices, including shades and lighting controls, connected through common communication link.

F. Automated Shade Control Software:

1. Primary Goals of the shade control system are:
   a. Uses open loop solar adaptive algorithm to minimize the penetration depth of direct sunlight based on seasonal solar variation. System must account for seasonal changes in the sun’s location.
   b. Provide manual override capability for occupants via wall mounted keypad or simple remote control
   c. Provide automatic override capability on dark cloudy days
   d. Provide at minimum 24 repeatable and precise shade positions
   e. Maximize occupants connectivity with outdoors by optimizing view
   f. Shades along same façade will, start, stop and track in unison to maintain a consistent exterior aesthetic
   g. Provide a preset, also referred to as visor position, to limit maximum amount of light entering a space

G. Hardware:

1. Provide Single Processor with operation of solar tracking program through non-windows based operating system provided in one panel.
2. RS-232 or Contact Closure Control of shading system is not accepted.
3. All control hardware (processor, control stations, motorized window

treatments) to be provided in Division 12.

H. Control Software:

1. Control software shall incorporate solar tracking software that:

   a. Calculates the sun's position in the sky relative to the building and then calculates when shade movement is necessary by façade.

   b. Calculates the position of the shade to limit direct sunlight penetration to a predetermined limit

   c. Control software shall be controlled using the following inputs for start up:

      1) Building location

      2) Façade orientation

      3) Window Dimensions

      4) Solar depth of penetration

      5) Number of shade movements per day

      6) Visor position of shades

   d. Control software shall require minimal long term maintenance and service. System will not require user to make daily changes to programming or overall system functionality, unless desired by the owner. Control software shall not be accessible from manufacturer's or third party IT network and be self contained on the User's LAN. Systems that are accessible from third party or manufacturer's network will not be accepted.

   e. User Interface

      1) PC Graphic User Interface: User Interface will provide access to all adjustable parameters of solar depth of penetration and number of shade movements per day

      2) Override:

         a) Manual: Temporary override of the control program shall be capable through optional manual keypads.

         b) Keypads shall be capable of providing manual control of shades in a particular area.

I. System Performance:

1. One-touch control of shades by means of keypad, lighting control, or infrared remote.

2. Capable of stopping within accuracy of 0.125 inch at any point between open and close limits.

3. Store over 250 programmable stop points, including open, close, and any other position.

4. Presets set by 5-second button push and hold from keypad, lighting control, or handheld remote control.

5. Motorized Shades to be powered by 24VDC power panels.

6. Open and close limits programmable from electronic drive unit, lighting control, wall-mounted keypad, or handheld remote control.

7. System components electro static discharge protected.

2.2 ROLLER SHADES

A. Mounting:

1. Brackets to provide symmetrical light gaps of 0.75 inch on each side of shade.
2. Roller shade leveling adjustment allowing leveling adjustment while roller shades are mounted to brackets.
3. Allow side-to-side adjustment up to 0.375 inch on each side while shade is mounted to bracket.
4. Projection adjustment up to 0.50 inch.
5. Provide universal mounting brackets for wall, ceiling, and jamb mounting.
6. Two-piece mounting bracket providing level, projection and shade centering adjustments from mounting bracket.
7. Provide dual brackets permit two shades rollers to be mounted in same opening.
8. Coupling:
   a. Single electronic drive unit capable of driving multiple shades with coupling pin.
   b. Pin allows for precision adjustment of bottom bar levels without removing roller from installed point or fabric from roller tube.

B. Shade Tube: Fabric connected to tube using double sided adhesive strip with minimum of one turn of fabric on roller before working section of fabric starts.

C. Fabric:

1. Pass NFPA 701 large and small scale tests.
2. Where applicable, seal shade fabric or treat PVC-coated fabric edges to prevent fraying.
3. Minimum 5 mm "No Growth Contact Area", tested to ASTM G22 for ATCC6538 (Staphylococcus aureus) and ATCC13388 (Pseudomonas aeroginosa).
4. No growth, tested to ASTM G21 for ATCC9642, ATCC9348, and ATCC9645.
5. Fabric selection: Solar and Room darkening, color to be selected from manufacturer's standards.

D. Bottom Bar: 1 inch wide x 0.1875 inch thick extruded aluminum enclosed on all sides in thermally sealed pocket across bottom of shading fabric.

1. Provide flexible bottom hem bar on all bottom-up shades to prevent shades from being visible in the "open" status.

E. Provide bottom-up and top-down roller shades from single manufacturer.

2.3 ACCESSORIES

A. Wall Mounted Controls:

1. Low voltage keypads with faceplates attached without visible means of attachments, product color to match NEMA WD1, with backlit buttons.

2. Visible parts ultraviolet color stabilized, tested to ASTM D4674.

3. Type: Three button with raise/lower.

2.4 MATERIALS

A. Shade Cloth:[translucent][opaque.]

B. Staples (For Cloth Window Shades): Nonferrous metal or zinc-coated steel.

C. Stainless Steel: ASTM A167

D. Cords for Venetian Blinds: No. 4 braided nylon or No. 4-1/2 braided cotton having not less than 175 pounds breaking strength.

E. Extruded Aluminum: ASTM B221/B221M.

2.5 FASTENINGS

A. Zinc-coated or cadmium plated metal, aluminum or stainless steel fastenings of proper length and type. Except as otherwise specified, fastenings for use with various structural materials shall be as follows:

Type of Fastening	Structural Material
Wood screw	Wood
Tap screw	Metal
Case-hardened, self-tapping screw	Sheet Metal
Screw or bolt in expansion shields	Solid masonry
Toggle bolts	Hollow blocks, wallboard and plaster

2.6 FABRICATION

A. Fabricate cloth shades to fit measurements of finished openings obtained at site.

B. Cloth Window Shades: Rolling type, constructed of shade cloth mounted on rollers. Shade cloth shall have plain sides, and with hem at bottom to accommodate wood slat. Separate shades are required for each individual sash within opening. Length of shades shall exceed height of window approximately 300 mm (12 inches) measured from head to sill, in addition to material required to make-up hem:

1. Provide rollers with spindles, nylon bearings, tempered steel springs, and all other related accessories required for positive action. Provide rollers of diameter recommended by shade manufacturer. Staple shade cloth to wood rollers to prevent wrinkling or folding, and on line parallel to axis of rollers so that shade will hang plumb. Space staples not over 90 mm (3-1/2 inches) on centers. Use of tacks is prohibited.

2. Wood slats shall be smooth, tapered, and inserted in the bottom hem of the shade cloth.

3. Eyelets shall have clear openings large enough to accommodate cords. Edges of eyelets shall not cut into cloth when set.

4. Cords shall be of sufficient length to permit shades to be drawn to bottom of opening with ends looped and held with cord rings. Attach cords to

hems through metal eyelets in center of slats in bottom hems.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cloth Window Shades: Mount window shades on end of face brackets, set on metal gussets, or casing of windows as required. Provide extension face brackets where necessary at mullions.

1. Locate rollers in level position as high as practicable at heads of windows to prevent infiltration of light over rollers.
2. Where extension brackets are necessary, on mullions or elsewhere, for alignment of shades, provide metal lugs, and rigidly anchor lugs and brackets.
3. Place brackets and rollers so that shades will not interfere with window and screen hardware.
4. Mount shades at wire mesh window guards on head rails of hinged frame.
5. Mount shades at detention, or protection screens on head rail (room side) of hinged frame, with face brackets located approximately 38 mm (1-1/2 inches) from outside edges.
6. Shade installation methods not specifically described, are subject to approval of Resident Engineer.

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SECTION 12 32 00

MANUFACTURED WOOD CASEWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies plastic laminate casework as detailed on the drawings, including related components and accessories required to form integral units. Wood casework items shown on the drawings, but not specified below shall be included as part of the work under this section, and applicable portions of the specification shall apply to these items. Each like item of casework shall be of the same design and by one manufacturer.

B. Where shown, provide plastic laminate casework items as follows:

1. Cabinets and counters.

1.2 RELATED WORK

A. Custom Casework: Section 06 20 00, FINISH CARPENTRY.

B. Color and Finish of Plastic Laminate: Section 09 06 00, SCHEDULE FOR FINISHES.

C. Lavatories and Plumbing in Casework: Section 22 40 00, PLUMBING FIXTURES.

1.3 MANUFACTURER'S QUALIFICATIONS

1. The fabrication of casework shall be by a manufacturer who produces casework similar to the casework specified and shown.

1.4 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

   c. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

2. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

3. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify that no added urea formaldehyde is present in any composite wood materials, agrifiber material or adhesive.

4. Documentation for all new wood products, including FSC Certified. Provide

vendor invoices for all permanently installed wood products, FSC Certified or not. Each wood product must be identified on a line-item basis, FSC products must be identified as such on a line item basis, the dollar value of each line item must be shown, the vendors Chain-of-Custody certificate number must be shown on any invoice that includes FSC products.

5. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

6. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Manufacturer's Literature and Data:

1. Sinks, trim and fittings.

2. Locks for doors and drawers

3. Adhesive cements

D. Samples:

1. Counter top, solid surface, 150 mm (six inch) square.

E. Shop Drawings (1/2 full size):

1. All casework, showing details of construction, including materials, hardware and accessories.

2. Cabinets and counters showing faucets in connection with sink bowls, and electrical fixtures and receptacles which are mounted on cabinets and counters.

3. Fastenings and method of installation.

1.5 QUALITY ASSURANCE REQUIREMENTS

A. LEED Building Performance Requirements:

1. Materials that contain recycled content shall be documented in accordance with the LEED Building Submittal Requirements of this Section.

2. Steel materials used for work in this section shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

3. Engineered wood, not including salvaged wood, shall contain a minimum of 10% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittal Requirements of this Section.

4. All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) to be permanently installed on the interior of project shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI). Certification of these products shall be in accordance with the LEED Building Submittal Requirements of this Section.
5. Adhesives used for work in this section including plastic laminating adhesives shall contain no added Urea Formaldehyde.
6. Wood Materials manufactured, fabricated, and or harvested within 500 miles (by air) of the project site shall be documented in accordance with the LEED Building Submittal Requirements of this Section.
7. Solid wood materials shall be FSC Certified as sustainably harvested by the Forest Stewardship Council Documentation of FSC Certification shall be in accordance with the LEED Building Submittal requirements of this Section.
8. All wood flooring must be certified as compliant with FloorScore Standard as developed by the Resilient Floor Covering Institute.
9. Adhesives, sealants, paints and coatings used for work in this section shall meet the requirements of Division 1, Section 018113: “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable. VOC Limits include, but are not limited to the following:

Wood Flooring Adhesive	100 g/l
Clear Wood Varnish	350 g/l
Clear Wood Lacquer	550 g/
Wood Stains	250 g/l
Sanding Sealers	275 g/l
Clear Shellac	730 g/l
Pigmented Shellac	550 g/l

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. American Society for Testing and Materials (ASTM):

1. A167-99 (R2004) Stainless and Heat-Resisting chromium- Nickel Steel Plate, Sheet and Strip
2. A1008-07 Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy
3. C1036-06 Flat Glass

C. Composite Panel Association (CPA):

1. A208.1-99 Particleboard.

D. U.S. Department of Commerce Product Standards (Prod. Std):

1. PS1-95 Construction And Industrial Plywood.

E. Hardwood, Plywood and Veneer Association (HPVA):

1. HP.1-04 Hardwood and Decorative Plywood

F. Architectural Woodwork Institute (AWI):

1. Architectural Woodwork Quality Standards, Guide Specifications Quality Certification Program - 1999.

G. American Society of Mechanical Engineers (ASME):

1. A112.18.1-05 Plumbing Fixture Fittings.

H. National Electrical Manufacturers Association (NEMA):

1. LD3-05 High Pressure Decorative Laminates.

2. Performance, Application Fabrication and Installations of High-Pressure Decorative Laminates.

I. Hardwood Plywood and Veneer Association

1. HP-1 Hardwood and Decorative Plywood

PART 2 - PRODUCTS

2.1 PLASTIC LAMINATE

A. NEMA LD-3.

B. Exposed decorative surfaces including countertops, both sides of cabinet doors, and for items having plastic laminate finish. General purpose Type HGL.

C. Cabinet Interiors Including Shelving: Both of following options to comply with NEMA, LD3.1 as a minimum.

1. Resin impregnated decorative paper thermally fused to particle board.

D. Backing sheet on bottom of plastic laminate covered wood tops. Backer Type BKL.

2.2 PLYWOOD, SOFTWOOD

A. Prod. Std. PS1, five ply construction from 13 mm to 28 mm (1/2 inch to 1-1/8 inch) thickness, and seven ply for 31 mm (1 1/4 inch) thickness.

2.3 PARTICLEBOARD

A. CPA A208.1, Type 1, Grade 1-M-3.

2.4 RUBBER OR VINYL BASE

A. Cove (for resilient floor); 100 mm (4 inch) high, 3 mm (1/8 inch) thick, flexible to conform to irregularities in walls, partitions and floors, Unless noted otherwise.

2.5 PLUMBING FIXTURES

A. ASME A112.18.1, except die-cast zinc-alloy material is not acceptable.

2.6 HARDWARE

A. Where pin tumbler locks are specified, disc tumbler lock "Duo A", with brass working parts and case, as manufactured by the Illinois Lock Company will be an acceptable substitute. Locks for each type casework, shall be keyed differently and shall be master-keyed for each type service, such as Nurses, Psychiatric, and Administration. Provide two keys for each lock. Exposed hardware, except as otherwise specified, shall be satin finished chromium plated brass or nickel plated brass.

B. Marking of Locks and Keys:

1. The name of the manufacturer, or trademark by which manufacturer can readily be identified, legibly marked on each lock.

2. The key change number marked on the exposed face of lock, and also stamped on each key.

3. Key change numbers shall provide sufficient information for replacement of the key by the manufacturer.

C. Hinged Doors:

1. Doors 900 mm (36 inches) and more in height shall have three hinges and doors less than 900 mm (36 inches) in height shall have two hinges. Each door shall close against two rubber bumpers.

2. Hinges: Fabricate hinges with minimum 2 mm (0.072 inch) thick chromium plated steel leaves, and with minimum 3.5 mm (0.139 inch) diameter stainless steel pin. Hinges shall be five knuckle design with 63 mm (2-1/2 inch) high leaves and hospital type tips.

3. Fasteners: Provide full thread wood screws to fasten hinge leaves to door and cabinet frame. Finish screws to match finish of hinges.

D. Locks:

1. Cylinder type pin tumbler.

2. Equip doors and drawers where shown with locks.

E. Drawer and Door Pulls:

1. Doors and drawers shall have flush pulls, fabricated of either chromium plated brass, chromium plated steel, stainless steel, or anodized aluminum.

F. Drawer Slides:

1. Full extension steel slides with nylon ball-bearing rollers.

2. Slides shall have positive stop.

3. Equip drawers with rubber bumpers.

G. Sliding Doors:

1. Plastic guides are not acceptable.

2. Each door shall have rubber silencers set near top and bottom of each jamb.

H. Shelf Standards (Except For Fixed Shelves):

1. Bright zinc-plated steel for recessed mounting with screws, 16 mm (5/8 inch) wide by 5 mm (3/16 inch) high providing 13 mm (1/2 inch) adjustment,

complete with shelf supports.

I. Gate Bolt:

1. Surface mounted barrel type with strike.

J. Hinged Gates:

1. Gates shall have two double-acting hinges, size as required.

2.7 FABRICATION

A. Casework shall be of the flush overlay design and, except as otherwise specified, be of premium grade construction and of component thickness in conformance with AWI Quality Standards.

B. Fabricate casework of plastic laminated covered plywood or particleboard as follows:

1. Where shown, all semi-concealed surfaces shall be plastic laminated.

2. Horizontal and vertical reveals between doors and drawer for reveal overlay design shall be 19 mm (3/4 inch) unless otherwise shown.

C. Electrical Fixtures, Receptacles, Wiring and Junction Boxes required for Fixtures and Receptacles:

1. For electrical lighting fixtures, see drawings.

2. For electric receptacles and lighting fixtures installed below or adjacent to wall cabinets or above counter tops, see electrical sections or specifications.

3. Install wiring in built-in raceways and terminate at junction box mounted on rear of cabinet and counter.

4. For final hook-up at junction box see electrical sections of specifications.

D. Base:

1. Provide rubber with close, flush joints; set with adhesive.

2. Remove adhesive from exposed surfaces.

3. Install base at floor line after casework has been accurately leveled.

E. Countertops:

1. Countertops, splash backs shall be solid surface polymer glued to either a plywood (PS1), or particleboard (CPA A208.1) core.

2. Countertops shall be 1-1/2 inches) thick.

3. Provide cut-outs for plumbing trim where shown.

F. Sink Bowls:

1. Solid Surface Polymer and Stainless Steel, of size and design shown.

2. Secure sink bowls with concealed fastenings.

3. For service lines from service fixtures, see other sections of specifications.

G. Provide the following Plumbing Trim and Fittings:

1. Faucets: ASME A112.18.1 Type I, compression type, countertop mounted,

chromium plated brass, having two valves and with swing-spout and gooseneck spout as shown, elevated to clear handles.

2. Fittings shall have an elongated escutcheon for spout and handles, replaceable valve seats and four arm or lever style indexed chromium plated brass or stainless steel handles; handles either with or without hood.

H. Faucets:

1. ASME A112.18.1 Type I, compression type, splash back mounted, chromium plated brass, having two valves and with swing-spout and gooseneck spout as indicated.

2. Fittings shall have exposed body union inlets and adjustable flanges.

3. Valves shall have indexed chromium plated brass or stainless steel lever handles and replaceable valves seats; handles either with or without hood.

I. Drain:

1. Cast or wrought brass or stainless steel with flat strainer.

2. Surfaces of drains exposed from above shall have a chromium plated finish.

J. Traps: Cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set casework in place; level, plumb and accurately scribe and secure to walls, and/or floors.

B. The installation shall be complete including all trim and hardware. Leave the casework clean and free from defects.

3.2 FASTENINGS

A. Fastenings for securing casework to adjoining construction shall be as detailed on the drawings or approved shop drawings.

B. See Section 05 50 00, METAL FABRICATIONS for reinforcement of walls and partitions for casework anchorage.

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SECTION 12 36 00

COUNTERTOPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies casework countertops with integral accessories.

B. Integral accessories include:

1. Sinks with traps and drains.
2. Hot Plates (Range)

1.2 RELATED WORK

A. Color and patterns of plastic laminate: SECTION 09 06 00, SCHEDULE FOR FINISHES.

B. DIVISION 22, PLUMBING.

C. DIVISION 26, ELECTRICAL.

D. Equipment Reference Manual for SECTION 12 36 00, COUNTERTOPS.

1.3 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittal Requirements under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:
   a. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.
   b. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).
   c. Provide material costs for the materials included in the contractor's or subcontractor's work. Material cost does not include costs associated with labor and equipment.

b. Letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the amount of recycled content.

c. Letters of Certification provided from the product manufacturer on the manufacturer's letterhead, to verify that no added urea formaldehyde is present in any composite wood materials, agrifiber material or adhesive.

d. Product Cut Sheets for all materials that meet the LEED Building Performance Requirements this Section.

e. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC content, then product data sheets, manufacturer literature, or a letter of

certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

B. Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Shop Drawings

1. Show dimensions of section and method of assembly.

2. Show details of construction at 1/2 scale.

D. Samples:

1. 150 mm (6 inch) square samples each top.

2. Front edge, back splash, end splash and core with surface material and booking.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Hardboard Association (AHA):

1. A135.4-95 Basic Hardboard

C. Composite Panel Association (CPA):

1. A208.1-09 Particleboard

D. American Society of Mechanical Engineers (ASME):

1. A112.18.1-05 Plumbing Supply Fittings

2. A112.1.2-04 Air Gaps in Plumbing System

3. A112.19.3-08(R2004) Stainless Steel Plumbing Fixtures (Designed for Residential Use)

E. American Society for Testing and Materials (ASTM):

1. A167-99 (R2009) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

2. A1008-09 Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength, Low Alloy

3. D256-06 Pendulum Impact Resistance of Plastic

4. D570-98(R2005) Water Absorption of Plastics

5. D638-08 Tensile Properties of Plastics

6. D785-08 Rockwell Hardness of Plastics and Electrical Insulating Materials

7. D790-07 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

8. D4690-99(2005) Urea-Formaldehyde Resin Adhesives

9. G21-96 (R2002) Determining Resistance of Synthetic Polymeric Materials to Fungi

F. Federal Specifications (FS):

1. A-A-1936 Adhesive, Contact, Neoprene Rubber

G. U.S. Department of Commerce, Product Standards (PS):

1. PS 1-95 Construction and Industrial Plywood

H. National Electrical Manufacturers Association (NEMA):

1. LD 3-05 High Pressure Decorative Laminates

2. LD 3.1-95 Performance, Application, Fabrication, and Installation of High Pressure Decorative Laminates

PART 2 - PRODUCTS

2.1 MATERIALS

98% Acetic Acid	Butyl Alcohol	Acetone
90% Formic Acid--	Benzine	Chloroform
28% Ammonium Hydroxide	Xylene	Carbon Tetrachloride
Zinc Chloride (Sat.)	Toluene	Cresol
Sodium Carbonate (Sat.)	Gasoline	Ether
Calcium Hypochlorite (Sat.)	Kerosene	Cottonseed Oil
Sodium Chloride (Sat.)	Mineral Oil	40% Formaldehyde
Methyl Alcohol	Ethyl Acetate	Trichlorethylene
Ethyl Alcohol	Amyl Acetate	

77% Sulfuric Acid	37% Hydrochloric Acid	85% Phenol
33% Sulfuric Acid	20% Nitric Acid	Furfural
85% Phosphoric Acid	30% Nitric Acid	

Flexural strength	70 MPa (10,000 psi)	ASTM D790
Rockwell hardness	105	ASTM D785
Water absorption, 14 hours (weight)	.01%	

1. Material of uniform mixture throughout.

B. Particleboard: CPA A208.1, Grade 2-M-2.

C. Plywood: PS 1, Exterior type, veneer grade AC not less than five ply construction.

D. Adhesive

1. For Field Joints:

a. Epoxy type, resistant to chemicals as specified for plastic laminate laboratory surfaces.

E. Fasteners:

1. Metals used for welding same metal as materials joined.

F. Solid Polymer Material:

1. Filled Methyl Methacrylic Polymer.

2. Performance properties required:

Property	Result	Test

Property	Result	Test
Elongation	0.3% min.	ASTM D638
Hardness	90 Rockwell M	ASTM D785
Gloss (600 Gordon)	5-20	NEMA LD3.1
Color stability	No change	NEMA LD3 except 200 hour
Abrasion resistance	No loss of pattern Max wear depth 0.0762 mm (0.003 in) - 10000 cycles	NEMA LD3
Water absorption weight (5 max)	24 hours 0.9	ASTM D-570
Izod impact	14 N·m/m(0.25 ft-lb/in)	ASTM D256 (Method A)
Impact resistance	No fracture	NEMA LD-3 900 mm (36") drop 1 kg (2 lb.) ball
Boiling water surface resistance	No visible change	NEMA LD3
High temperature resistance	Slight surface dulling	

3. Cast into sheet form and bowl form.
4. Color throughout with subtle veining through thickness.
5. Joint adhesive and sealer: Manufacturers silicone adhesive and sealant for joining methyl methacrylic polymer sheet.
6. Bio-based products will be preferred.

2.2 SINKS

A. Stainless Steel:

1. ANSI/ASME A112.19.3, Type 304.

B. Stainless steel circular or oval shaped bowl.

C. Sinks of Methyl Methacrylic Polymer:

1. Minimum 19 mm (3/4 inch) thick, cast into bowl shape with overflow to drain.
2. Provide for under hung installation to countertop.
3. Provide openings for drain.

2.3 TRAPS AND FITTINGS

A. Material as specified in DIVISION 22, PLUMBING.

2.4 WATER FAUCETS

A. ASME A112.18.1.

B. As specified in DIVISION 22, PLUMBING.

SERVICE	COLOR	CODE	COLOR OF LETTERS
Cold Water	Dark Green	CW	White
Hot Water	Red	HW	White
Laboratory Air	Orange	AIR	Black
Fuel Gas	Dark Blue	GAS	White

SERVICE	COLOR	CODE	COLOR OF LETTERS
Laboratory Vacuum	Yellow	VAC	Black
Distilled Water	White	DW	Black
Deionized Water	White	DI	Black
Oxygen	Light Green	OXY	White
Hydrogen	Pink	H	Black
Nitrogen	Gray	N	Black
All Other Gases	Light Blue	CHEM.SYM.	

2.5 ELECTRICAL RECEPTACLES

A. Hospital grade per electrical specifications.

2.6 COUNTERTOPS

A. Fabricate in largest sections practicable.

B. Fabricate with joints flush on top surface.

C. Fabricate countertops to overhang front of cabinets and end of assemblies 25 mm (one inch) except where against walls or cabinets.

D. Provide 1 mm (0.039 inch) thick metal plate connectors or fastening devices (except epoxy resin tops).

E. Join edges in a chemical resistant waterproof cement or epoxy cement, except weld metal tops.

F. Fabricate with end splashes where against walls or cabinets.

G. Splash Backs and End Splashes:

1. Not less than 19 mm (3/4 inch) thick.
2. Height 100 mm (4 inches) unless noted otherwise.
3. Laboratories and pharmacy heights or where fixtures or outlets occur: Not less than 150 mm (6 inches) unless noted otherwise.
4. Fabricate epoxy splash back in maximum lengths practical of the same material.

H. Drill or cutout for sinks, and penetrations.

1. Accurately cut for size of penetration.

I. Methyl Methacrylic Polymer Tops:

1. Fabricate countertop of methyl methacrylic polymer cast sheet, 19 mm (3/4 inch) thick.
2. Fabricate back splash and end splash to height shown.
3. Fabricate skirt to depth shown.
4. Fabricate with marine edge where sinks occur.
5. Fabricate in one piece for full length from corner to corner up to 3600 mm (12 feet).
6. Join pieces with adhesive sealant.
7. Cut out countertop for lavatories, plumbing trim.
8. Provide concealed fasteners and epoxy cement for anchorage of sinks to

countertop.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installing countertops verify that wall surfaces have been finished as specified and that mechanical and electrical service locations are as required.

B. Secure countertops to supporting rails of cabinets with metal fastening devices, or screws through pierced slots in rails.

1. Where type, size or spacing of fastenings is not shown or specified, submit shop drawings showing proposed fastenings and method of installation.

2. Use round head bolts or screws.

3. Use epoxy or silicone to fasten the epoxy resin countertops to the cabinets.

4. Use wood or sheet metal screws for wood or plastic laminate tops; minimum penetration into top 16 mm (5/8 inch), screw size No 8, or 10.

C. Rubber Moldings:

1. Where shown install molding with butt joints in horizontal runs and mitered joints at corners where ceramic tile occurs omit molding.

2. Fasten molding to wall and to splash backs and splash ends with adhesive.

D. Sinks

1. Install methyl methacrylic polymer sinks in manufacturers recommended adhesive sealer or epoxy compound to underside of methyl methacrylic polymer countertop.

a. Bolt or screw to countertop to prevent separation of bowl and fracture of adhesive sealant joint.

b. Install drain and traps to sink.

E. Faucets, Fixtures, and Outlets:

1. Seal opening between fixture and top.

2. Secure to top with manufacturers standard fittings.

F. Range Tops, Electrical Outlets:

1. Set in cutouts with manufacturer’s gasket sealing joint with top to prevent water leakage.

2. Install control unit and electric outlets where shown. Seal escutcheon plate at lap if on counter or top to prevent water leakage.

3.2 PROTECTION AND CLEANING

A. Tightly cover and protect against dirt, water, and chemical or mechanical injury.

B. Clean at completion of work.

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SECTION 12 48 16

ENTRANCE FLOOR GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes recessed foot grilles and frames.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for slab depression grouting and filling for recessed foot grilles and frames.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide foot grilles and frames capable of withstanding the following loads and stresses:

1. Uniform floor load of 300 lbf/sq. ft..

2. Wheel load of 500 per wheel.

1.4 INFORMATION SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:

1. A completed LEED Building Materials Certification Form, per Section 013323 – Submittals under the LEED Building Submittal Requirements article of these specifications. Information to be supplied includes:

2. The percentage by weight of recycled content in the product(s). Identify post-consumer and/or pre-consumer recycled content.

3. The manufacturing location for the product(s); and the location (source) of the raw materials used to manufacture the product(s).

4. Provide material costs for the materials included in the contractor’s or subcontractor’s work. Material cost does not include costs associated with labor and equipment.

B. Letters of Certification, provided from the product manufacturer on the manufacturer’s letterhead, to verify the amount of recycled content.

C. Product Cut Sheets for all materials that meet the LEED Performance Requirements this Section.

D. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the

manufacturer can be submitted in addition to the MSDS to indicate the VOC content).

1.5 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for foot grilles and frames.

B. Shop Drawings: Show the following:

1. Items penetrating foot grilles and frames, including the following:

a. Door control devices.

2. Divisions between grille sections.

3. Perimeter floor moldings.

C. Samples for Verification: For each type of product indicated.

1. Foot Grille: 12-inch- square assembled sections.

2. Frame Members: 12-inch- long Sample of each type and color.

3. Carpet Inserts: 12-inch- long sample of each type and color.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For foot grilles and frames to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain foot grilles and frames through one source from a single manufacturer.

B. Accessibility Requirements: Provide installed foot grilles that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.8 PROJECT CONDITIONS

A. Field Measurements: Indicate measurements on Shop Drawings.

1.9 COORDINATION

A. Coordinate size and location of recesses in concrete to receive foot grilles and frames.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated in SCHEDULE FOR FINISHES 090600 or a

comparable product.

2.2 MATERIALS

A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.

2.3 FOOT GRILLES

A. General: Provide manufacturer's standard foot-grille assemblies consisting of treads of type and profile indicated, interlocked or joined together by cross members, and with support legs (if any) and other components needed to produce a complete installation.

B. Stainless-Steel Foot Grille: Type 304.

1. Surface Treads: 0.140 inch wire with 0.125-inch- wide openings between wires.

2. Support Rods: Spaced 1 inch o.c., welded to each wire.

3. Pit Grating: 1-1/8 inches deep.

4. Stainless-Steel Finish: Mill finish.

5. Grille Size: As indicated.

6. Carpet Inserts: Solution dyed Nylon (32-oz/yd) fusion bonded to a rigid two-ply backing to prevent fraying and supplied in continuous splice free lengths.

a. Insert Spacing: 6"

b. Colors: As indicated in SCHEDULE FOR FINISHES 090600.

C. Lockdown: Hidden.

2.4 FRAMES

A. Provide manufacturer's standard frames of size and style for grille type, for permanent recessed installation in subfloor, complete with installation anchorages and accessories. Unless otherwise indicated, fabricate frame of same material and finish as grilles.

2.5 SUPPORT SYSTEM

A. Level Bed Applications: Provide manufacturer's standard, vinyl cushion support system.

2.6 FABRICATION

A. Shop fabricate foot grilles to greatest extent possible in sizes as indicated. Unless otherwise indicated, provide each grille as a single unit; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.

B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.8 STAINLESS-STEEL FINISHES

A. Mill finish.

B. Directional Satin Finish: No. 4.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, size, minimum recess depth, and other conditions affecting installation of foot grilles and frames.

B. Examine roughing-in for drainage piping systems to verify actual locations of piping connections before foot grille and frame and drain pan installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install recessed foot grilles and frames to comply with manufacturer's written instructions at locations indicated and with top of foot grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set foot-grille tops at height for most effective cleaning action. Coordinate top of foot-grille surfaces with doors that swing across grilles to provide clearance under door.

3.3 PROTECTION

A. After completing frame installations, provide temporary filler of plywood or fiberboard in foot-grille recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

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SECTION 14 24 00

HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the, engineering, furnishing and installation of the complete electro-hydraulic elevator system as described herein and shown on the drawings.

B. Electric passenger elevators No. P-2A15 , shall be oil hydraulic type with microprocessor based control, single car selective collective automatic operation with car leveling device, signal system, power-operated single-speed center opening car and hoist way doors. Elevators shall have Class "A" loading.

1.2 QUALITY CONTROL

A. LEED Building Performance Requirements:

1. Adhesives or sealants used for work in this section for interior applications shall meet the requirements of Division 1, Section 018113 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings”, where applicable

B. Qualifications:

1. Approval by the Contracting Officer is required of products or services of proposed manufacturer, suppliers, and installers and will be contingent upon submission by Contractor of a certificate stating the following:

   a. Manufacturer is currently and regularly engaged in manufacturing of elevator equipment as one of his principal products.

   b. Installer has technical qualifications of at least three years of successful experience, trained supervisory and installation personnel, and facilities to install elevator equipment specified herein.

   c. Contractor shall submit a list of two or more prior hospital installations where all the elevator equipment the contractor proposes to furnish on this project has performed satisfactorily together under conditions of normal use. The list shall include projects that have been in operation for a period of not less than two years preceding the date of these specifications; include the name and addresses of the Medical Center and the Medical Center Administrators.

2. All hydraulic elevators shall be the product of the same manufacturer.

3. Approval of manufacturer's equipment will be contingent upon his having a permanent and satisfactory maintenance service branch which shall render services within four hours of receipt of notification. Manufacturer shall submit the names and address of his authorized branch or service department which will render service to this installation,

together with certification that the quantity and quality of replacement parts stock on hand is sufficient to warranty continued operation of the elevator installation.

4. Approval will not be given to any Elevator Contractor and/or manufacturer who has established on prior projects, either Government, municipal, or commercial, a record for unsatisfactory elevator installations, or has repeatedly failed to complete contracts awarded to him within the contract time, or has not the requisite record of satisfactorily performing elevator installations of similar type and magnitude.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only:

B. Federal Specifications (Fed. Spec.):

1. J-C-30B(l) Cable and Wire, Electrical (Power, Fixed Installation)
2. J-C-580B(l) Cord, Electrical and Wire, Electrical (O to 600-Volt Service)
3. W-C-596/12F Connector, Receptacle, Electrical, General Purpose, Duplex, Hospital Grade Grounding, 2 Pole, 3 Wire, 15 Amperes, 125 Volts, 50/60 Hertz
4. W-F-406D Fittings for Cable, Power, Electrical and Conduit, Metal Flexible
5. W-F-408E Fittings for Conduit, Metal, Rigid (Thick-Wall and Thin-Wall (EMT) Type)
6. W-S-610E Splice Connectors
7. FF-S-325 Shield, Expansion; Nail Expansion; and Nail, Drive
8. QQ-S-766D Steel, Stainless and Heat Resisting, Alloys, Plate, Sheet and Strip
9. L-P-508H Plastic Sheet, Laminated, Decorative and Non- Decorative (Style "D" Type I Class 25 Plastic Laminate)
10. TT-E-489 Enamel, Alkyd, Gloss, Low Voc Content
11. WW-C-566C Conduit, Metal, Flexible

C. American Society for Testing and Materials (ASTM):

1. A1008/A1008M-02 Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formation
2. C612-00a Mineral Fiber Block and Board Thermal Insulation
3. E1042-92(1997)e1 Acoustically Absorptive Materials Applied by Trowel or Spray

D. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):

1. SP-58-1993 Pipe Hangers and Supports

E. American Society of Mechanical Engineers (ASME):

1. A17.1-2000 Safety Code for Elevators and Escalators
2. A17.2-2001 Inspectors Manual for Elevators and Escalators

F. National Fire Protection Association (NFPA):
1. 70-2002 or current code. National Electric Code
2. 252-2003 Fire Test of Door Assemblies

G. Society of Automotive Engineers, Inc. (SAE)
1. J517-91 .Hydraulic Hose, Standard; April 1991

H. Gages:
1. For Sheet and Plate: U.S. Standard (USS)
2. For Wires: American Wire Gauge (AWG)

I. American Welding Society (AWS):
1. D1.1-2002 Structured Welding Code - Steel

J. National Electrical Manufacturers' Association (NEMA):
1. LD3-2000 High-Pressure Decorative Laminates

K. Underwriter's Laboratories (UL):
1. 486A-97 Ninth Edition Wire Connectors and Soldering Lugs for Use with Copper Conductors
2. 797-83 High Safety Electrical Metallic Tubing

L. Regulatory Standards:
1. A Specification 16721 Fire Alarm - Local Building System
2. VA Barrier Free Design Handbook (H-08-13)
3. Uniform Federal Accessibility Standards - 1988
4. Americans with Disabilities Act - 1991

1.4 SUBMITTALS

A. LEED Building Submittal Requirements: The contractor or subcontractor shall submit the following LEED Building certification items:
1. Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings applied on the interior of the building. MSDS shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product’s VOC content, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC content)..

B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Complete scaled and dimensioned layout of each elevator installation in plan, elevation, and section.

D. Complete layout showing location of storage tank; pump; controller; selectors and supervisory panels; outside diameter of cylinder; plunger;

piping layout and working pressure; clearance of car at top and bottom of hoist way when car makes normal stops at terminals, and clearance of car at bottom of hoist way when buffers are fully compressed; car platform; size of car frame members; support assembly and weights of principal parts.

E. Complete drawings of hoist way entrances and doors showing details of construction, and method of fastening to structural members of building.

1. If dry-wall construction is used to enclose hoist way, submit details of interface fastenings between entrance frames and drywall.

F. Drawing showing methods of fastening conduit or duct systems, fixture boxes, fascia plates, intermediate supports, rail brackets, and hoist way construction.

G. Complete drawings of elevator car enclosure, showing dimensioned details of construction, location of car equipment, fastenings to platform, car lighting, ventilation, ceiling framing and top exit:

1. Dimensioned drawings showing details of guide shoes.

H. Dimensioned drawings showing details of all signal and car equipment and fixtures.

I. Complete drawings showing details of jack unit.

J. Dimensioned drawings and description of power door operator and photo-electric devices.

K. Dimensioned drawings and description of hoist way door hangers.

L. Cuts of drawings of hydraulic fluid scavenger pump system.

M. Complete dimensioned hydraulic fluid storage tank and jack unit.

N. Samples (One each):

1. Stainless steel plate, 75 mm by 125 mm (3-inches by 5-inches.)

2. Baked enamel plate, 75 mm by 125 mm (3-inches by 5-inches.)

3. Color vinyl floor tile, .31 mm (12-inch square.)

4. Protection pads, 75 mm by 125 mm (3-inches by 5-inches.)

5. No other samples of materials specified shall be submitted unless specifically requested after submission of manufacturer's name. In case such samples are furnished pursuant to request, adjustment in contract price and time will be made as provided in Section 00 72 00, GENERAL CONDITIONS.

O. Materials Data: Submit the name of manufacturer and type or style designation of the following for approval:

1. Controllers.

2. Size of hydraulic power unit.

3. H.P. and R.P.M. of hydraulic power unit motor.

4. Electric control valves, including capacity range.

5. Electric power and power door operator.

6. Hoist way door interlocks and electric contacts.

7. Stroke, certified maximum and minimum loads and maximum striking speed

of car buffers.

8. HP and CFM rating on cab ventilation unit.

1.5 WIRING DIAGRAMS

A. Provide three (3) sets field wiring and straight line wiring diagrams showing all electrical circuits of all elevator equipment in the hoist way, as well as the machine room. One (1) set of diagrams shall be framed under plastic or on pivoted hardboards coated with an approved plastic sealer, and mounted in each elevator machine room as directed by Resident Engineer. In the event field modifications are found necessary during installation, diagrams shall be revised to include all corrections made prior to and during the final inspection.

B. Diagrams shall be delivered to the Resident Engineer within 30 days of final acceptance.

1.6 ADDITIONAL EQUIPMENT

A. Furnish and install any additional equipment required to operate specified equipment manufactured or contemplated for this installation.

B. Special equipment not required by specification, but manufactured by elevator contractor, which would improve the operation as a whole, may be installed on or in conjunction with the specified equipment by the contractor at his option at no additional cost to the Government, provided prior approval is obtained from the Contracting Officer.

1.7 TOOL CABINET

A. Provide a metal tool cabinet, having two shelves and a hinged door. cabinet size shall be approximately 1200 mm (48 inches) high, 450 mm (18 inches) wide, 375 mm (15 inches) deep and shall contain not less than 213.4 cubic cm (7 cubic feet) of storage.

1.8 PERFORMANCE STANDARDS

A. The elevators shall be capable of meeting the highest standards of the industry and specifically the following:

1. Contract speed shall mean speed in the UP direction with full capacity load in the car. Speed variation under any load condition, regardless of direction, shall be no more than ten (10) percent.

2. Starting, stopping, and leveling shall be smooth and comfortable without appreciable steps of acceleration and deceleration.

B. The door opening time:

1. Door opening shall be manufacturer's standard number of seconds .

2. Door closing time shall be manufacturer's standard number of seconds.

C. Cycle time shall be measured from the time the doors starts to close until the car has reached the next floor level, with the car stopped within the level allowance of plus or minus 3 mm (1/8 inch). Cycle time shall be not more than manufacturer's standard number of seconds. The measured floor-to-floor time interval shall be accomplished without re-leveling, and with advance door opening action.

D. Pressure: Fluid system components shall be designed and factory tested for 500 p.s.i. maximum operating pressure shall be 500 p.s.i.

E. Floor Accuracy

1. Accuracy shall be maximum 3 mm (1/8 inch) above or below the floor, regardless of load condition.

1.9 WARRANTY

A. Submit all labor and materials furnished in connection with elevator system and installation to terms of "Warranty of Construction" articles of FAR clause 52.246-21. Warranty shall commence upon final inspection and completion of performance test and upon full acceptance of the installation and shall concur with the length of the maintenance contract.

B. If it becomes evident during warranty period that any device is not functioning properly or in accordance with specification requirements, or if in the opinion of the Contracting Officer, excessive maintenance and attention must be employed to keep device operational, device shall be removed and a new device meeting all requirements shall be installed as part of work until satisfactory operation of installation is obtained. Period of warranty shall start anew for such parts from date of completion of each new installation performed, in accordance with foregoing requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Where stainless steel is specified, it shall be corrosion resisting steel complying with Fed. Spec. QQ-S-766, Class 302 or 304, Condition A with Number 4 finish (150 grit) on exposed surfaces. Stainless steel shall have the grain of belting in the direction of the longest dimension and surfaces shall be smooth and without waves. During erection, protect all stainless steel surfaces with a suitable material.

B. Where cold rolled steel is specified, it shall be low-carbon steel rolled to stretcher leveled standard flatness, complying with ASTM A109.

2.2 MANUFACTURED PRODUCTS

A. Materials, devices and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items.

B. When two or more units of same class of materials, devices or equipment are required, these units shall be products of one manufacturer.

C. Manufacturers of equipment assemblies which include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit shall be products of same manufacturer.

2. Parts which are alike shall be the product of a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for the intended service.

D. Welding: Welding at the project site shall be made by welders and welding operators who have previously qualified by test as prescribed in American

Welding Society Publication AWS D1.1 to perform type of work required.

E. Motor nameplates shall state manufacturer's name, rated horsepower, speed, volts, amperes and other characteristics required by NEMA standards, and shall be securely attached to the item of equipment in a conspicuous location.

F. Where key-operated switches or key-operated cylinder locks are furnished in conjunction with any component of the elevator installation, four keys for each individual switch or lock shall be furnished. Barrel keys are not acceptable. Attach each key to a tag bearing a stamped or etched legend identifying its purpose. Engrave tags and imprint "Property of U.S. Government" on reverse side.

2.3 CAPACITY, SPEED AND TRAVEL

A. Each direct-plunger elevator shall have the capacity to lift the live load exclusive of the weight of entire car and plunger, as specified in the following schedule.Actual elevator speed shall not vary more than 10 percent above nor more than 10 percent below specified speed.

ELEVATOR SCHEDULE	
Elevator Number	2A15
Overall Platform Size	6' - 8" wide x 5' - 5" deep
Rated Load – kg (pounds)	1588 (3500)
Rated Speed – m/s (fpm)	0.75 (150)
Total Travel – m/s (fpm)	See drawings
Number of Stops	2
Number of Openings	1 per floor
Entrance Type & Size	Center opening; 4' - 0'' wide x 7'-0'' high

1. Basis of Design Product: Subject to compliance with requirements, provide ThyssenKrupp Elevator, AMEE 3500 Twinpost Holeless or comparable product.

B. Actual elevator speed shall not vary more than 10 percent above nor more than 10 percent below specified speed.

2.4 POWER SUPPLY

A. For power supply in each machine room see specification Division 26, ELECTRICAL and electrical drawings.

B. It shall be the electrical contractor's responsibility to supply the labor and materials for the installation of the following:

1. A feeder from the power source indicated on the drawings to each hydraulic controller.
2. Shunt Trip Circuit Breaker for each controller located at the strike side of the machine room Shall be lockable in the "Off" position.
3. Auxiliary circuits for hydraulic signal and control systems as indicated on the drawings, from the indicated source to each hydraulic controller. The hydraulic controller, the elevator contractor shall supply and install motor and power and signal wiring from the controller to the machine.

C. Elevator shall be equipped with a Battery Lowering Device which will lower the elevator cab to the First Floor in the event of a power failure. Upon arriving atthe Lower Level, elevator doors will remain open.

2.5 CONDUIT PER NEC

A. All conduit terminating in steel cabinets, junction boxes, wireways, switch boxes, outlet boxes and similar locations shall have approved insulation bushing. Install a steel locknut under the bushing if they are constructed completely of insulating materials. Protect the conductors at ends of conduits not terminating in steel cabinets or boxes by terminal fittings having an insulated opening for the conductors.

B. Do not use set screws or indentations as a means of attachment or connection. Use compression fittings.

C. Conduit size: 19mm (1/2") minimum.

D. Flexible metal conduit not less than 9.5 mm(3/8-inch) electrical trade size may be used, not exceeding 457 mm (18 inches) in length, for short connections between risers and limit switches, interlocks, and for other applications permitted by the NEC. Flexible heavy-duty service cord, type S.O., may be used between fixed car wiring and switches on car doors for safety edges and light ray devices.

E. Provide terminal boxes for the conduit and wiring connections to the pump motor.

2.6 CONDUCTORS

A. Unless otherwise specified, conductors, exclusive of traveling cables, shall be stranded or solid coated annealed copper in accordance with Fed. Spec. J-C-30 for either Type RHW or THW. Where 16 and 18 AWG are permitted by NEC, either single conductor cable in accordance with Fed. Spec. J-C-580 for Type TF, or multiple conductor cable, may be used provided the insulation of single conductor cable and outer jacket of multiple conductor cable is flame retardant and moisture resistant. Multiple conductor cable shall have color coding or other suitable identification for each conductor. Conductors for control boards shall be in accordance with NEC. Permit no joints or splices in wiring except at outlets. Tap connectors may be used in wireways provided they meet all UL requirements.

B. All wiring must test free from short circuits or grounds. Insulation resistance between individual external conductors and between conductors and ground shall be not less than one megohm.

C. Where size of conductors is not given, capacity shall be such that maximum

current shall not exceed limits prescribed by NEC.

D. Provide equipment grounding. Ground conduits, supports, controller enclosures, motors, platform and car frames, and all other non-current conducting metal enclosures for electrical equipment in accordance with NEC. The ground wires shall be copper, green, insulated and sized as required by NEC. Bond the grounding wires to all junction boxes, cabinets, and wire raceways.

E. Terminal connections for all conductors used for external wiring between various items of elevator equipment shall be solderless pressure wire connectors in accordance with Fed. Spec. W-S-610. The Contractor may, at his option, make these terminal connections on No. 10 or smaller conductors with approved terminal eyelets set on the conductor with a special setting tool, or with an approved pressure type terminal block. Terminal blocks using pierce-through serrated washers are not acceptable.

2.7 TRAVELING CABLES

A. Traveling cables from junction box on car to junction box in hoist way or directly to controller shall consist of flexible traveling cables conforming with requirements of NEC. Equip junction boxes in hoist way and on car with terminal blocks. Provide all connections to terminal blocks with either terminal eyelet connections or pressure wire connectors of the clamp type that meet UL 486A requirements from stranded wire. Terminal blocks shall have permanent indelible identifying numbers for each connection. Flame and moisture resistant outer covering must remain intact between junction boxes. Abrupt bending or twisting producing distortion of cable shall not be allowed.

B. Provide 10 percent, but not less than 5 spare conductors in each traveling cable.

C. Provide shielded traveling cable wires for the auto dial phone system in each elevator car. Cable shall extend from auto dial phone system in car directly to controller or from junction box in hoist way to controller.

D. For type and location of hoist way lighting and intercom junction boxes, see contract drawings. Provide traveling cable with conductors for future travel requirements.

2.8 CONTROLLERS

A. Compartment: Securely mount all assemblies, power supplies, chassis switches, relays, etc., on a substantial, self supporting steel frame. Completely enclose equipment with covers. Provide means to prevent overheating.

B. Wiring: Controller wiring shall be neatly arranged, readily accessible, easily traced and securely fastened in place. Identify all spare conductors to controller.

C. Identify each device and fuse (ampere rating) on panels by name, letter, or standard symbol, in an approved indelible and legible manner on device or panel. Coordinate identification markings with identical markings or wiring diagrams.

D. Provide solid state components and printed circuit boards to control the hydraulic machine or signal functions. If this option is exercised, complete

details of the components and printed circuit boards, together with a complete operational description, shall be submitted for approval prior to manufacture. Incorporate the following features into the design:

1. The electrical connections between the printed circuit boards (modules) and the circuit connectors incorporated in the mounting racks shall be made through individual tabs which shall be an integral part of each module. The tabs shall be nickel-gold plated or other approved metal of equal electrical characteristics. Notch modules so as to prevent insertion of the modules in the inverted position.
2. Light emitting diode (LEDS) may be used for visual monitoring of individual modules.
3. Components shall have interlocking circuits to assure fail-safe operation and to prevent unwarranted elevator movement in case any component fails to function properly.
4. Submit method of wire wrappings for point to point wire connections on the mounting racks for approval.
5. Modules shall be of the type that plug into pre-wired mounting racks. No field wiring or alteration shall be necessary in order to replace defective modules.
6. Any field wiring changes required during construction shall be made only to the mounting rack connection points and not to the individual module circuitry or components. Any changes to individual modules shall be performed at the factory.
7. Fabricate module boards from non-conductive, non-corrosive material which is of sufficient strength so as to support all components mounted thereon without warping. Space mounting racks sufficiently apart to prevent accidental contact between individual modules.
8. All logic symbols and circuitry designations shall be in accordance with ASME Standards.
9. Design solid state components to operate at a maximum of 40 degrees C (104 degrees F).
10. Bring wiring connections for operating circuits and for external control circuits to terminal blocks mounted in an accessible location within the controller cabinet. Terminal blocks using pierce-through serrated washers shall not be acceptable.

2.9 MICROPROCESSOR CONTROL SYSTEM

A. The Contractor shall, provide solid state components and printed circuit boards to control the hoisting machine and signal functions in accordance with these specifications. Complete details of the components and printed circuit boards, together with a complete operational description, shall be submitted for approval.

2.10 HYDRAULIC JACK UNIT

A. Design cylinder and plunger in accordance with ASME A17.1. It shall be of sufficient size to lift gross load the height specified. Factory test at a pressure equal to twice the calculated working pressure, for strength and to insure freedom from leakage. Provide bottom of cylinder head with internal

guide bearing and top of cylinder head with removable packing gland. Packing gland shall permit ready replacement of packing. Victaulic type packing gland head will not be permitted.

1. Provide a bleeder valve located below the cylinder flange on the jack unit to release air or other gases from the system.
2. Equip cylinder with drip ring below the packing gland to collect leakage of hydraulic fluid.
3. Bolt the jack unit mounting brackets to continuous footing channels that also support the rails and buffers.

B. Install a copper tubing scavenger line with a electrically operated pump between the piston drip ring and oil storage tank. Scavenger line, pump and strainers shall operate independently of hydraulic fluid pressure. Equip scavenger pump with a water float designed to prevent operation of the pump, should the pit flood. Also, design to be manually reset. Strap the pump and reservoir to the pit floor.

C. Plunger shall be heavy seamless steel tubing, turned smooth and true to within plus or minus .38 mm (0.015-inches) tolerance and no diameter change greater than .07 mm (0.003-inches per-inch) of length. Ground the plunger surface to a fine polish finish, 12 micro-inches or finer. Where plunger is multi-piece construction, machine turn the joints to assure perfectly matching surfaces. No tool marks shall be visible.

1. Secure plunger to underside of platform supporting beams with fastenings capable of supporting four times the weight of the plunger. The platen shall incorporate piston car vibration isolator as, hereinafter, specified.
2. Provide a stop ring electrically welded or screwed to the bottom of plunger to positively prevent plunger from leaving its cylinder. [**For jack units that include future travel, locate the stop ring to permit only the actual travel and required run by**].
3. Isolate plunger head from the platen to prevent corrosion or electrolysis.
4. Carefully protect plunger and replace if gouged, nicked or scored.
5. If conditions beneath the pit floor are not adequate to support the total loading of the elevator, install reinforcing members in the pit floor.

D. Before installation, clean entire cylinder wall of all traces of oil, grease, moisture, dirt and scale.

2.11 PUMP UNIT ASSEMBLY

A. Completely integrate the pump unit for the control of the elevator and self-contain in a unit fabricated of structural steel. The unit shall consist of a hydraulic fluid pump driven by an induction motor together with oil control valves, piping, etc. Do not install hydraulic equipment within the storage tank. Completely enclose unit on four open sides of the power unit frame with not less than 16 gauge steel removable panel sections. Fully line panel sections on the interior with one-inch rigid board, mineral or glass fiber, or equivalent acoustical insulation.

B. Design hydraulic system so that working pressure does not exceed 400 p.s.i.

under any loading condition.

C. Pump shall be positive-displacement, rotary screw type, specially designed for hydraulic elevator service, having a steady discharge without pulsation to give smooth and quiet operation. Pump output shall be capable of lifting elevator car with rated capacity, with a speed variation of no more than ten percent between no load and full load. Pump shall operate under flooded suction in an accurately machined case with the clearance required to assure maximum efficiency. Hydraulic fluid by-pass shall discharge directly into storage tank.

D. Submersible pump unit not acceptable.

E. Motor shall be squirrel-cage, drip proof, ball bearing, induction type, with a synchronous speed not in excess of 1800 RPM. Design motor specifically for elevator service, not to exceed nameplate full load current by more than 10% and be continuously rated 80 starts per hour without exceeding a rise of 40 degrees C. Include closed transition SCR soft start.

F. Connect motor and pump with multiple V-belt. Size belts and sheaves for duty involved and design to prevent any metallic contact between motor and pump shaft. Provide isolation units of rubber in shear to prevent transmission of pump and motor vibration to the building. Install expanded metal sheave guard that can be easily removed for servicing and inspection.

2.12 HYDRAULIC SYSTEM

A. Construct the storage tank of sheet steel, welded construction, and a steel cover. Suitable means for filling, a minimum one-inch protected vent opening, an overflow connection, and a valved drain connection. Tank shall act as a storage tank only, and sized to pass through machine room door as shown on drawings. Provide marked gauge to meter hydraulic fluid level. Tank shall be of capacity to hold volume of hydraulic fluid required to lift elevator to top terminal landing, plus a reserve of not less than ten gallons. Provide a baffle in the bottom of the tank to prevent entry of any sediment or foreign particles into hydraulic system. Baffle shall also minimize aeration of hydraulic fluid. Permissible minimum hydraulic fluid level shall be clearly indicated. Hydraulic fluid shall be of good grade to assure free flow when cool, and have minimum flash point of 400 degrees F. Provide initial supply of hydraulic fluid for operation of elevator.

   1. Thermostatically control the viscosity of the hydraulic fluid with thermal cooling unit or chilled water heat exchanger and temperature thermostat to maintain the fluid temperature in the reservoir, pump and valves at a constant operating viscosity.

   2. Provide a data plate on the tank framing indicating the characteristics of the hydraulic fluid used.

B. Furnish and install connections between the storage tank, pump, muffler, operating valves, and cylinder complete with necessary valves, pipe supports, and fittings. All connections between the discharge side of the pump, check valve, muffler, cylinder, lowering valves shall be of schedule 40 steel with screw, flanged, welded, or approved flexible or mechanical couplings. Size of pipe and couplings between cylinder and pumping unit shall be such that fluid pressure loss is limited to 10 percent.

C. Do not subject valves, piping, and fittings to working pressure greater than

those recommended by the manufacturer.

D. Support all horizontal piping. Place hangers or supports within 3 mm (12 inches) on each side of every change of direction of pipe line and space supports not over 3.0 meters (10 feet) apart. Secure vertical runs properly with iron clamps at sufficiently close intervals to carry weight of pipe and contents. Provide supports under pipe to floor.

   1. Provide all piping from remote machine room to hoist way, including necessary supports or hangers. If remote piping is underground or in damp, inaccessible areas, install hydraulic piping thru PVC sleeve pipe.

E. Install pipe sleeves where pipes pass through walls or floors. Set sleeves during construction. After installation of piping, equip the sleeves with snug fitting inner liner of either glass or mineral wool insulation.

F. Install blowout-proof, non-hammering, oil-hydraulic muffler in the hydraulic fluid supply pressure line near power unit in machine room. Design muffler to reduce to a minimum any pulsation or noises that may be transmitted through the hydraulic fluid into the hoist way.

G. Solenoid operate and arrange control valves so hydraulic fluid flow will be controlled in positive and gradual manner to insure smooth starting and stopping of elevator.

H. Provide safety check valve between cylinder and flexible pump connection which will hold elevator with specified load at any point when pump stops or pressure drops below minimum operating levels.

I. Provide an automatic shut-off valve in the oil supply line at the cylinder inlet. Weld pipe protruding from cylinder at inlet and thread to receive shut-off valve. Activate the automatic shut-off valve when there is a ten percent drop in no-load operating pressure. When activated, this device shall immediately stop the descent of the elevator, and hold the elevator until it is lowered by use of the manual lowering feature of the valve. Arrange the manual lowering feature of the automatic shut-off valve to limit the maximum descending speed of the elevator to 15 FPM. The exposed adjustments of the automatic shut-off valve shall have their means of adjustment sealed after being set to their correct position.

J. Provide external tank shut-off valve to isolate hydraulic fluid during maintenance operations.

K. Provide all pump relief and other auxiliary valves to comply with the requirements of the Code and to insure smooth, safe, and satisfactory operation of elevator.

L. Furnish and adjust by-pass and relief valve in accordance with Rule 3.19.4.2 of ASME A17.1.

M. Install check valve to hold the elevator car with rated load at any point when the pump stops.

N. Provide a shut-off valve in the pit near the jack and in the machine room capable of withstanding 150 percent of design operating pressure. Manual valve shall have handle attached to the valve.

O. Conveniently locate the manual lowering valve, easily accessible, and properly identified with a red arrow and not concealed within the storage tank. Mark the operating handle in red.

P. Provide a low oil control feature which shall shut off the motor and pump and return the elevator to the lowest landing. Upon reaching the lowest landing, doors will open automatically allowing passengers to leave the car. Then doors shall close. All control buttons, except the door open button, shall be made ineffective.

Q. Provide oil-tight drip pan for assembled pumping unit, including storage tank. Pan shall be not less than 16 gauge sheet steel, with one-inch sides.

R. The entire hydraulic system, including muffler, shall be tested to withstand a pressure equal to twice the calculated working pressure.

1. Submit certification that test has been performed.

2.13 GUIDE RAILS

A. Guide rails shall be planed steel, standard T-Section, securely fastened to building structure with steel brackets by means of bolts and heavy duty steel rail clips. Rails shall weigh not less than 15 pounds per foot and have suitable size and weight for the application. Rails shall conform with ASME A17.1, and located so that the entire car assembly is in true balance with the guide rails.

B. Support guide rails by brackets at each floor. Where fastenings are over 4.3 meters (14 feet) apart, reinforce rails with 2.3 mm (9 inch) channel backing, or approved equal, to secure the rigidity required for elevator capacity, platform size and method of loading.

C. Locate all joints so as not to interfere with supporting clamps and brackets. Design shims used to secure rail alignment so that they remain in position, even though the fastening bolts may be loosened.

D. Extend guide rails from channels on pit floor to within three-inches of the underside of the concrete slab at the top of the hoist way with a maximum deviation of 1/8 inch from plumb in all directions. Provide a minimum of 3/4-inch clearance between bottom of rails and top of channels.

E. Guide rail anchorages in pit shall be made in a manner that will not reduce the effectiveness of the pit waterproofing.

F. Clean guide rails of any signs of rust or abrasion, and file to remove all rough edges prior to final inspection. File all guide rail joints to assure perfectly matching surfaces.

G. For attachment of guide rails in concrete or brick, where steel framing is not available, install approved inserts or bond blocks.

2.14 CAR GUIDES

A. Install on car frame four adjustable roller guides , each assembled on a substantial metal base, to permit individual self- alignment to the guide rails.

B. Roller Guides

1. Each guide shall be of an approved type consisting of not less than three (3) wheels, each with a durable, resilient oil-resistant material tire rotating on ball bearings having sealed-in lubrication. Assemble rollers on a substantial metal base and mount to provide continuous spring pressure contact of all wheels with the corresponding rail surfaces under all conditions of loading and operation. The wheels shall be of ample

diameter and shall run on three-machine finished dry rail surfaces. Secure the roller guides at top and bottom on each side of car frame and counterweight frame. All mounting bolts shall be fitted with nuts, flat washers, split lock washers and if required, beveled washers.

2. Provide sheet metal guards to protect wheels on top of car.

3. Minimum diameter of car rollers shall not be less than 152 mm (6 inches). The entire elevator car shall be properly balanced to equalize pressure on all guide rollers. Cars shall be balanced in post-wise and front-to-back directions. Test for this balanced condition shall be witnessed at time of final inspection.

2.15 CROSSHEAD DATA PLATE

A. Permanently attach a non-corrosive metal data plate to car crosshead. Data plate shall bear information required by Rule 2.16.3 and 2.20.2.1 of ASME A17.1. Etch or stamp such information on plate.

2.16 CAR BUFFERS

A. Provide a minimum of two spring buffers for each car, in accordance with Rule 3.22 of ASME A17.1. Securely fasten buffers and supports to the pit channels, and in the alignment with striker plates on car. Permanently fasten to each buffer a metal plate showing stroke and loading rating. Buffer anchorage shall not puncture pit waterproofing.

B. Design and install buffers to provide minimum car run by required by Rule 3.4.2 of ASME A17.1.

C. Furnish pipe stanchions and struts, as required, to properly support the buffer.

2.17 NORMAL AND FINAL TERMINAL STOPPING DEVICES

A. Mount normal stopping switch on car or in hoist way to slow speed of car and bring it to an automatic stop level with the terminal landings.

1. Switch shall function with any load up to and including 125 percent of rated elevator capacity at any speed obtained in normal operation.

2. Switch, when opened, shall permit operation of car in reverse direction.

3. No normal stopping device, other than one mounted on car and activated by cams in hoist way, or mounted in hoist way and activated by cams on car, shall be permitted.

B. Mount final terminal stopping switches in the hoist way.

1. Switches shall be positively opened by car, should the car travel beyond the normal stopping switches.

2. Switches shall be independent of other stopping devices.

3. Switches, when opened, shall remove power from hoist motor, apply hoist machine brake, and prevent operation of car in either direction.

C. After final stopping switches have been adjusted, through bolt switches to guide rail.

2.18 TOP-OF-CAR OPERATING DEVICE

A. The device shall conform to ASME A17.1 and the following:

1. Activate the device by a toggle switch mounted in the device. The switch shall have the "ON" and "OFF" positions permanently marked on the faceplate with 1/4-inch letters.
2. Accomplish movement of the elevator by the continuous pressure on a direction button and a safety button.
3. Provide an emergency stop toggle type switch as per ASME.
4. Provide permanent identifications for the operation of all components in the device.
5. Permanently attach the device to the elevator crosshead, on the side of the elevator which is nearest to the hoist way door opening.

2.19 WORKMAN™S LIGHTS AND OUTLETS

A. Provide duplex GFCI protected type receptacles and lamp, with wire guards on top of elevator car and beneath platform.

B. The receptacles shall be in accordance with Fed. Spec. W-C-596/12D for Type D7, 2-pole, 3-wire grounded type rated for 15 amperes and 125 volts.

2.20 CAR LEVELING DEVICE

A. Provide car leveling device for elevator which shall automatically bring car to within 3 mm (1/8 inch) of exact level with floor landing regardless of load in car or direction of travel.

B. When the car is traveling in the up direction, the car shall level up to the floor; and when the car is traveling in the down direction, the car shall level down to the floor. The car shall at all times level into the floor and shall not stop above or below the floor and level back.

C. One-way leveling, augmented with an anti-creep device, shall not be acceptable.

2.21 EMERGENCY STOP SWITCHES

A. Provide each top-of-car device, pit, etc., with emergency stop toggle switches. Mount stop switch on top-of-car in a common fixture with the top-of-car operating device and stop switch in the pit adjacent to pit access door or at top of pit ladder.

B. Each stop switch shall be red in color and shall have its "Identity" and "STOP" and "RUN" positions legibly and indelibly identified.

2.22 OPERATING DEVICE FACEPLATES

A. Fabricate faceplates for all elevator operating and signal devices from not less than 3 mm (1/8-thick flat stainless steel, with all edges beveled at least 15 degrees. Install all faceplates flush with surface upon which they are mounted.

B. Corridor push button faceplates shall be at least 65 mm (2 1/2-inches) wide by 200 mm (8 inches) The centerline of all corridor pushbutton fixtures shall be 1 meter (3 feet 6 inches) above the corridor floor.

C. Fasten all car and corridor operating device and signal device faceplates with non- corrosive white metal spanner head or bristol head tamperproof screws.

D. Design car and corridor pushbutton faceplates so that pressure on pushbuttons are independent of pressure on pushbutton contacts.

E. Engraved legends or raised numerals in faceplates shall have lettering ¼ inch high filled with black paint.

2.23 OPERATING DEVICES AT HOIST WAY LANDINGS

A. Provide a single riser of landing call buttons. Fixtures for intermediate landings shall contain "UP" and "DOWN" buttons. Each button shall contain an integral registration light which shall illuminate upon registration of a call and extinguish when the call is answered If a landing button is operated while the car and hoist way doors are closing at the floor, the doors shall stop and reopen and remain open for a normal passenger transfer time.

2.24 ELEVATOR CAR OPERATING PANELS

A. Locate main car operating panel in car enclosure so that the highest passenger use device shall be no more than 1200 mm (4 feet) above the finished floor. Locate the alarm bell button at the bottom of the panel with the centerline no less than 875 mm (35 inches) above the finished floor.

1. All terminology on main car operating panel and auxiliary panel shall be engraved. Use 6 mm (1/4 inch) or larger letters for all passengers use devices in main and auxiliary car operating panels. Use 3 mm (1/8 inch) letters to identify all other devices in lower section of the main car operating panel.

a. Phase II Firefighters™ operating instructions

b. Unique car number

c. "No Smoking"

d. Car capacity in pounds

B. Main car operating panel with manufacturer's standard front return panel.

1. The control panel shall contain:

a. A complete set of raised or flush illuminated pushbuttons with a minimum diameter of 25.4 mm (1 inch). Buttons shall have the floor designation indelibly marked on their face using 13 mm (1/2 inch) characters. The button illumination shall extinguish when the car reverses its travel. As the car stops for a floor, that corresponding button shall be extinguished.

b. Emergency stop key switch (red in color) with markings to show "RUN" and "STOP". Emergency stop switch shall be key operated.

1) Connect emergency signal alarm bell button to a 150 mm (6 inch) vibrating bell located on top of car. Furnish and install bell including the necessary wiring and auxiliary devices.

c. Emergency signal alarm bell button (red in color). Illuminate button when actuated.

d. Two position key operated independent service transfer switch marked "INDEPENDENT SERVICE" with two positions marked "ON" and "OFF".

e. A three position key operated Fire Service switch marked "FIRE OPERATION" with three positions marked "OFF, HOLD and ON".

f. A red translucent light jewel with a visual graphic per ASME A17.1 which shall illuminate when required on Fire Service operation. It shall be marked "FIRE SERVICE".

g. An audible signal system for Fire Service operation.

h. A button marked "CALL CANCEL" for Fire Service operation.

i. Door "OPEN" and door "CLOSE" buttons located below the car buttons. Locate the door "OPEN" button adjacent to the car door entrance column. For rear openings provide rear door "OPEN" and "CLOSE" buttons for full selective door operation.

j. Emergency "Push to Call" button for two way communication with auto dial system. "Push to Call" button or adjacent light jewel shall illuminate and flash when call is acknowledged. Button shall match floor pushbutton design. Provide "Push to Call" button, tactile symbol and Braille adjacent to button mounted integral with car front return panel Engrave "Push To Talk" in 6 mm(1/4 inch) letters over button.

2.25 AUXILIARY CAR OPERATING PANEL

A. Provide an auxiliary car operating panel in the front return panel opposite the main car operating panel . The auxiliary car operating panel shall contain only those controls essential to passenger operation.

1. Mount red emergency signal alarm bell button, door "OPEN" and door "CLOSE" buttons in an easily identifiable group with stop switch and the alarm bell button mounted at a point no closer than 875 mm (35 inches) to the finished floor and nearest the door jamb.

2. Complete set of illuminated pushbuttons with a minimum diameter of 25.4 mm (1 inch). Buttons shall have the floor designation indelibly marked on their face using 13 mm (1/2 inch) characters, corresponding to the numbers of the main car operating buttons. Provide the buttons in a compact vertical grouping for center opening doors and a horizontal group for two-speed doors.

3. Cross-Connect all buttons in the auxiliary car operating panels to their respective buttons in the main car operating panel. Registration of a car call in either panel shall cause the corresponding button to illuminate in both the main and auxiliary car operating panels.

4. The auxiliary car operating panel faceplate shall match the main car operating panel faceplate in material and general design. Secure the faceplate with non- corrosive white metal spanner head or bristol head tamperproof screws.

5. Submit design of auxiliary car operating panel for approval.

6. Install auto dial phone in auxiliary car operating panel.

7. Emergency push to talk button for two way communication with auto dial system.

2.26 SINGLE CAR SELECTIVE COLLECTIVE AUTOMATIC OPERATION

A. Provide selective collective automatic operation for passenger elevator.

B. Design system so that upon registration of one or more landing calls, car shall start automatically, provided hoist way door interlock circuits and car door circuits are established, and shall stop at the first floor reached for which a car or landing call has been registered which corresponds to the direction in which the car is traveling. Car shall stop at floors for which car and/or landing calls have been registered, in natural order in which floors are reached by car, without regard to sequence in which the calls have been registered, provided a call for a given floor has been registered sufficiently in advance of arrival at that floor to permit stop to be made. Arrange operation so that if no car calls have been registered and the car starts up in response to several "DOWN" landing calls, car shall travel to highest "DOWN" call first and then reverse to collect other "DOWN" calls. Collect "UP" landing calls in the same manner, when the car starts down in response to "UP" calls by first stopping for lowest "UP" landing call. If while car is traveling in the up direction, "DOWN" landing calls are registered, the car shall make no response to the "DOWN" landing calls. However, "DOWN" calls shall remain registered and after highest "UP" call has been satisfied, car shall automatically proceed to the highest "DOWN" call and shall then collect "DOWN" calls as, hereinbefore, specified. Likewise, when the car is traveling down, no response shall be made to "UP" landing calls, but such "UP" calls shall remain registered and shall be answered by the car on its next up trip. Provide an adjustable time limit relay to hold car at landing for predetermined time after the car stops.

C. When all calls in the system have been satisfied, the elevator shall shut down at the last landing served with the car and hoist way doors closed. Registration of a call at the landing where the car is parked shall automatically open the car and hoist way doors.

2.27 INDEPENDENT SERVICE

A. Provide a two position key operated "INDEPENDENT SERVICE SWITCH" in the main car operating panel which shall have its positions marked "OFF" and "ON". When the switch is in the "ON" position, the car shall respond only to calls registered on landing push buttons. Car and hoist way door shall not close until a car button or the "DOOR CLOSE" button is pressed and held until the interlock circuits are established. Resume normal service when the switch is returned to the "OFF" position.

2.28 FIRE SERVICE

A. Provide Fire Service as per ASME A17.1.

B. Smoke Detectors:

1. Smoke detection devices in each elevator lobby, top of hoist way, and machine room, provided by General Contractor. Furnish and install the smoke detection devices, together with all necessary conduit, wiring, relay, etc., required between the Fire Alarm System and the junction box of the elevator lobby control panel, under "FIRE ALARM SYSTEMS". All necessary connections from the elevator lobby control panel to the elevator control system in the machine room shall be furnished and installed under this section of the specification.

2. Upon activation of an elevator lobby, top of hoist way, and machine room smoke detection device, transmit a signal to the building fire alarm control console. Transmit an "Alarm" signal from the console to the elevators, which shall activate the "Fire Service" Phase I operation. The "Alarm" signal received from any elevator lobby, top of hoist way, or machine room smoke detection device, except that device located in the main lobby shall activate the same sequence of operation activated by the "Fire Service" key operated switch in the main lobby control panel. Together the "Alarm" signal received from the smoke detection device, located in the main landing lobby, shall activate the same sequence of operation activated by sending the elevator to the designated alternate floor.

3. When an "Alarm" signal initiates Phase I operation, momentary movement of the "Fire Service" key in the lobby control panel to the "ON" position shall be required to return elevators to automatic operation if "Alarm" signal is cleared.

2.29 CAR POSITION INDICATOR

A. Provide an alpha-numeric LED digital position indicator in each main car operating panel, consisting of numerals and arrows not less than 50 mm (2 inch) high, to indicate position of car and direction of car travel. Indicator faceplate shall be stainless steel. Provide L.E.D. or L.C.D. illumination. Locate position indicator in the main car operating panel. When no direction has been established, neither arrow shall be illuminated.

B. Provide an audible signal to momentarily sound as the car is stopping at, or passing a floor. It shall be no less than 20dB with a frequency no higher than 1500 Hz. Provide space, adapters and wiring for future floors.

2.30 CORRIDOR LANTERNS

A. Provide each car entrance with a digital corridor lantern mounted over the hoist way entrances at all floors except main and alternate fire response floors. Provide each terminal landing with a single "UP" or "DOWN" 50mm (2 inch) arrow lantern and each intermediate landing with "UP" and "DOWN" lanterns. Each lens shall be illuminated with L.E.D. illumination of proper intensity, so shielded to illuminate individual lens only. Connect lanterns to signal, in advance of approach and direction of stopping car whether or not corridor button has been operated at the floor. Hall calls shall receive immediate assignment to individual cars and hall lantern shall sound and illuminate. Corridor lanterns shall not be illuminated when a car passes a floor without stopping. Each lantern shall be equipped with a clearly audible electronic tone which shall sound once for "UPWARD" bound car and twice for "DOWNWARD" bound car. Audible signal shall not sound when a car passes the floor without stopping. Provide adjustable sound level on audible signal.

2.31 AUDIO VOICE SYSTEM

A. Provide voice audio activated by stopping at a floor. Audio voice to give floor designations. The voice announcer shall be a digitized floor announcer that will announce the floor numbers and direction of travel and special announcements. The voice announcer will be a natural human voice that receives messages and shall comply with ADA requirements for audible car

position indicators. The voice announcer shall have two separate volume controls. One for the floor announcement and another for the floor direction. The voice announcer shall be 250 mm W x 250 mm H x 150 mm D (10 inch W x 10 inch L x 6 inch D) voice box 450 mm (18 inch) full range loud speaker to be located on top of the cab. The voice box shall be concealed above the elevator dome. The speaker shall be mounted center of the elevator dome or as directed by the Engineering Officer. The voice announcer unit shall contain 21 ports which can accommodate 21 standard floors and direction messages. Install voice announcer per manufacturer’s recommendations and instructions. The voice announcer shall be the product of one manufacturer of established reputation. Provide manufacturer literature and list of voice messages. Provide special messages for Fire Service, Medical Emergency, "Do not block doors" or others as directed by Resident Engineer.

2.32 HOIST WAY ACCESS SWITCHES

A. Provide hoist way access switch for elevator at top terminal landing to permit access to top of car, and at bottom terminal landing to permit access to pit.When center opening doors are specified, mount the access key switch six feet above the corridor alongside the jamb. The exposed portion of each access switch or its faceplate shall have legible, indelible legends to indicate identity and "UP", "DOWN", and "OFF" positions. Design and location of access switches shall be submitted for approval. Each access switch shall be a constant pressure cylinder type lock having not less than five pins or five stainless steel disc combination with key removable only when switch is in "OFF" position. Barrel keys not acceptable. Lock shall not be operable by any other key which will operate any other lock or device used for any other purpose in the hospital. Arrange the hoist way switch to initiate and maintain movement of the car. When the car is moved down from the top terminal landing, limit the zone of travel to a distance not greater than the height of the car crosshead.

B. Provide emergency keyway for all hoist way entrances.

2.33 **HOIST WAY ENTRANCES FOR PASSENGERS** ELEVATOR

A. Provide entrances of metal construction using cold rolled steel, except door frames which shall be of stainless steel. Complete entrances with sills, hanger supports, hangers, tracks, angle struts, unit frames, door panels, fascia plates, toe guards, hardware, bumpers, sight guards, and wall anchors.

B. Provide one piece extruded aluminum sills with non-slip wearing surface, grooved for door guides and recessed for fascia plates. Sills shall have an overall height of not less than 19 mm (3/4 inch), thickness of not less than 3 mm (1/8 inch), and set true, straight and level, with hoist way edges plumb over each other, and top surfaces flush with finished floor. Grout sills full length after installation.

C. Construct hanger supports of not less than 4.5 mm (3/16 inch) thick steel plate, and bolted to strut angles.

D. Structural steel angles 75 mm by 75 mm by 9 mm (3-inches by 3-inches by 3/8-inch) 127 mm by 127 mm by 12 mm (5" by 5" by 1/2") shall extend from top of sill to bottom of floor beam above, and shall be securely fastened at maximum 457 mm (18 inch) O.C. and at each end with two bolts.

E. Provide jambs and head soffits, of not less than 14 gauge stainless steel, for entrances. Jambs and head soffits shall be combination buck and jamb welded construction, and provided with three tile anchors each side. Side jambs shall be curved type. Radius of curvature shall be about 90 mm (3 1/2-inches). Head jamb shall be square type, and shall overhang corridor face of side jambs by 6 mm (1/4 inch). Rigidly fasten jambs and head soffits to building structure. Provide jambs and head soffits with oiled paper covering suitably taped at factory, or other suitable type of protective covering. After installation, protect jambs and head soffits with wood framing to prevent damage to finish. Solidly grout jambs.

F. If drywall is used for hoist way construction, submit method of anchoring jambs to front hoist way walls for approval.

G. Provide hoist way entrance with flush hoist way doors Elevators No. P_____S_____. Door panels shall be not less than 16 gauge sheet steel, flush type construction, and not less than 35 mm (1 1/2-inches) thick. Top and bottom of door panels shall have continuous stiffener channels welded in place. Reinforcement of the door panels shall be approximately 0.04-inch in thickness and of the hat section type. At bottom of each panel, provide two accurately fitted removable laminated phenolic or other approved material, guides with fire stops. Reinforce each door panel for hangers, interlock mechanism, power door operator and closer. One door panel of each entrance shall bear a BOCA label, Underwriters' label, or, in lieu of this, other labels may be furnished provided they are based on fire test reports and factory inspection procedures acceptable to Contracting Officer. Fasten sight guard of 14 gauge metal, extending full height of panel, to leading edge of each panel of center opening doors . Door finish shall be stainless steel.

H. Provide rubber bumpers at top and bottom of strike jambs and/or struts for stopping door panels at limits of travel in opening and closing directions. [**Provide continuous rubber astragal bumper strip of tongue and groove construction on center opening doors**].

I. Provide 14 gauge sheet steel fascia plates in hoist way to extend vertically from head of hanger support housing to sill above. Plates shall be the same width as the door opening of elevator and adequately reinforced to prevent waves and buckles. Below bottom terminal landing and over upper terminal landing provide suitable toe guard and dust cover beveled back to wall and adequately fastened. Provide cover plate the width of the door opening on hanger pockets.

J. Provide hangers for hoist way door panels and have means to transmit motion from one door panel to the other. Fasten the hangers to the door sections. Provide with reinforcements at the point of attachment. The hanger shall have provisions for vertical and lateral adjustment. The hanger shall be of the two-point suspension type, consisting of nylon or other non-metallic tired sheaves fitted with dustproof, grease packed ball or roller bearings mounted on a malleable iron or steel bracket. The hanger sheaves shall operate at a relatively low rotational speed, and shall roll on a high-carbon, cold-rolled or drawn steel track shaped so as to permit free movement of sheaves without regard to vertical adjustment of sheave, bracket or housing. Beneath the track and each hanger sheave, provide a hardened steel up-thrust roller capable of withstanding a vertical thrust equal to the carrying capacity of adjacent upper sheave. The up-thrust shall have fine

vertical adjustments, and the face of the roller shaped so as to permit free movement of the hanger sheave. The up-thrust roller shall have ball or roller bearings. Provide the hanger sheaves with steel fire stops to prevent disengagement from tracks. Fit each hanger sheave with a felt, or similar material, wiper to provide a light lubricating film between the sheave and hanger track.

K. Do not use hangers that are constructed integrally with the door panels.

L. Provide raised numerals for all openings, with a centerline of 50 mm (2 inches) high, located on each side of entrance frame, at a height of 1500 mm (5-feet) above the landing sill. The numerals shall also contain Braille.

M. Provide unique car number on every elevator entrance at designated level, minimum 75 mm (3 inches) in height.

2.34 ELECTRIC POWER DOOR OPERATORS, PASSENGER AND SERVICE ELEVATORS

A. Provide a high-speed, heavy duty, direct-current or alternating-current, master-type, door operator to automatically open the car and hoist way doors simultaneously when the car is leveling, and automatically close the doors simultaneously at the expiration of the door-open timing. Motor shall be of the high-internal resistance type, capable of withstanding high currents resulting from stall without damage to the motor. The door operator shall be capable of opening a car door and hoist way door simultaneously, at a maximum speed of not less than two feet per second. The closing speed of the doors shall be one foot per second. A reversal of direction of the doors from the closing to opening operation initiated by the infrared curtain unit reopening device, or the door "OPEN" button, shall be accomplished within no more than 38 mm (1 1/2-inches) maximum of door movement. Particular emphasis is to be placed on obtaining quiet interlock and door operation, and smooth, fast, dynamic braking for door reversals and stopping of the doors reversals, and stopping of the door extremes of travel. Construct all levers, operating the doors, of heavy steel members, and all pivot points shall have ball or roller bearings. Use electric power to open and close the doors. Auxiliary automatic door closers required under Rule 2.11.3 of ASME A17.1 shall be spring loaded sill mounted type.

B. Design the door operator so that in case of interruption or failure of the electric power from any cause, it shall permit emergency manual operation of both the car door and the hoist way door from within the car, at door zone only, outside of door zone, doors are restricted to 100 mm (4 inch) opening.

1. It shall not be possible for the doors to open by power unless the elevator is within the leveling zone.

2. Provide infrared curtain unit. The device shall cause the car and hoist way doors to reverse automatically to the fully-open position should the unit be actuated while the doors are closing. Unit shall function at all times when the doors are not closed, irrespective of all other operating features. The leading edge of the unit shall have an approved black finish.

C. Should the doors be prevented from closing for more than predetermined adjustable interval of 20 to 45 seconds by the interruption or failure of the infrared curtain unit door control shall be rendered inoperative and the doors shall close at reduced speed while a nudging buzzer located on

the car shall sound.

1. If an obstruction in the sill should not activate the infrared curtain unit door control device and prevent the doors from closing for more than a predetermined adjustable interval of 45 to 90 seconds, the doors shall reverse to the fully open position and reestablish the closing cycle.

D. Provide door "OPEN" and "CLOSE" buttons. When the door "OPEN" button is pressed and held, the doors, if in the open position, shall remain open and, if the doors are closing, they shall stop, reverse and reopen. Momentary pressure of the door "CLOSE" button shall initiate the closing of the doors prior to the expiration of the normal door open time.

2.35 ELECTRIC INTERLOCKS

A. Equip each hoist way door with true interlock, functioning as hoist way unit system, to prevent operation of car until all hoist way doors are locked in closed position as defined by ASME A17.1. Interlock shall prevent opening of hoist way door from corridor side, unless car is at rest at landing, is operating in leveling zone at landing, or hoist way access switch is used.

B. Hoist way door interlock shall not be accepted, unless it has successfully met requirements of Rule 2.12.6 of ASME A17.1. Securely fasten approved devices to the car, and arrange to operate the interlocks without objectionable noise, shock or jar.

C. Equip car doors with electric contact which prevents operation of car until doors are closed as defined in ASME A17.1 unless car is operating in leveling zone or hoist way access switch is used. Locate door contact to prevent its being tampered with from inside of car. Car door contact shall not be accepted, unless it has successfully met requirements of Rule 2.13 of ASME A17.1.

D. Wiring installed from the hoist way riser to each door interlock shall be NEC type (SF- 2), or equivalent.

1. Type SF-2 cable terminations in the interlock housing shall be sleeved with glass braid fillers, or asbestos braid jackets.

E. Provide devices, either mechanical or electrical, which shall prevent operation of the elevator in event an accident to or defective door operator equipment has permitted an independent car or hoist way door panel to remain in the "unclosed" or "unlocked" position.

2.36 CAR FRAME

A. Car frame shall conform with requirements of ASME A17.1, and constructed of steel plates and structural shapes securely riveted, bolted, or welded together. No iron casting will be permitted. The entire assembly shall be rugged construction, and amply braced to withstand unequal loading of platform. Car frame members shall be such as to relieve the car enclosure of all strains. Balance car front to back and side to side. Provide balancing weights and frames, properly located, to achieve the required true balance.

2.37 **CAR PLATFORM FOR PASSENGER** ELEVATOR

A. Construct the car platform so as to comply with all the requirements of ASME A17.1. Provide car entrances with extruded aluminum sill or better with machined or extruded guide grooves. Cover underside and all exposed edges

of wood filled platform with black sheet iron of not less than 27 gauge, with all exposed joints and edges folded under. Fire resistant paint is not acceptable. Platform shall have flexible vinyl composition tile flooring not less than 3 mm (1/8 inch) thick. For color, see Section 09 06 00, SCHEDULE FOR FINISHES. Adhesive material shall be type recommended by manufacturer of tile. Lay tile flush with threshold plate and coved base. Equip platform with 533 mm (21 inch deep sheet-steel toe-guard apron of not less than 12 gauge at hoist way entrance side. Extend at least three-inches beyond each side of entrance jamb. Securely brace toe-guard apron to car construction, and bevel bottom edge at not less than 60 degree angle nor more than 75 degree angle from horizontal. Install platform in the hoist way, so that the clearance between front edge and landing threshold shall not exceed 32 mm (1 1/4-inches).

B. Provide sound and vibration isolator of neoprene or other resilient material in compression, which will resist oil and aging, in conjunction with platform steel platen. Provide buffer strike plates securely fastened to car frame plank or bolster.

2.38 **CAR ENCLOSURE FOR PASSENGER** ELEVATOR

A. Car enclosure for passenger and service elevators shall have a minimum dome height inside the cab of 2440 mm (8 feet).

B. Securely fasten car enclosure to platform by through bolts located at intervals of not more than 457 mm (18 inches), running through an angle at the base of panels to underside of platform. Provide 6 mm (1/4 inch) bolts with nuts and lock washers.

C. Front return wall panel, entrance columns, rear corner columns, entrance head, jamb and transom shall be 14 gauge stainless steel. Side and rear wall panels 1220 mm (48 inches) from finished floor to top of panel shall be 14 gauge stainless steel. Side and rear panels from 1220 mm (48 inches) above finished floor up to and including the canopy shall be 14 gauge cold rolled steel covered with high pressure plastic laminate. Apply the plastic laminate to a minimum thickness of 15 mm (5/8 inch) particle board that meets ASME and Federal requirements. Submit a method of fastening particle board to steel. This particle board shall be one piece on back and sides. It shall be flush with the face of the bottom section of the stainless steel. Plastic laminate shall comply with Federal Spec. L-P-508, Style Type 1, Class 1. Color is specified in Section 09 06 00, SCHEDULE FOR FINISHES. Interior shall be flush panel construction with angles welded on exterior to insure adequate rigidity. Coat exterior of panels with mastic sound insulation material approximately 2.5 mm (3/32-inch) thick followed by a prime coat. Mastic material shall conform to ASTM E1042. Stainless steel wainscot and wall panels above shall be radius "vee" joint with ends of panels turned to exterior and bolted together.

1. Face side and rear wall panels above the stainless steel wainscot with high pressure plastic laminate. Smooth and flush all joints with no ragged or broken edges. Plastic laminate shall comply with NEMA LD3, textured finish, general purpose type, grade designation GP 50, 0.050-inch thickness, except with a minimum wear resistance of 1200 cycles, and backer sheet, grade designation BK 20, .51 mm (0.020-inch) thickness. For color and finish of plastic laminate see Section 09 06 00, SCHEDULE FOR FINISHES.

D. Provide a hinged top emergency exit to conform to ASME A17.1. Exit shall be unobstructed when open, and shall have a mechanical and electrical stop. Provide contacts to prevent operation of the elevator when the emergency exit is open.

E. Locate car position indicator in main car operating panel.

F. Provide duplex, GFCI protected type receptacle in car. Locate flush-mounted receptacle on the centerline of the main car operating panel, 6-inches above the car floor. The receptacle shall be in accordance with Fed. Spec. W-C-596, 2-pole, 3-wire grounded type rated for 15 amperes and 125 volts. Receptacle face plate stainless steel, and if removable, fasten with white metal tamperproof spanner head or bristol head screws. Receptacle shall permit current to flow only while a standard plug is in the proper position in the receptacle.

G. Construct canopy of not less than 12 gauge steel.

H. Provide car lighting with indirect fluorescent, lamps mounted above lighting coves along each side of cab, front to back. Ballasts for fluorescent fixtures shall be rapid starting type, UL Class P with a power factor not less than 90 percent. Sound ratings shall be "A", except for ballast sizes which are not available with "A" ratings as standard products of any manufacturer. Such ballast shall have the quietest ratings available. Equip the fluorescent fixtures with a symmetrical reflector having specular ALZAK (or equal) finish. Maintain light level at a minimum 20 foot candles. Enclose the entire vertical space between the light trough outer edge and the cab canopy with approved clear plastic sheeting. Install the plastic sheets so that they are removable for cleaning and relamping.

I. Provide a blower unit arranged to exhaust through an opening in the canopy. Provide a stainless or chrome plated fan grill around the opening. Provide 2-speed type unit, capable of rated free delivery air displacement of approximately 380 and 700 cfm at respective speed. Mount unit on top of car with rubber isolation to prevent transmission of vibration to car structure. Provide screening over exhaust end of blower. Provide a 3- position switch to control the unit in main car operating panel.

J. Car enclosure base shall be of 14-gauge stainless steel, 150 mm (6 inches) high. Provide straight type base at front return sides, and rear of car. Vertical face of base at sides and rear shall be flush with, or recessed behind, the wainscot directly above the base. Base shall be not less than 14 gauge. There shall be no exposed fastenings in base. Provide a series of baffled openings around the base of the enclosure which shall provide a minimum area of 450 square mm (18 square inches) and a maximum area of 610 square mm (24 square inches).

K. Provide car enclosure with cylindrical handrails of solid stainless steel, not less than 38 mm (1 1/2" inches) diameter. Locate handrails approximately 38 mm (1 1/2-inches) from cab wall. Install handrails on two sides and rear. Curve ends of handrails to wainscoting. Conceal all handrail fastenings, and handrails shall be removable from inside the car enclosure. The centerlines of the handrails shall be 34 inches above the car floor.

L. Provide car entrance with single speed center opening horizontal sliding car doors, of same type as hoist way doors . Construct door panels to be flush hollow metal construction, not less than 25 mm (1 inch) thick, consisting of not less than one piece continuous 16 gauge stainless steel

on car side face and leading and trailing edges. Separate the two plates by a sound-deadening material, and reinforce by steel shapes welded to the plates at frequent intervals. Reinforce panels as required for installation of hangers, power-operating and door-opening devices. Hang doors on two-point suspension hangers having ball-bearing sheaves not less than 75 mm (3 inches) in diameter, with rubber or non-metallic sound-reducing tires. Equip hangers with adjustable ball-bearing rollers to take upward thrust of panels. Upthrust roller shall be capable of being locked in position after adjustment to a maximum of 0.015-inch clearance. Provide two non- metallic gibs on each door panel. Gibs shall be replaceable without removal of door panel.

M. Provide a permanently attached stainless steel capacity plate on elevator. Capacity plate shall be conspicuously located on the front return panel containing the main car- operating panel. Plate shall show the rated load of the elevator in pounds, with engraved or cast letters not less than 6 mm (1/4 inch) high. Fill engraved letters with black paint. The capacity may be engraved in the main car-operating panel faceplate, in lieu of a separate capacity plate.

N. Provide an emergency car lighting system on each car, consisting of a rechargeable battery, charger, controls, and light fixture. The system shall automatically provide emergency light in the car upon failure or abnormal interruption of the normal car lighting service, and function irrespective of the position of the light control switch in the car. The system shall be capable of maintaining a minimum illumination of 1.0 foot- candle when measured four feet above the car floor, and approximately one foot in front of the car operating panel, for a period of not less than four hours. The emergency light shall be located in the main car operating panel.

O. A constant pressure switch that automatically returns to the "OFF" position when released, and a pilot light, for the periodic testing of battery and lamps, shall be provided.

2.39 AUTO DIAL PHONE SYSTEM

A. Furnish and install a complete intercommunication system, as part of this work.

B. The auto dial system shall be located in the auxiliary car operating panel. The speaker and unit shall be mounted on the backside of the perforated stainless steel plate cover.

C. An auto dial system shall be provided for each elevator. The auto dial, when activated by the "PUSH TO TALK" button, shall automatically dial to the 24 hour area.

D. Each elevator shall have an individual phone number.

2.40 SEISMIC REQUIREMENTS

A. Support and maintain pump unit, controller, selector, rails, rail brackets, conduit, buffers, piping, scavenger pumps and jack unit assembly in place as to effectively prevent any part from sliding, rotating or overturning or jumping under conditions imposed by seismic forces not less than that required to produce an acceleration of gravity horizontally and ½ gravity vertically acting simultaneously. Design the total system to continue operation without interruption under specified seismic acceleration, as

outlined in H-18-8.

B. Support all vertical conduit systems within the hoist way at points above the center of gravity of riser. Provide lateral guides at regular intervals.

C. Provide hydraulic equipment mounted on vibration isolators with seismic restraints.

D. Bolt controller and selector panels to the floor and provide with sway braces at top. Secure all electrical components within the panels to the panel frame. Fit doors and hinged panels with positive locking latches.

E. Car guide rail brackets and rail clip bolts shall be guarded against snagging below the hoist way junction box on the side of the rail adjacent to the point of suspension of the traveling cables.

F. Provide car guide rails with at least one intermediate bracket between brackets located at each floor so that bracket spacing does not exceed 2400 mm (8 feet). If intermediate brackets cannot be installed because of lack of structural support, reinforce rails with 225 mm (9 inch) channel or approved equal backing.

G. Size guide rails no less than 15 pounds per foot.

H. Submittals are required for all equipment anchors, supports, restraints and detectors. Submittals shall include weights, dimensions, center of gravity, standard connections, calculations, manufacturer's recommendations, behavior problems (vibration, thermal, expansion, etc.,) so that design can be properly reviewed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine work of other trades on which the work of this Section depends. Report defects to Resident Engineer in writing which may affect the work of this trade or equipment operation, dimensions from site for preparation of shop drawings.

B. Ensure that shafts and openings for moving equipment are plumb, level and in line, and that pit is to proper depth, waterproofed and drained with necessary access doors, ladder, guard.

C. Ensure that machine room is properly illuminated, heated and ventilated, and equipment, foundations, beams correctly located complete with floor and access door.

D. Before fabrication, take necessary job site measurements, and verify where work is governed by other trades. Check measurement of space for equipment, and means of access for installation and operation. Obtain dimensions from site for preparation of shop drawings.

E. Ensure the following preparatory work, provided under other Sections, has been properly completed to receive the elevator work:

1. Supply of electric feeder wires to the terminals of the elevator control panel, including shunt trip circuit breaker. Provision of hoist way outlets for car light and for light in the pit and outlets in machine room for light. Furnishing of electric power for testing and adjusting elevator equipment.

2. Furnish circuit breaker panel in machine room for car and hoist way lights and receptacles.
3. Supply of power for emergency cab lighting and ventilation from a power panel specified in Division 26, ELECTRICAL and fed by building emergency circuits.
4. Machine room enclosed and protected from moisture, with self closing, self locking door.
5. Provide fire extinguisher in machine room.

F. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.

3.2 INSTALLATION

A. Perform work with competent mechanics skilled in this work and under the direct control and supervision of the elevator manufacturer's experienced Foreman.

B. Set hoist way entrances in alignment with car openings, and true with plumb sill lines.

C. Install machinery, guides, controls, car and all equipment and accessories in accordance with manufacturer's instructions, applicable codes, and standards, to provide a quiet, smooth operating installation, free from side sway, oscillation or vibration.

D. Isolate and dampen machine vibration with properly sized sound-reducing anti-vibration pads.

E. Erect hoist way sills, headers and frames prior to erection of rough walls and doors. Erect fascias and toe guards after rough walls are finished.

F. Grout sills and hoist way entrance frames.

3.3 CLEANING

A. Prior to final acceptance, remove protection from finished or ornamental surfaces, and clean and polish surfaces with due regard to type of material.

3.4 SPACE CONDITIONS

A. Attention is called to overhead clearance, pit clearances, overall space in machine room, and construction conditions at building site in connection with elevator work. Addition or revision of space requirements, or construction changes that may be required for the complete installation of the elevators, must be arranged for and obtained by the Contractor, subject to approval of Contracting Officer. Include cost of such changes in bid, and form a part of the contract. Provide proper, satisfactory code legal installation of equipment as a whole, including all construction, accessories and devices in connection with elevator, mechanical and electrical work specified herein.

B. Where concrete beams, floor slabs or other building construction protrude more than 50 mm (2 inches) into hoist way, bevel all top surfaces of said projections 20 gauge steel to an angle of at least seventy-five degrees with the horizontal.

3.5 ARRANGEMENT OF EQUIPMENT

A. Clearance around elevator, mechanical and electrical equipment shall comply with applicable provisions of NEC.

B. Arrange equipment in machine room so that major equipment components can be removed for repair or replacement, without dismantling or removing other equipment in same machine room.

C. Where applicable, locate controller near and visible to its respective pump unit.

3.6 WORKMANSHIP AND PROTECTION

A. All installations shall be made in a first class, neat and skillful manner by mechanics experienced in the trade involved. Mechanically and electrically correct all details of the installation. All materials and equipment shall be new, and without imperfections.

B. Include recesses, cutouts, slots, holes, patching, grouting, refinishing and the like, to accommodate installation of equipment in the elevator contractor's work. Core drill all new holes in concrete.

C. No structural members shall be cut or altered. Restore work in place, which has been damaged or defaced, equal to original condition.

D. Finish work shall be straight, level and plumb, with true, sharp surfaces and lines. Protect all machinery and equipment against dirt, water or mechanical injury. Thoroughly clean all work at final completion, and deliver in perfect unblemished condition.

E. Grease gun fittings shall be pressure relief type.

F. Completely enclose selector cables or tapes, which are exposed to accidental contact in the machine room with 16 gauge sheet metal or expanded metal guards.

G. Guard exposed gears, sprockets, selector drums, etc. from accidental contact, in accordance with Rule 2.10.1 of ASME A17.1.

3.7 PAINTING AND FINISHING

A. Elevator equipment shall be factory painted with manufacturer's standard finish and color.

1. Elevator pump unit, controllers, and crossheads of cars shall be identified by 100 mm (4 high numerals and letters located as directed. Color of numbers shall contrast with color surfaces to which they are applied.

2. Surface (except contact surfaces of working parts) of elevator items, such as, controllers, car frame, underside of platforms, guide rails, rail brackets, all uncoated ferrous metal items and hydraulic piping shall be given approved prime coat.

3. Upon completion of installation and prior to final inspection, all equipment shall be thoroughly cleaned of grease oil, cement, plaster, and other debris. All equipment, except that which is otherwise specified to have factory finish, shall then be given two coats of paint of approved color.

4. Paint floor designation numbers not less than 100 mm (4 inches) high,

on hoist way doors, fascias or walls as required by Rule 100.7 of ASME A17.1. The color of the paint used shall contrast with the color of the surfaces to which it is applied.

B. Hoist way entrances of passenger elevators:

1. Door panels shall be parkerized or given equivalent rust resistant treatment and a factory finish of one coat of baked on primer and one factory finish coat of baked on enamel, unless stainless steel.

2. Fascia plates, toe guards, dust covers, hanger covers and other metal work, including built-in or hidden work and structural metal, (except stainless steel entrance frames and surfaces to receive baked enamel finish) shall be given approved prime coat in the shop, and one field coat of paint of approved color.

C. Elevator cabs for passenger elevators:

1. Interior and exterior steel surfaces shall be parkerized or given equivalent rust resistant treatment before finish is applied.

2. Factory finish interior steel surfaces with one coat of baked on enamel or proxylin lacquer. For color, see Section 09 06 00, SCHEDULES FOR FINISHES.

3. Give exterior faces of car doors one finish coat of oil base paint of medium gray color.

3.8 PRE-TESTS AND TEST

A. Pre-test as per specifications, the elevators and related equipment, in the presence of the Resident Engineer. Test for proper operation before requesting final inspection. Conduct final inspection at other than normal working hours, if required by the Resident Engineer’s Representative. Test elevators as specified in the presence of, and under the direction of, the Resident Engineer’s Representative. Procedure outlined in the "Inspectors’ Manual for Hydraulic Elevators ASME shall apply.

B. Upon completion of elevator installation, conduct operating and car testing for approval of Contracting Officer. Furnish test instruments and materials, including properly marked test weights, voltmeters, amp probe, sound level meter, centigrade thermometers, light meter, stop watch, MEGGER, pressure gauges, direct reading tachometer for making tests and a means of two-way communication. Conduct tests in the presence of, and witnessed by, a QEI certified elevator inspector.

C. Speed Load Runs: Speed test with no load, 50 percent load, and contract load shall be made in both directions, before the full load run test and after the full load test.

D. Full Load Run Test: Subject the elevator to a test for a period of one hour continuous run, with specified full load in the car. During test run, stop the car at all floors in both directions of travel, for a standing period of not less than eight nor more than twelve seconds per floor. Elevator starting, stopping, acceleration and deceleration shall remain consistent during the test.

E. Temperature Rise Test: Test motors during Full Load Run Test to demonstrate that the temperature rise under operating conditions in the building will not exceed 40 degrees C, above ambient, when measured with a thermometer

or other approved means. Do not make full load run tests until constant temperatures are reached on all such pieces of equipment.

F. For installations where microprocessor controls are used:

1. A diagnostic testing device, maintenance terminal or approved means of diagnostic and maintenance suitable for all trouble shooting procedures related to the specific type microprocessor controls installed on this project, shall be provided. This diagnostic testing device or maintenance terminal shall conform to the following:

   a. The diagnostic testing device or maintenance terminal shall become the property of the Veteran’s Administration.

   b. The diagnostic testing device or maintenance terminal shall be demonstrated and tested during the final testing of the elevator installation.

   c. A series of not less than ten simulated malfunctions shall be diagnosed properly by the device.

   d. A period of at least four hours shall be dedicated to the instruction of its use to a representative of the Department of Veterans Affairs designated by the Resident Engineer.

   e. The diagnostic testing device shall be programmed specifically for this job and this job only.

   f. The device shall not require recalibration or reconfiguration and shall be functional for the life of the equipment specified herein.

G. Car Leveling Test: Test elevator car leveling device for accuracy of leveling at all floors with no load, 50 percent load, and full load in car, in both directions of travel before and after temperature test. Accuracy of floor leveling, as specified, shall be within plus or minus 3 mm (1/8 inch) of level with any landing floor for which the stop has been initiated (with a definite range of distance in advance of the landing), regardless of load in car or direction of travel. The car leveling device shall automatically correct over travel as well as under travel, and shall maintain the car floor within plus or minus 3 mm (1/8 inch) of level with the landing floor regardless of change in load.

H. Setting of the Car-Door Contacts: Measure the position of the car door at which the car may be started. The distance from full closure shall not exceed that required by ASME A17.1. This test shall be made with the hoist way doors closed, or the hoist way door contact inoperative.

I. Setting of Interlocks: Measure the position of the hoist way door at which the car may be started. And shall not exceed ASME A17.1 requirements.

J. Overload Devices: Test all overload current protection devices in the system at final inspection.

K. Operating and Signal Systems: Operate the car by the operating devices provided. The operation, signals, and automatic floor leveling shall function in accordance with the requirements specified. Starting, stopping and leveling shall be smooth and comfortable, without bumps or

L. Working Pressure: Verify working pressure of the hydraulic system by pressure gauges placed in the system line. Take readings in the machine room with no load, 50 percent load, balanced load and full load in car.

M. Test automatic shutoff valve for proper operation.

N. Insulation Resistance: Elevator's complete wiring system shall be free from short circuits and grounds; and the insulation resistance for the system shall be determined by use of MEGGER.

O. Evidence of malfunction in any tested system or parts of equipment or component part thereof that occurs during, or as a result of, the tests, shall be corrected, repaired, or replaced at no additional cost to the Government, and the test repeated.

P. If any equipment fails test requirements and a re-inspection is required, the Contractor shall be responsible for the cost of re-inspection including salaries, transportation expenses and other expenses incurred by the representatives of the Contracting Officer.

3.9 INSTRUCTION OF PERSONNEL

A. Provide competent instructors to train Veteran’s Administration personnel in care and operation of all parts of equipment. Instruction on hydraulic elevator installation shall be given during regular working hours. Instruction shall commence upon completion of all work required and upon initial operation before final acceptance of work. Instructors shall be qualified representatives, possessing complete knowledge of equipment.

B. Instructors shall be available for one 8-hour working day minimum, with instruction period directed by the Resident Engineer.

C. In addition to oral instruction, written instructions in triplicate relative to care and operation of all parts of equipment shall be furnished and delivered to the Resident Engineer in independently bound folders. Video cassette recording will also be acceptable. Written instructions shall include complete, correct and legible wiring diagrams, nomenclature sheets of all electrical apparatus, including location of each device, complete and comprehensive sequence of operations, complete parts lists with descriptive literature and identification, diagrammatic cuts of equipment and parts, etc. Information shall also include electrical operating characteristics of all circuits, fields, relays, timers and electronic devices, as well as RPM values and related characteristics for all rotating equipment. Provide any supplementary instructions for adjustment and care of new equipment as may become necessary due to changes, modifications and/or replacement of equipment or its operation, under requirements of paragraph entitled, "Warranty of Construction".

3.10 INSPECTIONS AND MAINTENANCE

A. Furnish complete maintenance and inspection service on entire elevator installation for a period of (1) one year after completion and acceptance of the elevator installation by the Resident Engineer. This maintenance service shall begin concurrently with the warranty. Maintenance work shall be performed by skilled elevator personnel directly employed and supervised by the same company that furnished and installed the elevator equipment specified herein.

B. The maintenance service shall include the following:

1. Bi-weekly systematic examination of equipment.

2. Cleaning, lubricating, adjusting, repairing and replacing of all parts

as necessary to keep the equipment in first class condition and proper working order.

3. Furnishing all lubricant, cleaning materials and parts required.
4. The performance standards set forth in this specification, including flight time, cycle time, and door times shall be maintained at all times.
5. The operational system shall be maintained to the standards specified hereinafter including any changes or adjustments required to meet varying conditions of hospital occupancy.
6. Maintain smooth starting and stopping and accurate leveling at all times.

C. Maintenance service shall not include the performance of any work required as a result of improper use, accidents, or negligence for which the contractor is not directly responsible.

D. Provide 24 hour emergency call-back service which shall consist of promptly responding to calls within two hours for emergency service should a shutdown or emergency trouble develop between regular examinations. Overtime emergency call- back service shall be limited to minor adjustments and repairs required to protect the immediate safety of the equipment and persons in and about the elevator.

E. Service and emergency personnel shall report to the Resident Engineer or his authorized representative upon arrival at the hospital and again upon completion of the required work. A copy of the work ticket containing a complete description of the work performed shall be given to the Resident Engineer.

F. The contractor shall maintain a log in the machine room. The log shall list the date and time of all weekly examinations and all trouble calls. Each trouble call shall be fully described including the nature of the call, necessary correction performed or parts replaced.

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PROJECT MANUAL

VOLUME 2

Lebanon VA Medical Center Behavioral Health Complex

VA Project No.: 595-109
Array Project No.: 3468

1700 South Lincoln Avenue
Lebanon, PA 17042

100% Construction Documents
July 27, 2012

ARRAY HEALTHCARE FACILITIES SOLUTIONS

PROJECT MANUAL

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1700 South Lincoln Avenue
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100% Construction Documents
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DEPARTMENT OF VETERANS AFFAIRS
VHA MASTER SPECIFICATIONS

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SECTION 21 05 11
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 21.

B. Definitions:

1. Exposed: Piping and equipment exposed to view in finished rooms.
2. Option or optional: Contractor's choice of an alternate material or method.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.

D. Building Components for Attachment of Hangers: Section 05 36 00, COMPOSITE METAL DECKING.

E. Section 05 50 00, METAL FABRICATIONS.

F. Section 07 84 00, FIRESTOPPING.

G. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

H. Section 07 92 00, JOINT SEALANTS.

I. Section 09 91 00, PAINTING.

J. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

1.3 QUALITY ASSURANCE

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.
2. Equipment Service: Products shall be supported by a service organization which maintains a complete inventory of repair parts and is located reasonably close to the site.
3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
5. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on

equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

6. Asbestos products or equipment or materials containing asbestos shall not be used.

B. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Resident Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

C. Guaranty: In GENERAL CONDITIONS.

D. Supports for sprinkler piping shall be in conformance with NFPA 13.

E. Supports for standpipe shall be in conformance with NFPA 14.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.

1. Equipment and materials identification.
2. Fire-stopping materials.
3. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
4. Wall, floor, and ceiling plates.

C. Coordination Drawings: Provide detailed layout drawings of all piping systems.

D. Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):
A36/A36M-2001.....Carbon Structural Steel

A575-96.....Steel Bars, Carbon, Merchant Quality, M-Grades R (2002)

E84-2012.....Standard Test Method for Burning Characteristics of Building Materials

E119-2012.....Standard Test Method for Fire Tests of Building Construction and Materials

C. National Fire Protection Association (NFPA):

90A-12.....Installation of Air Conditioning and Ventilating Systems

101-12.....Life Safety Code

PART 2 - PRODUCTS

2.1 LIFTING ATTACHMENTS

Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.2 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.

C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.

D. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.

E. Valve Tags and Lists:

1. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm(1/4-inch) for service designation on 19 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.

2. Valve lists: Typed or printed plastic coated card(s), sized 216 mm (8-1/2 inches) by 280 mm (11 inches) showing tag number, valve

function and area of control, for each service or system. Punch sheets for a 3-ring notebook.

3. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a label in ceiling.

2.3 FIRESTOPPING

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping.

2.4 GALVANIZED REPAIR COMPOUND

Mil. Spec. DOD-P-21035B, paint form.

2.5 PIPE PENETRATIONS

A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.

B. To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.
2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from this requirement must receive prior approval of Resident Engineer.

D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.

G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.

H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.6 TOOLS AND LUBRICANTS

A. Furnish, and turn over to the Resident Engineer, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Tool Containers: Hardwood or metal, permanently identified for in tended service and mounted, or located, where directed by the Resident Engineer.

D. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.7 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate location of piping, sleeves, inserts, hangers, and equipment. Locate piping, sleeves, inserts, hangers, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Resident Engineer. Damaged or defective items in the opinion of the Resident Engineer, shall be replaced.
2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly exposed materials and equipment.

C. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

D. Install gages, valves, and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

E. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.

F. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 LUBRICATION

Field check and lubricate equipment requiring lubrication prior to initial operation.

3.3 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the Resident Engineer.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

3.4 INSTRUCTIONS TO VA PERSONNEL

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

- - - E N D - - -

SECTION 21 08 00

COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 21.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. This Section includes requirements for commissioning the Fire Suppression systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

C. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the VA’s Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following Fire Suppression systems will be commissioned:

1. Fire Protection System (Wet-pipe fire suppression).

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3- EXECUTION

3.1 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.2 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 21 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF VA PERSONNEL

A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 21 Sections for additional Contractor training requirements.

----- END -----

SECTION 21 13 13
WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Design, installation and testing shall be in accordance with NFPA 13 except for specified exceptions.

B. The design and installation of a hydraulically calculated automatic wet system complete and ready for operation, for all portions of the Building.

1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Section 33 10 00, WATER UTILITIES.

C. Section 07 84 00, FIRESTOPPING, Treatment of penetrations through rated enclosures.

D. Section 09 91 00, PAINTING.

E. Section 28 31 00, FIRE DETECTION AND ALARM, Connection to fire alarm of flow switches, pressure switches and valve supervisory switches.

F. Section 21 05 11 COMMON WORK RESULTS FOR FIRE SUPPRESSION

1.3 QUALITY ASSURANCE

A. Installer Reliability: The installer shall possess a valid State of Pennsylvania contractor's license. The installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.

B. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL and approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the VA.

C. Submittals: Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering. As Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and

provide index referencing the appropriate specification section. Submittals shall include, but not be limited to, the following:

1. Qualifications:
   a. Provide a copy of the installing contractors state contractors license.
   b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings are stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering.
2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to NFPA 13. Include a site plan showing the piping to the water supply test location.
3. Manufacturers Data Sheets:
   a. For backflow preventers, provide flow test curves from UL, FM, or the Foundation for Hydraulic Research and Cross-Connection Control to verify pressure loss calculations.
   b. Provide for materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.
4. Calculation Sheets: Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of NFPA 13.
5. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Submittals shall include, but not be limited to, the following:
   a. One complete set of reproducible as-built drawings showing the installed system with the specific interconnections between the waterflow switch or pressure switch and the fire alarm equipment.
   b. Complete, simple, understandable, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing all equipment, and a complete trouble shooting manual. Provide maintenance instructions on replacing any components of the system including internal parts, periodic cleaning and adjustment of the equipment and components with information as to the address and telephone number of both the manufacturer and the local supplier of each item.

c. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA 13.
d. Certificates shall document all parts of the installation.
e. Instruction Manual: Provide one copy of the instruction manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser.

D. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13. Recommendations in appendices shall be treated as requirements.
1. Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.
2. Sprinkler Protection: To determining spacing and sizing, apply the following coverage classifications:

a. Light Hazard Occupancies: Patient care, treatment, and customary access areas.
b. Ordinary Hazard Group 1 Occupancies: Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, Elevator Shafts, Elevator Machine Rooms.
c. Ordinary Hazard Group 2 Occupancies: Storage rooms, trash rooms, clean and soiled linen rooms, pharmacy and associated storage, laundry, kitchens, kitchen storage areas, retail stores, retail store storage rooms, storage areas, building management storage, boiler plants, energy centers, warehouse spaces, file storage areas for the entire area of the space up to 140 square meters (1500 square feet) and Supply Processing and Distribution (SPD).
d. Request clarification from the Government for any hazard classification not identified.

3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.
4. Water Supply: Base water supply on a flow test of:
a. Location Adjacent to Site (Hydrant #14)
b. Static pressure: 68 psi

c. Residual pressure: 60 psi

d. Flow: 995 gpm

e. Date: December 10, 2011

5. Zoning:

a. For each sprinkler zone provide a control valve, flow switch and a test and drain assembly with pressure gauge.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):
13-2012.....Installation of Sprinkler Systems
101-2012.....Safety to Life from Fire in Buildings and Structures (Life Safety Code)
170-2012.....Fire Safety Symbols

C. Underwriters Laboratories, Inc. (UL):
Fire Protection Equipment Directory – 2012

D. Factory Mutual Engineering Corporation (FM):
Approval Guide – 2012

E. Uniform Building Code – 2012

F. Foundation for Cross-Connection Control and Hydraulic Research-2005

PART 2 PRODUCTS

2.1 PIPING & FITTINGS

A. Sprinkler systems in accordance with NFPA 13.

2.2 VALVES

A. Valves in accordance with NFPA 13.

B. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.

C. The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI. (No Substitutions Allowed).

D. Alarm valve shall be UL Listed and Factory Mutual Approved. The alarm valve shall be equipped with a removable cover assembly. The alarm valve shall be listed for installation in the vertical or horizontal position. The alarm valve shall be equipped with gauge connections on

the system side and supply side of the valve clapper. The alarm valve shall be equipped with an external bypass to eliminate false water flow alarms. The alarm valve trim piping shall be externally galvanized. Maximum water working pressure to 250 PSI.

E. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads.

2.3 FIRE DEPARTMENT SIAMESE CONNECTION

A. Brass, flush wall type, exterior fire department connection with brass escutcheon plate, without sill cock, and a minimum of two 65 mm (2-1/2 inch) connections threaded to match those on the local fire protection service, with polished brass caps and chains. Provide escutcheon with integral raised letters /"Automatic Sprinkler". Install an automatic ball drip between fire department connection and check valve with drain piping routed to the exterior of the building or a floor drain.

2.4 SPRINKLERS

A. All sprinklers except “institutional” type sprinklers shall be FM approved. “Institutional” type sprinklers in Mental Health and Behavior Units shall be UL listed and FM approved quick response type. Maximum break away strength shall be certified by the manufacturer to be no more than 39 kPa (85 pounds). Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval.
   1. Cold storage rooms: Standard response dry pendant sprinklers.
   2. Elevator shafts and elevator machine rooms: Standard response sprinklers.
   3. Elevator pit: sidewall sprinklers.
   4. In generator rooms: Standard response sprinklers.
      (Note: Provide ‘cages’ to protect sprinkler heads from breakage/damage when the elevation of the head is less than 7 feet 6 inches above finished floor (mechanical rooms, janitor closets, etc).

B. Temperature Ratings: In accordance with NFPA 13, except as follows:
   1. Sprinklers in elevator shafts, elevator pits, and elevator machine rooms: Intermediate temperature rated.
   2. Sprinklers in Generator Rooms: High temperature rated.

2.5 SPRINKLER CABINET

Provide sprinkler cabinet with the required number of sprinkler heads of all ratings and types installed, and a sprinkler wrench for each system. Locate adjacent to the riser. Sprinkler heads shall be installed in center of tile or center to center.

2.6 IDENTIFICATION SIGNS/HYDRAULIC PLACARDS

Plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Enter pertinent data for each system on the hydraulic placard.

2.7 SWITCHES:

A. Contain in a weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, 13 mm (1/2 inch) conduit entrance and necessary facilities for attachment to the valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.

B. Water flow Alarm Switches: Mechanical, non-coded, non-accumulative retard and adjustable from 0 to 60 seconds minimum. Set flow switches at an initial setting between 20 and 30 seconds.

C. Pressure Switches: Activation by any flow of water equal to or in excess of the discharge from one sprinkler. Water Flow Indicating Pressure Switch will activate an alarm by way of an alarm pressure switch. The alarm pressure switch shall be compatible with system devices. The alarm pressure enclosure shall be UL Listed and Factory Mutual Approved for the application in which it is used. The alarm pressure switch shall have the ability to be wired for Class A or Class B service.

D. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.

2.8 GAUGES

Provide gauges as required by NFPA 13.

2.9 PIPE HANGERS AND SUPPORTS

Supports, hangers, etc., of an approved pattern placement to conform to NFPA 13. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in NFPA 13, Standard for Installation of Sprinkler Systems. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application. Hangers or supports not specifically listed for service shall be designed and bear the seal of a professional engineer. //

2.10 WALL, FLOOR AND CEILING PLATES

Provide chrome plated steel escutcheon plates for exposed piping passing though walls, floors or ceilings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.

B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Install concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists, install sprinklers so as not to obstruct the movement or operation of the equipment. Locate piping in stairways as near to the ceiling as possible to prevent tampering by unauthorized personnel, and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). To prevent an obstruction to egress, provide piping clearances in accordance with NFPA 101.

C. Welding: Conform to the requirements and recommendations of NFPA 13.

D. Drains: Pipe drains to discharge at safe indicated on the drawings. Do not provide a direct drain connection to sewer system. Install drips and drains where necessary and required by NFPA 13.

E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.

F. Waterflow Alarm Switches: Install waterflow switch and adjacent valves in easily accessible locations.

G. Inspector's Test Connection: Install and supply in conformance with NFPA 13, locate in a secured area, and discharge to the exterior of the building.

H. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.

I. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls,

floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.

J. Provide pressure gauge at each water flow alarm switch location and at each main drain connection.

K. For each fire department connection, provide the symbolic sign given in NFPA 170 and locate 2400 to 3000 mm (8 to 10 feet) above each connection location. Size the sign to 450 by 450 mm (18 by 18 inches) with the symbol being at least 350 by 350 mm (14 by 14 inches).

L. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.

M. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.

N. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.

3.2 INSPECTION AND TEST

A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in the presence of the Contracting Officers Technical Representative (COTR) or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.

B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COTR/Resident Engineer to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

3.3 INSTRUCTIONS

Furnish the services of a competent instructor for not less than two hours for instructing personnel in the operation and maintenance of the system, on the dates requested by the COTR/Resident Engineer.

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SECTION 22 05 11
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section shall apply to all sections of Division 22.

B. Definitions:

1. Exposed: Piping and equipment exposed to view in finished rooms.
2. Option or optional: Contractor's choice of an alternate material or method.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 31 20 00, EARTH MOVING: Excavation and Backfill.

D. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.

E. Section 05 31 00, STEEL DECKING.

F. Section 05 50 00, METAL FABRICATIONS.

G. Section 07 84 00, FIRESTOPPING.

H. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations.

I. Section 07 92 00, JOINT SEALANTS.

J. Section 09 91 00, PAINTING.

K. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

L. Section 23 07 11, PLUMBING, INSULATION.

M. Section 23 09 23, DIRECT DIGITAL CONTROLS FOR HVAC.

N. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

O. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT .

P. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 QUALITY ASSURANCE

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology

and basic design that has a proven satisfactory service record of at least three years.

2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the Contracting Officers Technical Representative (COTR).
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Asbestos products or equipment or materials containing asbestos shall not be used.

B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
   1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
   2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
   3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
   4. All welds shall be stamped according to the provisions of the American Welding Society.
C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COTR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
D. Execution (Installation, Construction) Quality:
   1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract drawings and specifications shall be referred to the COTR for resolution. Written hard copies or computer files of manufacturer’s installation instructions shall be provided to the COTR at least two weeks prior to commencing installation of any item.
   2. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved.
E. Guaranty: Warranty of Construction, FAR clause 52.246-21.
F. Plumbing Systems: IPC, International Plumbing Code.

1.4 SUBMITTALS

A. Submittals shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMNON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.

C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.

D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

F. Upon request by Government, lists of previous installations for selected items of equipment shall be provided. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.

G. Manufacturer's Literature and Data: Manufacturer’s literature shall be submitted under the pertinent section rather than under this section.

1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
2. Equipment and materials identification.
3. Fire stopping materials.
4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
5. Wall, floor, and ceiling plates.

H. Coordination Drawings: In accordance with GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION. Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and

adequate clearance for all equipment, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping until layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.

1. Mechanical equipment rooms.
2. Hangers, inserts, supports, and bracing.
3. Pipe sleeves.
4. Equipment penetrations of floors, walls, ceilings, or roofs.

I. Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided.
3. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COTR. Such replacement shall be at no additional cost to the Government.
3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.

4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC), latest edition. All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Mechanical Engineers (ASME):
Boiler and Pressure Vessel Code (BPVC):
SEC IX-2007.....Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications.

C. American Society for Testing and Materials (ASTM):
A36/A36M-2008.....Standard Specification for Carbon Structural Steel
A575-96 (R 2007).....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades R (2002)
E84-2005.....Standard Test Method for Surface Burning Characteristics of Building Materials
E119-2008a.....Standard Test Methods for Fire Tests of Building Construction and Materials

D. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
SP-58-02.....Pipe Hangers and Supports-Materials, Design and Manufacture

SP 69-2003 (R 2004).....Pipe Hangers and Supports-Selection and Application

E. National Electrical Manufacturers Association (NEMA):

MG1-2003, Rev. 1-2007...Motors and Generators

F. International Code Council, (ICC):

IBC-06, (R 2007).....International Building Code

IPC-06, (R 2007).....International Plumbing Code

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be products of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment, which serve the same function, shall be the same make and model

2.2 COMPATIBILITY OF RELATED EQUIPMENT

Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.3 SAFETY GUARDS

A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and

attached to pump base with minimum of four 6 mm (1/4-inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

B. All Equipment shall have moving parts protected from personal injury.

2.4 LIFTING ATTACHMENTS

Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.5 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

A. All material and equipment furnished and installation methods shall conform to the requirements of Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT; Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS; and, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). All electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems shall be provided. Premium efficient motors shall be provided. Unless otherwise specified for a particular application, electric motors shall have the following requirements.

B. Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Government.
2. Assemblies of motors, starters, and controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
   a. Wiring material located where temperatures can exceed 71°C (160°F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.
   b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.

c. Shielded conductors or wiring in separate conduits for all instrumentation and control systems shall be provided where recommended by manufacturer of equipment.

4. Motor sizes shall be selected so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
5. Motors utilized with variable frequency drives shall be rated “inverter-ready” per NEMA Standard, MG1, Part 31.4.4.2.

C. Motor Efficiency and Power Factor: All motors, when specified as “high efficiency or Premium Efficiency” by the project specifications on driven equipment, shall conform to efficiency and power factor requirements in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as “NEMA premium efficient” and the requirements generally exceed those of the Energy Policy Act of 1992 (EPACT). Motors not specified as “high efficiency or premium efficient” shall comply with EPACT.

D. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).

E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. A time delay (20 seconds minimum) relay shall be provided for switching from high to low speed.

F. Rating: Rating shall be continuous duty at 100 percent capacity in an ambient temperature of 40° C (104° F); minimum horsepower as shown on drawings; maximum horsepower in normal operation shall not exceed nameplate rating without service factor.

G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame shall be measured at the time of final inspection.

2.6 VARIABLE SPEED MOTOR CONTROLLERS

A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for specifications.

B. The combination of controller and motor shall be provided by the respective pump manufacturer, and shall be rated for 100 percent output

performance. Multiple units of the same class of equipment, i.e. pumps, shall be product of a single manufacturer.

C. Motors shall be premium efficient type, “invertor duty”, and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.

D. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system.

2.7 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, fans, etc. shall be identified.

C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.

D. Control Items: All temperature, pressure, and controllers shall be labeled and the component’s function identified. Identify and label each item as they appear on the control diagrams.

E. Valve Tags and Lists:

1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
2. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm(1/4-inch) for service designation on 19 gage, 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated

valve list card(s), sized 216 mm (8-1/2 inches) by 280 mm (11 inches) shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3-ring binder notebook. A copy of the valve list shall be mounted in picture frames for mounting to a wall.

4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling.

2.8 FIRE STOPPING

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION, for pipe insulation.

2.9 GALVANIZED REPAIR COMPOUND

Mil. Spec. DOD-P-21035B, paint.

2.10 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC), latest edition, and SECTION 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Submittals based on the International Building Code (IBC), latest edition, SECTION 13 05 41 requirements, or the following paragraphs of this Section shall be stamped and signed by a professional engineer registered in a state where the project is located. The Support system of suspended equipment over 227 kg (500 pounds) shall be submitted for approval of the COTR in all cases. See these specifications for lateral force design requirements.

B. Type Numbers Specified: MSS SP-58. For selection and application refer to MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.

C. For Attachment to Concrete Construction:

1. Concrete insert: Type 18, MSS SP-58.
2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (4 inches) thick when approved by the COTR for each job condition.

3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (4 inches) thick when approved by the COTR for each job condition.

D. For Attachment to Steel Construction: MSS SP-58.
   1. Welded attachment: Type 22.
   2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8-inch) outside diameter.

E. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING.

F. For Attachment to Wood Construction: Wood screws or lag bolts.

G. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

H. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Trapeze hangers are not permitted for steam supply and condensate piping.
   1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
   2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13 mm (1/2-inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.

I. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
   1. General Types (MSS SP-58):
      a. Standard clevis hanger: Type 1; provide locknut.
      b. Riser clamps: Type 8.
      c. Wall brackets: Types 31, 32 or 33.

d. Roller supports: Type 41, 43, 44 and 46.

e. Saddle support: Type 36, 37 or 38.

f. Turnbuckle: Types 13 or 15.

g. U-bolt clamp: Type 24.

h. Copper Tube:

1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with isolation tape to prevent electrolysis.

2) For vertical runs use epoxy painted or plastic coated riser clamps.

3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.

4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

5) Movement up to 20 mm (3/4-inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.

6) Movement more than 20 mm (3/4-inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.

i. Spring hangers are required on all plumbing system pumps one horsepower and greater.

2. Plumbing Piping (Other Than General Types):

a. Horizontal piping: Type 1, 5, 7, 9, and 10.

b. Chrome plated piping: Chrome plated supports.

c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.

d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gage) minimum.

J. Pre-insulated Calcium Silicate Shields:

1. Provide 360 degree water resistant high density 965 kPa (140 psi) compressive strength calcium silicate shields encased in galvanized metal.

2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
3. Shield thickness shall match the pipe insulation.
4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
   a. Shields for supporting cold water shall have insulation that extends a minimum of one inch past the sheet metal.
   b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psi) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear plates welded to the bottom sheet metal jacket.
5. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

K. Seismic Restraint of Piping: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

2.11 PIPE PENETRATIONS

A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.

B. Pipe penetration sleeve materials shall comply with all fire stopping requirements for each penetration.

C. To prevent accidental liquid spills from passing to a lower level, provide the following:
   1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
   2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
   3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

D. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COTR.

E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and

partitions, unless brass or steel pipe sleeves are specifically called for below.

F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.

G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel Sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.

H. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.

I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.12 TOOLS AND LUBRICANTS

A. Furnish, and turn over to the COTR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the COTR.

D. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.13 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3 inch) pipe, 0.89 mm (0.035-inch) for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

2.14 ASBESTOS

Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.

Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.

C. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.

D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

E. Cutting Holes:

1. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by the COTR where working area space is limited.
2. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by the COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to the COTR for approval.
3. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.

F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.

G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

H. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COTR. Damaged or defective items in the opinion of the COTR, shall be replaced.
2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

I. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE. shall be used for all pad or floor mounted equipment. Gages,

thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

J. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.

K. Many plumbing systems interface with the HVAC control system. See the HVAC control points list and section 23 09 23 DIRECT DIGITAL CONTROLS FOR HVAC

L. Work in Existing Building:

1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will cause the least interfere with normal operation of the facility.

M. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.

N. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.

O. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans,

pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Para. 3.1 shall apply.

C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

3.3 RIGGING

A. Openings in building structures shall be planned to accommodate design scheme.

B. Alternative methods of equipment delivery may be offered and will be considered by Government under specified restrictions of phasing and service requirements as well as structural integrity of the building.

C. All openings in the building shall be closed when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.

D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.

E. Contractor shall check all clearances, weight limitations and shall provide a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

F. Rigging plan and methods shall be referred to the COTR for evaluation prior to actual work.

3.4 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the COTR.

B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.

C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work shall be provided.

D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC), latest edition, and these specifications.

E. Overhead Supports:

1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
3. Tubing and capillary systems shall be supported in channel troughs.

F. Floor Supports:

1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.

3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.
4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 LUBRICATION

A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.

B. All devices and equipment shall be equipped with required lubrication fittings. A minimum of one liter (one quart) of oil and 0.5 kg (one pound) of grease of manufacturer's recommended grade and type for each different application shall be provided. All materials shall be delivered to the COTR in unopened containers that are properly identified as to application.

C. A separate grease gun with attachments for applicable fittings shall be provided for each type of grease applied.

D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

E. All lubrication points shall be extended to one side of the equipment.

3.6 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
2. The following Material And Equipment shall NOT be painted::
   a. Motors, controllers, control switches, and safety switches.
   b. Control and interlock devices.
   c. Regulators.
   d. Pressure reducing valves.

e. Control valves and thermostatic elements.

f. Lubrication devices and grease fittings.

g. Copper, brass, aluminum, stainless steel and bronze surfaces.

h. Valve stems and rotating shafts.

i. Pressure gages and thermometers.

j. Glass.

k. Name plates.

3. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint obtained from manufacturer or computer matched.
4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
6. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this.

3.7 IDENTIFICATION SIGNS

A. Laminated plastic signs, with engraved lettering not less than 5 mm (3/16-inch) high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.

B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance shall be placed on factory built equipment.

C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.8 STARTUP AND TEMPORARY OPERATION

Start up of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.9 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COTR.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests such systems respectively during first actual seasonal use of respective systems following completion of work.

3.10 OPERATION AND MAINTENANCE MANUALS

A. Provide four bound copies. The Operations and maintenance manuals shall be delivered to the COTR not less than 30 days prior to completion of a phase or final inspection.

B. All new and temporary equipment and all elements of each assembly shall be included.

C. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.

D. Manufacturer’s installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.

E. Lubrication instructions, type and quantity of lubricant shall be included.

F. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.

G. Set points of all interlock devices shall be listed.

H. Trouble-shooting guide for the control system troubleshooting guide shall be inserted into the Operations and Maintenance Manual.

I. The combustion control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.

J. Emergency procedures.

3.11 INSTRUCTIONS TO VA PERSONNEL

Instructions shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

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SECTION 22 05 12
GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION:

This section describes the general motor requirements for plumbing equipment.

1.2 RELATED WORK:

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements common to more than one section of Division 26.

B. 26 29 11, LOW-VOLTAGE MOTOR STARTERS: Starters, control and protection of motors: Section

C. Section 26 24 19, MOTOR-CONTROL CENTERS: Motor Control Centers.

1.3 SUBMITTALS:

A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Motor nameplate information shall be submitted including electrical ratings, dimensions, mounting details, materials, horsepower, power factor, current as a function of speed, current efficiency, speed as a function of load, RPM, enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.
3. Motor parameters required for the determination of the Reed Critical Frequency of vertical hollow shaft motors shall be submitted.

C. Manuals:

1. Companion copies of complete maintenance and operating manuals, including technical data sheets and application data shall be submitted simultaneously with the shop drawings.

D. Certification: Two weeks prior to final inspection, unless otherwise noted, four copies of the following certification shall be submitted to the Resident Engineer:

1. Certification shall be submitted stating that the motors have been properly applied, installed, adjusted, lubricated, and tested.

1.4 APPLICABLE PUBLICATIONS:

A. The publications listed below (including amendments, addenda, revisions, supplements and errata) shall form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Electrical Manufacturers Association (NEMA):

MG 1-07.....Motors and Generators

MG 2-01.....Safety Standard and Guide for Selection, Installation and Use of Electric Motors and Generators

C. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 MOTORS:

A. For alternating current, fractional and integral horsepower motors, NEMA Publications MG 1 and MG 2 shall apply.

B. Voltage ratings shall be as follows:

1. Single phase:
   a. Motors connected to 120-volt systems: 115 volts.
   b. Motors connected to 208-volt systems: 200 volts.
   c. Motors connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
2. Three phase:
   a. Motors connected to 208-volt systems: 200 volts.
   b. Motors, less than 74.6 kW (100 HP), connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
   c. Motors, 74.6 kW (100 HP) or larger, connected to 240-volt systems: 230 volts.
   d. Motors, 74.6 kW (100 HP) or larger, connected to 480-volt systems: 460 volts.
   e. Motors connected to high voltage systems: Shall conform to NEMA Standards for connection to the nominal system voltage shown on the drawings.

C. Number of phases shall be as follows:

1. Motors, less than 373 W (1/2 HP): Single phase.
2. Motors, 373 W (1/2 HP) and larger: 3 phase.

3. Exceptions:
   a. Hermetically sealed motors.
   b. Motors for equipment assemblies, less than 746 W (1 HP), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

D. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation.

E. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.

F. Motor Enclosures:
   1. Shall be the NEMA types shown on the drawings for the motors.
   2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types, which are most suitable for the environmental conditions where the motors are being installed.
   3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.
   4. All motors in hazardous locations shall be approved for the application and meet the Class and Group as required by the area classification.

G. Electrical Design Requirements
   1. Motors shall be continuous duty.
   2. The insulation system shall be rated minimum of class B, 130° C (266° F).
   3. The maximum temperature rise by resistance at rated power shall not exceed Class B limits, 80° C (176° F).
   4. The speed/torque and speed/current characteristics shall comply with NEMA Design A or B, as specified.
   5. Motors shall be suitable for full voltage starting, unless otherwise noted.
   6. Motors for variable frequency drive applications shall adhere to NEMA standards publication MG 1, Part 30, Application considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable voltage or

Adjustable frequency controls, or both, or Part 31, Definite Purpose Inverter Fed Polyphase Motors.

H. Mechanical Design Requirements

1. Bearings shall be rated for a minimum of 26,280 hours L-10 life at full load direct coupled, except vertical high thrust motors.
2. Vertical motors shall be capable of withstanding a momentary up thrust of at least 30% of normal down thrust.
3. Grease lubricated bearings shall be designed for electric motor use. Grease shall be capable of the temperatures associated with electric motors and shall be compatible with Polyurea based greases.
4. Grease fittings, if provided, shall be Alemite type or equivalent.
5. Oil lubricated bearings, when specified, shall have an externally visible sight glass to view oil level.
6. Vibration shall not exceed 0.15 inch per second, unfiltered peak.
7. Noise level shall meet the requirements of the application.
8. Motors on 180 frames and larger shall have provisions for lifting eyes or lugs capable of a safety factor of 5.
9. All external fasteners shall be corrosion resistant.
10. Condensation heaters, when specified, shall keep motor windings at least 5° C (41° F) above ambient temperature.
11. Winding thermostats, when specified shall be normally closed, connected in series.
12. Grounding provisions shall be in the main terminal box.

I. Additional requirements for specific motors, as indicated in other sections, shall also apply.

J. NEMA Premium Efficiency Electric Motors, Motor Efficiencies: All permanently wired polyphase motors of 746 Watts (1 Horsepower) or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 746 Watts (one horsepower) or more with open, drip-proof or totally enclosed fan-cooled enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

Minimum Efficiencies Open Drip-Proof				Minimum Efficiencies Totally Enclosed Fan-Cooled			
Rating kW (HP)	**1200 RPM**	**1800 RPM**	**3600 RPM**	**Rating kW (HP)**	**1200 RPM**	**1800 RPM**	**3600 RPM**
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%
93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%
112 (150)	95.4%	95.8%	94.1%	112 (150)	95.8%	95.8%	95.0%
149.2 (200)	95.4%	95.8%	95.0%	149.2 (200)	95.8%	96.2%	95.4%

K. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM. Power factor correction capacitors shall be installed unless the motor is controlled by a variable frequency drive. The power factor correction capacitors shall be able to withstand high voltage transients and power line variations without breakdown.

PART 3 - EXECUTION

3.1 INSTALLATION:

Install motors in accordance with manufacturer’s recommendations, the NEC, NEMA, as shown on the drawings and/or as required by other sections of these specifications.

3.2 FIELD TESTS

Megger all motors after installation, before start-up. All shall test free from grounds.

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SECTION 22 05 19
METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

This section describes the requirements for water meters and pressure gages.

1.2 RELATED WORK

Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data:

1. Pressure Gages.
2. Product certificates for each type of meter and gauge

C. Operations and Maintenance manual shall include:

1. System Description
2. Major assembly block diagrams
3. Troubleshooting and preventive maintenance guidelines
4. Spare parts information.

D. Shop Drawings shall include the following:

1. One line, wiring and terminal diagrams including terminals identified, protocol or communication modules, and Ethernet connections.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI):
American Society of Mechanical Engineers (ASME): (Copyrighted Society)
B40.1-05.....Gauges-Pressure Indicating Dial Type-Elastic

C. International Code Council (ICC):
IPC-06.....(2007 Supplement) International Plumbing Code

1.5 AS-BUILT DOCUMENTATION

A. The electronic documentation and copies of the Operations and Maintenance Manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program

complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template made available for review and included as part of the Operations and Maintenance Manual or closeout documentation. All available accessibility functions listed in the Voluntary Accessibility Template shall be enabled in the prepared electronic files. As Adobe Acrobat is a common industry format for such documentation, following the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge is recommended.”

B. Four sets of manufacturer’s literature and data updated to include submittal review comments and any equipment substitutions.

C. Four sets of operation and maintenance data updated to include submittal review comments shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

PART 2 – PRODUCTS

2.1 PRESSURE GAGES FOR WATER USAGE

A. ANSI B40.1 all metal case 114 mm (4-1/2 inches) diameter, bottom connected throughout, graduated as required for service, and identity labeled. Range shall be 0 to 1375 kPa (0 to 200 psi) gauge.

B. The pressure element assembly shall be bourdon tube. The mechanical movement shall be lined to pressure element and connected to pointer.

C. The dial shall be non-reflective aluminum with permanently etched scale markings graduated in kPa and psi.

D. The pointer shall be dark colored metal.

E. The window shall be glass.

F. The ring shall be brass or stainless steel.

G. The accuracy shall be grade A, plus or minus 1 percent of middle half of scale range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Direct mounted pressure gages shall be installed in piping tees with pressure gage located on pipe at the most readable position.

B. Valves and snubbers shall be installed in piping for each pressure gage.

C. Test plugs shall be installed on the inlet and outlet pipes all heat exchangers or water heaters serving more than one plumbing fixture.

D. Pressure gages shall be installed where indicated on the drawings and at the following locations:

1. Building water service entrance into building
2. Inlet and outlet of each pressure reducing valve
3. Suction and discharge of each domestic water pump or re-circulating hot water return pump.

3.2 FIELD QUALITY CONTROL

The meter assembly shall be visually inspected and operationally tested

- - - E N D - - -

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

This section describes the requirements for general-duty valves for domestic water systems.

1.2 RELATED WORK

Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data:

1. Valves.
2. Backflow Preventers.
3. Pressure Reducing Valves.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):A536-84(R 2004) Standard Specification for Ductile Iron Castings

C. American Society of Sanitary Engineering (ASSE)

ASSE 1003-01 (R 2003)...Performance Requirements for Water Pressure Reducing Valves

ASSE 1012-02.....Backflow Preventer with Intermediate Atmospheric Vent

ASSE 1013-05.....Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers

D. International Code Council (ICC)

IPC-06 (R 2007).....International Plumbing Code

E. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-25-98.....Standard Marking System for Valves, Fittings, Flanges and UnionsSP-67-02a (R 2004) Butterfly Valve of the Single flange Type (Lug Wafer)

SP-70-06.....Cast Iron Gate Valves, Flanged and Threaded Ends.

SP-72-99.....Ball Valves With Flanged or Butt Welding For General Purpose

SP-80-03.....Bronze Gate, Globe, Angle and Check Valves.

SP-110-96.....Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

1.5 DELIVERY, STORAGE, AND HANDLING

A. Valves shall be prepared for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Valves shall be prepared for storage as follows:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature.

C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES

A. Asbestos packing and gaskets are prohibited.

B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.

C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.

D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 meters (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.

E. Ball valves, pressure regulating valves, gate valves, globe valves, and plug valves used to supply potable water shall meet the requirements of NSF 61.

F. Shut-off:

1. Cold, Hot and Re-circulating Hot Water:

a. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-72, SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4140 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be soldered.

b. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A 536, ductile iron.

c. 100 mm (DN100) (4 inches) and larger:

1) Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS-SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A 126, grey iron with bolted bonnet, flanged ends, bronze trim, and solid wedge disc. The gate valve shall be gear operated for sizes under 200 mms or DN200 (8 inches) and crank operated for sizes 200 mms or DN200 (8 inches) and above

2) Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The butterfly valve shall be lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.

3) Grooved end, ductile iron butterfly valves. The grooved butterfly valve shall meet the MSS SP-67 standard. The

grooved butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall be polyamide coated ductile iron conforming to ASTM A536 with two piece stainless steel stem, EPDM encapsulated ductile iron disc, and EPDM seal. The butterfly valve shall be gear operated

G. Balancing:

1. Hot Water Re-circulating, 80 mm or DN80 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (¼″ NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.

H. Check:

1. Check valves less than 80 mm or DN80 (3 inches) and smaller) shall be class 125, bronze swing check valves with non metallic Buna-N disc. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B 62, solder joints, and PTFE or TFE disc.

   a. All check valves on the discharge side of submersible sump sumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

2.2 WATER PRESSURE REDUCING VALVE AND CONNECTIONS

A. 80 mm or DN80 (3 inches) or smaller: The pressure reducing valve shall consist of a bronze body and bell housing, a separate access cover for the plunger, and a bolt to adjust the downstream pressure. The bronze bell housing and access cap shall be threaded to the body and shall not require the use of ferrous screws. The assembly shall be of the balanced piston design and shall reduce pressure in both flow and no

flow conditions. The assembly shall be accessible for maintenance without having to remove the body from the line.

B. The regulator shall have a tap for pressure gauge.

C. The regulator shall have a temperature rating of 100° C (210° F) for hot water or hot water return service. Pressure regulators shall have accurate pressure regulation to 6.9-kPa (+/- 1 psig).

D. Setting: Entering water pressure, discharge pressure, capacity, size, and related measurements shall be as shown on the drawings.

E. Connections Valves and Strainers: shut off valves shall be installed on each side of reducing valve and a bypass line equal in size to the regulator inlet pipe shall be installed with a normally closed globe valve. A strainer shall be installed on inlet side of, and same size as pressure reducing valve. A pressure gage shall be installed on the low pressure side of the line.

2.3 BACKFLOW PREVENTERS

A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. The backflow prevention assembly shall be ASSE 1013 listed and certified.

B. Reduced pressure backflow preventers shall be installed in the following applications.

1. Water make up to heating systems, cooling tower, chilled water system, generators, and similar equipment consuming water.
2. Water service entrance from loop system.
3. Power washer
4. Atmospheric Vacuum Breaker: ASSE 1001
   a. Hose bibs and sinks w/threaded outlets.
   b. Disposers.
   c. Hydrotherapy units.
   d. All kitchen equipment, if not protected by air gap.

C. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port OS&Y gate valves and an integral relief monitor switch. The main body and access cover shall be epoxy coated duct iron conforming to ASTM A536 grade 4. The seat ring and check valve shall be Noryl (NSF listed). The stem shall be stainless steel conforming to ASTM A276. The seat disc elastomer shall be EPDM. The checks and the relief valve shall be accessible for maintenance without

removing the device from the line. An epoxy coated wye type strainer with flanged connections shall be installed on the inlet.

D. The atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be either cast bronze. All internal polymers shall be NSF listed. The seat disc elastomer shall be silicone. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable.

E. The double check detector backflow prevention assembly shall be ASSE listed 1048 and supply with full port OS&Y gate valves. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade. The seat ring and check valve shall be Noryl (NSF listed). The stem shall be stainless steel conforming to ASTM A 276. The seat disc elastomers shall be EPDM. The first and second check valve shall be accessible for maintenance without removing the device from the line.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.

B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.

C. Threads on valve and mating pipe shall be examined for form and cleanliness.

D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.

C. Valves shall be installed in horizontal piping with stem at or above center of pipe

D. Valves shall be installed in a position to allow full stem movement.

E. Check valves shall be installed for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves shall be replaced if persistent leaking occurs.

- - E N D - - -

SECTION 22 05 41
NOISE AND VIBRATION CONTROL FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

Noise criteria, seismic restraints for equipment, vibration tolerance and vibration isolation plumbing work.

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete inertia bases.

B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural equipment

C. Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING: Requirements for flexible pipe connectors to reciprocating and rotating mechanical equipment.

D. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS: Requirements for optional Air Handling Unit internal vibration isolation.

E. Section 23 31 00, HVAC DUCTS AND CASINGS: requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining.

F. SECTION 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: requirements for sound and vibration tests.

1.3 QUALITY ASSURANCE

A. Refer to article, QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

B. Noise Criteria:

1. Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed following NC levels:

TYPE OF ROOM	NC LEVEL
Audio Speech Pathology	25
Audio Suites	25
Auditoriums, Theaters	35
Bathrooms and Toilet Rooms	40
Chapels	35
Conference Rooms	35
Corridors (Nurse Stations)	40
Corridors(Public)	40

Dining Rooms, Food Services/ Serving	35
Examination Rooms	35
Gymnasiums	50
Kitchens	50
Laboratories	45
Laundries	50
Lobbies, Waiting Areas	40
Locker Rooms	50
Offices, large open (3 or more occupants)	40
Offices, small private (2 or fewer occupants)	35
Operating Rooms	40
Patient Rooms	35
Phono/ Cardiology	25
Recreation Rooms	50
Shops	50
SPD	35
Therapeutic Pools	45
Treatment Rooms	35
Warehouse	50
X-Ray & general Work Rooms	40

2. For equipment which has no sound power ratings scheduled on the plans, the contractor shall select equipment such that the foregoing noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in accordance with ASHRAE Fundamentals Handbook, Chapter 7, Sound and Vibration.
3. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as, furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference

between sound power level emitted to room and sound pressure level in room.

4. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.

C. Seismic Restraint Requirements:

1. Equipment:

a. All mechanical equipment not supported with isolators external to the unit shall be securely anchored to the structure. Such mechanical equipment shall be properly supported to resist a horizontal force of 50 percent of the weight of the equipment furnished.

b. All mechanical equipment mounted on vibration isolators shall be provided with seismic restraints capable of resisting a horizontal force of 50 percent of the weight of the equipment furnished.

2. Piping: Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

3. Ductwork: Refer to specification Section 23 31 00, HVAC DUCTS AND CASINGS.

D. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.

1.4 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Vibration isolators:

a. Floor mountings

b. Hangers

c. Snubbers

d. Thrust restraints

2. Bases.

3. Seismic restraint provisions and bolting.
4. Acoustical enclosures.

C. Isolator manufacturer shall furnish with submittal load calculations for selection of isolators, including supplemental bases, based on lowest operating speed of equipment supported.

D. Seismic Requirements: Submittals are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, standard connections, and manufacturer's certification that all specified equipment will withstand seismic Lateral Force requirements as shown on drawings,

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
2005.....Fundamentals Handbook, Chapter 7, Sound and Vibration

C. American Society for Testing and Materials (ASTM):
A123/A123M-02.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A307-04.....Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
D2240-05.....Standard Test Method for Rubber Property - Durometer Hardness

D. Manufacturers Standardization (MSS):
SP-58-02.....Pipe Hangers and Supports-Materials, Design and Manufacture

E. Occupational Safety and Health Administration (OSHA):
29 CFR 1910.95.....Occupational Noise Exposure

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to minimum requirements indicated herein and in the schedule on the drawings.

B. Elastometric Isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness of 60 durometer and have a straight-line deflection curve.

C. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.

D. Color code isolators by type and size for easy identification of capacity.

2.2 SEISMIC RESTRAINT REQUIREMENTS FOR EQUIPMENTS

A. Bolt pad mounted equipment, without vibration isolators, to the floor or other support using ASTM A307 standard bolting material.

B. Floor mounted equipment, with vibration Isolators: Type SS. Where Type N isolators are used provide channel frame base horizontal restraints bolted to the floor, or other support, on all sides of the equipment Size and material required for the base shall be as recommended by the isolator manufacturer.

C. On all sided of suspended equipment, provide bracing for rigid supports and provide restraints for resiliently supported equipment. The slack cable restraint method, Mason Industries, or equal, is acceptable.

2.3 VIBRATION ISOLATORS

A. Floor Mountings:

1. Double Deflection Neoprene (Type N): Shall include neoprene covered steel support plated (top and bottom), friction pads, and necessary bolt holes.
2. Spring Isolators (Type S): Shall be free-standing, laterally stable and include acoustical friction pads and leveling bolts. Isolators shall have a minimum ratio of spring diameter-to-operating spring height of 1.0 and an additional travel to solid equal to 50 percent of rated deflection.
3. Captive Spring Mount for Seismic Restraint (Type SS):
   a. Design mounts to resiliently resist seismic forces in all directions. Snubbing shall take place in all modes with adjustment to limit upward, downward, and horizontal travel to a maximum of 6 mm (1/4-inch) before contacting snubbers. Mountings shall have a minimum rating of one G coefficient of gravity as calculated and certified by a registered structural engineer.
   b. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than

0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. Mountings shall have ports for spring inspection. Provide an all directional neoprene cushion collar around the equipment bolt.

4. Spring Isolators with Vertical Limit Stops (Type SP): Similar to spring isolators noted above, except include a vertical limit stop to limit upward travel if weight is removed and also to reduce movement and spring extension due to wind loads. Provide clearance around restraining bolts to prevent mechanical short circuiting.
5. Pads (Type D), Washers (Type W), and Bushings (Type L): Pads shall be felt, cork, neoprene waffle, neoprene and cork sandwich, neoprene and fiberglass, neoprene and steel waffle, or reinforced duck and neoprene. Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 345 kPa (50 pounds per square inch).
6. Seismic Pad (Type DS): Pads shall be felt, cork neoprene waffle, neoprene and cork sandwich, neoprene and fiberglass, neoprene and steel waffle, or reinforced duck and neoprene, with steel top plate and drilled for an anchor bolt. Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 345 kPa (50 pounds per square inch).

B. Hangers: Shall be combination neoprene and springs unless otherwise noted and shall allow for expansion of pipe.

1. Combination Neoprene and Spring (Type H): Vibration hanger shall contain a spring and double deflection neoprene element in series. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
2. Spring Position Hanger (Type HP): Similar to combination neoprene and spring hanger except hanger shall hold piping at a fixed elevation during installation and include a secondary adjustment feature to transfer load to spring while maintaining same position.

3. Neoprene (Type HN): Vibration hanger shall contain a double deflection type neoprene isolation element. Hanger rod shall be separated from contact with hanger bracket by a neoprene grommet.
4. Spring (Type HS): Vibration hanger shall contain a coiled steel spring in series with a neoprene grommet. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
5. Hanger supports for piping 50 mm (2 inches) and larger shall have a pointer and scale deflection indicator.

C. Snubbers: Each spring mounted base shall have a minimum of four all-directional or eight two directional (two per side) seismic snubbers that are double acting. Elastomeric materials shall be shock absorbent neoprene bridge quality bearing pads, maximum 60 durometer, replaceable and have a minimum thickness of 6 mm (1/4 inch). Air gap between hard and resilient material shall be not less than 3 mm (1/8 inch) nor more than 6 mm (1/4 inch). Restraints shall be capable of withstanding design load without permanent deformation.

D. Thrust Restraints (Type THR): Restraints shall provide a spring element contained in a steel frame with neoprene pads at each end attachment. Restraints shall have factory preset thrust and be field adjustable to allow a maximum movement of 6 mm (1/4 inch) when the fan starts and stops. Restraint assemblies shall include rods, angle brackets and other hardware for field installation.

2.4 BASES

A. Rails (Type R): Design rails with isolator brackets to reduce mounting height of equipment and cradle machines having legs or bases that do not require a complete supplementary base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension but not less than 100 mm (4 inches). Where rails are used with neoprene mounts for small fans or close coupled pumps, extend rails to compensate overhang of housing.

B. Integral Structural Steel Base (Type B): Design base with isolator brackets to reduce mounting height of equipment which require a complete supplementary rigid base. To assure adequate stiffness, height

of members shall be a minimum of 1/12 of longest base dimension, but not less than 100 mm (four inches).

C. Inertia Base (Type I): Base shall be a reinforced concrete inertia base. Pour concrete into a welded steel channel frame, incorporating prelocated equipment anchor bolts and pipe sleeves. Level the concrete to provide a smooth uniform bearing surface for equipment mounting. Provide grout under uneven supports. Channel depth shall be a minimum of 1/12 of longest dimension of base but not less than 150 mm (six inches). Form shall include 13-mm (1/2-inch) reinforcing bars welded in place on minimum of 203 mm (eight inch) centers running both ways in a layer 40 mm (1-1/2 inches) above bottom. Use height saving brackets in all mounting locations. Weight of inertia base shall be equal to or greater than weight of equipment supported to provide a maximum peak-to-peak displacement of 2 mm (1/16 inch).

D. Curb Mounted Isolation Base (Type CB): Fabricate from aluminum to fit on top of standard curb with overlap to allow water run-off and have wind and water seals which shall not interfere with spring action. Provide resilient snubbers with 6 mm (1/4 inch) clearance for wind resistance. Top and bottom bearing surfaces shall have sponge type weather seals. Integral spring isolators shall comply with Spring Isolator (Type S) requirements.

2.5 SOUND ATTENUATING UNITS

Refer to specification Section 23 31 00, HVAC DUCTS AND CASINGS.

2.6 ACOUSTICAL ENCLOSURES IN MECHANICAL ROOMS

Provide where shown on the drawings. Enclosures shall be removable and sectional, of a size and weight that sections can be readily handled with typical lifting and moving equipment available in the equipment room. Enclosures must contain access openings, observation ports, lights, and ventilation where required for normal operation, observation and servicing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Vibration Isolation:

1. No metal-to-metal contact will be permitted between fixed and floating parts.
2. Connections to Equipment: Allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections,

and other items made to rotating or reciprocating equipment (pumps, compressors, etc.) which rests on vibration isolators, shall be isolated from building structure for first three hangers or supports.

3. Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive rigid alignment with provision for adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling, and bolting.
4. Provide heat shields where elastomers are subject to temperatures over 38 degrees C (l00 degrees F).
5. Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.
6. Non-rotating equipment such as heat exchangers and convertors shall be mounted on isolation units having the same static deflection as the isolation hangers or support of the pipe connected to the equipment.

B. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.

3.2 ADJUSTING

A. Adjust vibration isolators after piping systems are filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4inch (6-mm) movement during start and stop.

D. Adjust active height of spring isolators.

E. Adjust snubbers according to manufacturer's recommendations.

F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

G. Torque anchor bolts according to equipment manufacturer's recommendations to resist seismic forces.

- - - E N D - - -

SELECTION GUIDE FOR VIBRATION ISOLATORS

EQUIPMENT		ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
		BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
REFRIGERATION MACHINES																
ABSORPTION		---	D	---	---	SP	1.0	---	SP	1.0	---	SP	1.7	---	SP	1.7
PACKAGED HERMETIC		---	D	---	---	SP	1.0	---	SP	1.7	---	SP	1.7	R	SP	2.5
OPEN CENTRIFUGAL		B	D	---	B	SP	1.0	---	SP	1.7	B	SP	1.7	B	SP	3.5
RECIPROCATING:																
500 - 750 RPM		---	D	---	---	SP	1.7	R	SP	1.7	R	SP	2.5	R	SP	3.5
751 RPM & OVER		---	D	---	---	SP	1.0	---	---	1.7	R	SP	2.5	R	SP	2.5
COMPRESSORS AND VACUUM PUMPS																
UP THROUGH 1-1/2 HP		---	D,L, W	---	----	D,L, W	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---
2 HP AND OVER:																
500 - 750 RPM		---	D	---	---	S	1.7	---	S	2.5	---	S	2.5	---	S	2.5
750 RPM & OVER		---	D	---	---	S	1.0	---	S	1.7	---	S	2.5	---	S	2.5
PUMPS																
CLOSE COUPLED	UP TO 1-1/2 HP	---	---	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---

EQUIPMENT		ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
		BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
	2 HP & OVER	---	---	---	I	S	1.0	I	S	1.0	I	S	1.7	I	S	1.7
BASE MOUNTED	UP TO 10 HP	---	---	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---
	15 HP THRU 40 HP	I	S	1.0	I	S	1.0	I	S	1.7	I	S	1.7	I	S	1.7
	50 HP & OVER	I	S	1.0	I	S	1.0	I	S	1.7	I	S	2.5	I	S	2.5
ROOF VENTILTORS																
ABOVE OCCUPIED AREAS:																
5 HP & OVER		---	---	---	CB	S	1.0	CB	S	1.0	CB	S	1.0	CB	S	1.0
CENTRIFUGAL BLOWERS																
UP TO 50 HP:																
UP TO 200 RPM		B	N	0.3	B	S	2.5	B	S	2.5	B	S	3.5	B	S	3.5
201 - 300 RPM		B	N	0.3	B	S	1.7	B	S	2.5	B	S	2.5	B	S	3.5
301 - 500 RPM		B	N	0.3	B	S	1.7	B	S	1.7	B	S	2.5	B	S	3.5
501 RPM & OVER		B	N	0.3	B	S	1.0	B	S	1.0	B	S	1.7	B	S	2.5
60 HP & OVER:																
UP TO 300 RPM		B	S	1.7	I	S	2.5	I	S	3.5	I	S	3.5	I	S	3.5

EQUIPMENT	ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
301 - 500 RPM	B	S	1.7	I	S	1.7	I	S	2.5	I	S	3.5	I	S	3.5
501 RPM & OVER	B	S	1.0	I	S	1.7	I	S	1.7	I	S	2.5	I	S	2.5
COOLING TOWERS															
UP TO 500 RPM	---	---	---	---	SP	1.0	---	SP	1.7	---	SP	2.5	---	SP	3.5
501 RPM & OVER	---	---	---	---	SP	1.0	---	SP	1.0	---	SP	1.7	---	SP	2.5
INTERNAL COMBUSTION ENGINES															
UP TO 25 HP	I	N	0.3	I	N	0.3	I	S	1.7	I	S	2.5	I	S	2.5
30 THRU 100 HP	I	N	0.3	I	N	1.7	I	S	2.5	I	S	3.5	I	S	3.5
125 HP & OVER	I	N	0.3	I	N	2.5	I	S	3.5	I	S	4.5	I	S	4.5
AIR HANDLING UNIT PACKAGES															
SUSPENDED:															
UP THRU 5 HP	---	---	---	---	H	1.0	---	H	1.0	---	H	1.0	---	H	1.0
7-1/2 HP & OVER:															
UP TO 500 RPM	---	---	---	---	H, THR	1.7	---	H, THR	1.7	---	H, THR	1.7	---	H, THR	1.7
501 RPM & OVER	---	---	---	---	H, THR	1.0	---	H, THR	1.0	---	H,TH R	1.7	---	H,TH R	1.7
FLOOR MOUNTED:															
UP THRU 5 HP	---	D	---	---	S	1.0	---	S	1.0	---	S	1.0	---	S	1.0

EQUIPMENT	ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
7-1/2 HP & OVER:															
UP TO 500 RPM	---	D	---	R	S, THR	1.7	R	S, THR	1.7	R	S, THR	1.7	R	S, THR	1.7
501 RPM & OVER	---	D	---	---	S, THR	1.0	---	S, THR	1.0	R	S, THR	1.7	R	S, THR	1.7
IN-LINE CENTRIFUGAL AND VANE AXIAL FANS, FLOOR MOUNTED: (APR 9)															
UP THRU 50 HP:															
UP TO 300 RPM	---	D	---	R	S	2.5	R	S	2.5	R	S	2.5	R	S	3.5
301 - 500 RPM	---	D	---	R	S	1.7	R	S	1.7	R	S	2.5	R	S	2.5
501 - & OVER	---	D	---	---	S	1.0	---	S	1.0	R	S	1.7	R	S	2.5
60 HP AND OVER:															
301 - 500 RPM	R	S	1.0	R	S	1.7	R	S	1.7	R	S	2.5	R	S	3.5
501 RPM & OVER	R	S	1.0	R	S	1.7	R	S	1.7	R	S	1.7	R	S	2.5

NOTES:

1. Edit the Table above to suit where isolator, other than those shown, are used, such as for seismic restraints and position limit stops.
2. For suspended floors lighter than 100 mm (4 inch) thick concrete, select deflection requirements from next higher span.
3. For separate chiller building on grade, pump isolators may be omitted.
4. Direct bolt fire pumps to concrete base. Provide pads (D) for domestic water booster pump package.
5. For projects in seismic areas, use only SS & DS type isolators and snubbers.
6. For floor mounted in-line centrifugal blowers (ARR 1): use "B" type in lieu of "R" type base.
7. Suspended: Use "H" isolators of same deflection as floor mounted.

SECTION 22 07 11
PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field applied insulation for thermal efficiency and condensation control for
   1. Plumbing piping and equipment.

B. Definitions
   1. ASJ: All service jacket, white finish facing or jacket.
   2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
   3. Cold: Equipment, piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
   4. Concealed: piping above ceilings and in chases, and pipe spaces.
   5. Exposed: Piping, and equipment exposed to view in finished areas including mechanical, Boiler Plant and electrical equipment rooms or exposed to outdoor weather. Attics and crawl spaces where air handling units are located are considered to be mechanical rooms. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
   6. FSK: Foil-scrim-kraft facing.
   7. Hot: plumbing equipment or piping handling media above 41 degrees C (105 degrees F); 8. Density: kg/m^3 - kilograms per cubic meter (Pcf - pounds per cubic foot).
   8. Thermal conductance: Heat flow rate through materials.
      a. Flat surface: Watt per square meter (BTU per hour per square foot).
      b. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).
   9. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
   10. R: Pump recirculation.
   11. CW: Cold water.
   12. HW: Hot water.
   13. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.

B. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING and Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.

1.3 QUALITY ASSURANCE

A. Refer to article QUALITY ASSURANCE,

B. Criteria:

1. Test methods: ASTM E84, UL 723, or NFPA 255.
2. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.
3. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
   a. Insulation materials: Specify each type used and state surface burning characteristics.
   b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed equipment.
   c. Insulation accessory materials: Each type used.

d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.

e. Make reference to applicable specification paragraph numbers for coordination.

C. Samples:

1. Each type of insulation: Minimum size 100 mm (4 inches) square for board/block/ blanket; 150 mm (6 inches) long, full diameter for round types.

2. Each type of facing and jacket: Minimum size 100 mm (4 inches square).

3. Each accessory material: Minimum 120 ML (4 ounce) liquid container or 120 gram (4 ounce) dry weight for adhesives / cement / mastic.

1.5 STORAGE AND HANDLING OF MATERIAL

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. Federal Specifications (Fed. Spec.):

L-P-535E (2)-91.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.

C. Military Specifications (Mil. Spec.):

MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation

MIL-A-24179A (1)-87.....Adhesive, Flexible Unicellular-Plastic Thermal Insulation

MIL-C-19565C (1)-88.....Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier

MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

D. American Society for Testing and Materials (ASTM):

A167-99.....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

B209-04.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C411-97.....Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation

C449-00.....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

C533-04.....Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

C534-05.....Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

C547-06.....Standard Specification for Mineral Fiber pipe Insulation

C552-03.....Standard Specification for Cellular Glass Thermal Insulation

C553-02.....Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C585-90.....Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System) R (1998)

C612-04.....Standard Specification for Mineral Fiber Block and Board Thermal Insulation

C1126-04.....Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation

C1136-06.....Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

D1668-97a (2006).....Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing

E84-06.....Standard Test Method for Surface Burning Characteristics of Building Materials

E119-05a.....Standard Test Method for Fire Tests of Building Construction and Materials

E136-04.....Standard Test Methods for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C (1380 F)

E. National Fire Protection Association (NFPA):

101-06.....Life Safety Code

251-06.....Standard methods of Tests of Fire Endurance of Building Construction Materials

255-06.....Standard Method of tests of Surface Burning Characteristics of Building Materials

F. Underwriters Laboratories, Inc (UL):

723.....UL Standard for Safety Test for Surface Burning Characteristics of Building Materials with Revision of 08/03

G. Manufacturer’s Standardization Society of the Valve and Fitting Industry (MSS):

SP58-2002.....Pipe Hangers and Supports Materials, Design, and Manufacture

PART 2 - PRODUCTS

2.1 MINERAL FIBER

A. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) for use at temperatures 230 degrees C (450 degrees F).

2.2 CELLULAR GLASS CLOSED-CELL

A. Comply with Standard ASTM C177, C518, density 120 kg/m^3 (7.5 pcf) nominal, k = 0.033 (0.29) at 0 degrees C (75 degrees F).

B. Pipe insulation for temperatures up to 200 degrees C (400 degrees F).

2.3 POLYISOCYANURATE CLOSED-CELL RIGID

A. Preformed (fabricated) pipe insulation, ASTM C591, type IV, K=0.027(0.19), for use at temperatures up to 149 degree C (300 degree F) with factory applied PVDC or all service jacket vapor retarder with polyvinyl chloride premolded fitting covers.

B. Equipment insulation, ASTM C 591,type IV, K=0.027(0.19), for use at temperatures up to 149 degrees C (300 degrees F) with PVDC or all service jacket vapor retarder jacket.

2.4 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

A. ASTM C177, C518, k = 0.039 Watt per meter, per degree C (0.27), at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required.

2.5 CALCIUM SILICATE

A. Preformed pipe Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.

B. Premolded Pipe Fitting Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.

C. Equipment Insulation: ASTM C533, Type I and Type II

D. Characteristics:

Insulation Characteristics		
ITEMS	**TYPE I**	**TYPE II**
Temperature, maximum degrees C (degrees F)	649 (1200)	927 (1700)
Density (dry), Kg/m^3 (lb/ ft3)	232 (14.5)	288 (18)
Thermal conductivity: Min W/ m K (Btu in/h ft^2 degrees F)@ mean temperature of 93 degrees C (200 degrees F)	0.059 (0.41)	0.078 (0.540)
Surface burning characteristics: Flame spread Index, Maximum	0	0
Smoke Density index, Maximum	0	0

2.6 INSULATION FACINGS AND JACKETS

A. Vapor Retarder, higher strength with low water permeance $\underline{=}$ 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.

B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive

closure. Comply with ASTM C1136. Beach puncture 5 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 100 mm (4 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.

C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed equipment.

D. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.

E. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.

F. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.

G. Aluminum Jacket-Piping systems and circular breeching and stacks: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 20 mm (0.75 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.

H. Aluminum jacket-Rectangular breeching: ASTM B209, 3003 alloy, H-14 temper, 0.5 mm (0.020 inches) thick with 32 mm (1-1/4 inch) corrugations or 0.8 mm (0.032 inches) thick with no corrugations. System shall be weatherproof if used for outside service.

2.7 PIPE COVERING PROTECTION SADDLES

A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or

high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m^3 (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long
200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m^3 (3.0 pcf).

C. Boiler Plant Pipe supports: MSS SP58, Type 39. Apply at all pipe support points, except where MSS SP58, Type 3 pipe clamps provided as part of the support system.

2.8 ADHESIVE, MASTIC, CEMENT

A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.

B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.

C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.

D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.

E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.

F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.

G. Other: Insulation manufacturers' published recommendations.

2.9 MECHANICAL FASTENERS

A. Pins, anchors: Welded pins, or metal or nylon anchors with tin-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.

B. Staples: Outward clinching monel or stainless steel.

C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.

D. Bands: 20 mm (3/4 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.10 REINFORCEMENT AND FINISHES

A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).

B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.

C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.

D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.

E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.

F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.11 FIRESTOPPING MATERIAL

Other than pipe insulation, refer to Section 07 84 00 FIRESTOPPING.

2.12 FLAME AND SMOKE

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Required pressure tests of piping joints and connections shall be completed and the work approved by the COTR for application of

insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.

B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.

C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings. Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

E. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.

F. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

G. Plumbing work not to be insulated:

1. Piping and valves of fire protection system.
2. Chromium plated brass piping.
3. Water piping in contact with earth.
4. Piping in pipe basement serving wall hydrants.
5. Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 900 mm (3 feet).
6. Distilled water piping.

H. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

I. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

J. Firestop Pipe insulation:

1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
   a. Pipe risers through floors
   b. Pipe or duct chase walls and floors
   c. Smoke partitions
   d. Fire partitions

K. Provide metal jackets over insulation as follows:

a. All piping exposed to outdoor weather.
b. Piping exposed in building, within 1800 mm (6 feet) of the floor, that connects to sterilizers, kitchen and laundry equipment. Jackets may be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations.
c. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

3.2 INSULATION INSTALLATION

A. Molded Mineral Fiber Pipe and Tubing Covering:

1. Fit insulation to pipe, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.

2. Contractor's options for fitting, flange and valve insulation:
   a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
   b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
   c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
   d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
3. Nominal thickness in millimeters and inches specified in table below, for piping above ground:

Nominal Thickness of Molded Mineral Fiber Insulation				
Nominal Pipe Size, millimeters (inches):	25 (1) & below	32- 75 (1-1/4-3)	100-150 (4-6)	200 (8) and above
a. Domestic cold	15 (0.5)	15(0. 5)	15(0.5)	15 (0.5)
b. Roof drain conductor piping	N/A	25(1. 0)	25(1.0)	25 (1.0)
c. Domestic hot water supply and return	15 (0.5)	20(0.75)	25 (1.0)	40 (1.5)

4. Condensation control insulation: Minimum 20 mm (0.75 inch) thick for all pipe sizes.
   a. Plumbing piping as follows:
      1) Body of roof and overflow drains horizontal runs and offsets (including elbows) of interior downspout piping in all areas above pipe basement.

2) Waste piping from electric water coolers and icemakers to drainage system.
3) Waste piping located above basement floor from ice making and film developing equipment and air handling units, from fixture (including trap) to main vertical waste pipe.
4) Cold water piping.

5. Condensation control insulation: Minimum 20 mm (0.75 inch) thick for all pipe sizes.
   a. Plumbing piping as follows:
      1) Body of roof and overflow drains and horizontal runs and offsets (including elbows) of interior downspout piping in all areas above pipe basement.
      2) Waste piping from electric water coolers to drainage system.
      3) Waste piping located above basement floor from ice making and film developing equipment and air handling units, from fixture (including trap) to main vertical waste pipe.
      4) Cold Water Piping.

B. Flexible Elastomeric Cellular Thermal Insulation:
   1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
   2. Pipe and tubing insulation:
      a. Use proper size material. Do not stretch or strain insulation.
      b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
      c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.

3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
4. Pipe insulation: nominal thickness in millimeters (inches as specified in table below for piping above ground:

Nominal Thickness of Flexible Elastomeric Cellular Insulation				
Nominal Pipe Size millimeters (inches)	25 (1) & below	32-75 (1 1/4-3)	100-150 (4-6)	200 (8)
1. Domestic cold	15 (0.50)	15 (0.5)	15 (0.5)	15 (0.5)
2. Domestic hot water supply and return	15 (0.50)	20 (0.75)	25 (1.0)	40 (1.50)

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SECTION 22 08 00
COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 22.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. This Section includes requirements for commissioning plumbing systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

C. The commissioning activities have been developed to support the United States Green Building Council (USGBC) LEED™ rating program and to support delivery of project performance in accordance with the Contract Documents developed with the approval of the VA.

1. Commissioning activities and documentation for the LEED™ section on “Energy and Atmosphere” prerequisite of “Fundamental Building Systems Commissioning”.
2. Commissioning activities and documentation for the LEED™ section on “Energy and Atmosphere” requirements for the “Enhanced Building System Commissioning” credit.

3. Activities and documentation for the LEED™ section on “Measurement and Verification” requirements for the Measurement and Verification credit.

D. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the VA’s Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following Plumbing systems will be commissioned:

1. Domestic Hot Water Systems (Domestic water heaters, , hot water circulating pumps and motors, controls, combustion burners/fans/motors).
2. Sewage Ejection Pumps (Sump level controls, pump alternator, alarms and alarm panel, pumps and motors).
3. Storm Sump Pumps (Sump level controls, pump alternator, alarms and alarm panel, pumps and motors).

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRE-FUNCTIONAL CHECKLISTS

The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.2 CONTRACTORS TESTS

Contractor tests as required by other sections of Division 22 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the

COTR. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF VA PERSONNEL

Training of the VA operation and maintenance personnel is required in cooperation with the COTR and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the COTR after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 22 Sections for additional Contractor training requirements.

----- END -----

SECTION 22 11 00
FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

1.2 RELATED WORK

A. Penetrations in rated enclosures: Section 07 84 00, FIRESTOPPING.

B. Preparation and finish painting and identification of piping systems: Section 09 91 00, PAINTING.

C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

D. Pipe Insulation: Section 22 07 11, PLUMBING

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Piping.
2. Strainers.
3. All items listed in Part 2 - Products.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):

A-A-1427C.....Sodium Hypochlorite Solution

A-A-59617.....Unions, Brass or Bronze Threaded, Pipe Connections and Solder-Joint Tube Connections

C. American National Standards Institute (ANSI):

American Society of Mechanical Engineers (ASME): (Copyrighted Society)

A13.1-96.....Scheme for Identification of Piping Systems

B16.3-98.....Malleable Iron Threaded Fittings ANSI/ASME

B16.4-98.....Cast Iron Threaded Fittings Classes 125 and 250 ANSI/ASME

B16.9-01.....Factory-Made Wrought Steel Buttwelding Fittings ANSI/ASME

B16.11-01.....Forged Steel Fittings, Socket-Welding and Threaded ANSI/ASME

B16.12-98.....Cast Iron Threaded Drainage Fittings ANSI/ASME

B16.15-85(R 1994).....Cast Bronze Threaded Fittings ANSI/ASME

B16.18-01.....Cast Copper Alloy Solder-Joint Pressure Fittings ANSI/ASME

B16.22-01.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings ANSI/ASME Element ANSI/ASME

D. American Society for Testing and Materials (ASTM):

A47-99.....Ferritic Malleable Iron Castings Revision 1989

A53-02.....Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless

A74-03.....Cast Iron Soil Pipe and Fittings

A183-83(R1998).....Carbon Steel Track Bolts and Nuts

A312-03.....Seamless and Welded Austenitic Stainless Steel Pipe

A536-84(R1999) E1.....Ductile Iron Castings

A733-03.....Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

B32-03.....Solder Metal

B61-02.....Steam or Bronze Castings

B62-02.....Composition Bronze or Ounce Metal Castings

B75-99(Rev A).....Seamless Copper Tube

B88-03.....Seamless Copper Water Tube

B584-00.....Copper Alloy Sand Castings for General Applications Revision A

B687-99.....Brass, Copper, and Chromium-Plated Pipe Nipples

C564-03.....Rubber Gaskets for Cast Iron Soil Pipe and Fittings

E1120.....Standard Specification For Liquid Chlorine

E1229.....Standard Specification For Calcium Hypochlorite

E. American Water Works Association (AWWA):

C110-03/ A21.10-03.....Ductile Iron and Gray Iron Fittings - 75 mm thru 1200 mm (3 inch thru 48 inches) for Water and other liquids AWWA/ ANSI

C151-00/ A21.51-02.....Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids AWWA/ ANSI

C203-02.....Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied AWWA/ ANSI

C651-99.....Disinfecting Water Mains

F. American Welding Society (AWS):

A5.8-92.....Filler Metals for Brazing

G. National Association of Plumbing - Heating - Cooling Contractors (PHCC):

National Standard Plumbing Code - 1996

H. International Association of Plumbing and Mechanical Officials (IAPMO):

Uniform Plumbing Code - 2000

IS6-93.....Installation Standard

I. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-72-99.....Ball Valves With Flanged or Butt Welding For General Purpose

SP-110-96.....Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

J. American Society of Sanitary Engineers (ASSE):

1001-02.....Pipe Applied Atmospheric Type Vacuum Breakers

1018-01.....Performance for trap seal primer valve-water supply fed

1020-04.....Vacuum Breakers, Anti-Siphon, Pressure Type

K. Plumbing and Drainage Institute (PDI):

PDI WH-201.....Water Hammer Arrestor

PART 2 - PRODUCTS

2.1 WATER SERVICE CONNECTIONS TO BUILDINGS

A. From inside face of exterior wall to a distance of approximately 1500 mm (5 feet) outside of building and underground inside building, material selected shall be the same for the size specified.

B. Seventy five millimeters (3 inch) Diameter and Over: Ductile iron, AWWA C151, 850 kPa (125 pounds) water steam pressure (WSP), exterior bituminous coating, cement lined. Provide flanged and anchored connection to interior piping.

C. Under 75 mm (3 inch) Diameter: Copper tubing, ASTM B88, Type K, seamless, annealed. Fittings as specified under Article, INTERIOR

DOMESTIC WATER PIPING. Use brazing alloys, AWS A5.8, Classification BCuP.

D. Flexible Expansion Joint: Ductile iron with ball joints rated for 1725 kPa (250 psi) working pressure conforming to ANSI/AWWA A21.53/C153, capable of deflecting a minimum of 30 degrees and expanding simultaneously to the amount shown on the drawings. Flexible expansion joint shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure containing parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213 and shall be factory holiday tested with a 1500 volt spark test. Flexible expansion joint shall have flanged connections conforming to ANSI/AWWA A21.11/C110. Bolts and nuts shall be 316 stainless steel and gaskets shall be neoprene.

2.2 INTERIOR DOMESTIC WATER PIPING

A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless, steel ASTM A312, schedule 10 may be used.

B. Fittings for Copper Tube:

1. Wrought copper or bronze castings conforming to ANSI B16.18 and B16.22. Unions shall be bronze, MSS SP72 & SP 110, Solder or braze joints.
2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75 C12200, 125 to 150 mm (5 to 6 inch) bronze casting ASTM B584, CDA 844. Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or malleable iron, ASTM A47 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
3. Mechanically formed tee connection: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting. Braze joints.

C. Fittings for Stainless Steel:
   1. Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ANSI B16.9.
   2. Grooved fittings, stainless steel, Type 316, Schedule 10, conforming to ASTM A403. Segmentally fabricated fittings are not allowed. Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or Malleable iron, ASTM A47 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
D. Adapters: Provide adapters for joining screwed pipe to copper tubing.
E. Solder: ASTM B32 Composition Sb5 HA or HB. Provide non-corrosive flux.
F. Brazing alloy: AWS A5.8, Classification BCuP.

2.3 EXPOSED WATER PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
   1. Pipe: Fed. Spec. WW-P-351, standard weight.
   2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
   3. Nipples: ASTM B 687, Chromium-plated.
   4. Unions: Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

2.4 ETO WATER PIPING

Stainless steel, ASTM A312, Schedule 10 with stainless steel butt welded fittings.

2.5 TRAP PRIMER WATER PIPING:

A. Pipe: Copper tube, ASTM B88, type K, hard drawn.
B. Fittings: Bronze castings conforming to ANSI B16.18 Solder joints.
C. Solder: ASTM B32 composition Sb5. Provide non-corrosive flux.

2.6 WATERPROOFING

A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.

B. Floors: Provide cast iron stack sleeve with flashing device and a underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.

C. Walls: See detail shown on drawings.

2.7 STRAINERS

A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.

C. Body: Smaller than 80 mm (3 inches), brass or bronze; 80 mm (3 inches) and larger, cast iron or semi-steel.

2.8 DIELECTRIC FITTINGS

Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

2.9 STERILIZATION CHEMICALS

A. Liquid Chlorine: ASTM E1120.

B. Hypochlorite: ASTM E1229, or Fed. Spec. AA-1427C, grade B.

2.10 WATER HAMMER ARRESTER:

Closed copper tube chamber with permanently sealed 410 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N 0-rings pressure packed and lubricated with FDA approved Dow Corning No. 11 silicone compound. All units shall be designed in accordance with ASSE 1010 for sealed wall installations without an access panel. Size and install in accordance with Plumbing and Drainage Institute requirements (PDI WH 201). Unit shall be as manufactured by Precision Plumbing Products Inc., Watts or Sioux Chief. Provide water hammer arrestors at all solenoid valves, at all groups of two or more flush valves, at all quick opening or closing valves, and at all medical washing equipment.

2.11 WATER FILTER: (POINT OF USE / ICE MAKER)

Filter shall have a nominal degree of filtration of 5 microns, with a flow rate of up to 2 GPM, and shall include a taste/odor/sediment/rust removal cartridge. Unit shall be wall mountable with integral bracket and easy replacement cartridge. Filter shall be the Cuno Aqua-Pure Model AP200, with No. AP 217 cartridge, or approved equal to. Contractor shall furnish one (1) extra filter cartridge for spare.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the PHCC National Standard Plumbing Code and the following:

1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
3. All pipe runs shall be laid out to avoid interference with other work.
4. Install union and shut-off valve on pressure piping at connections to equipment.
5. Pipe Hangers, Supports and Accessories:
   a. All piping shall be supported per of the National Standard Plumbing Code, Chapter No. 8.
   b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with red lead or zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
   c. Floor, Wall and Ceiling Plates, Supports, Hangers:
      1) Solid or split unplated cast iron.
      2) All plates shall be provided with set screws.
      3) Pipe Hangers: Height adjustable clevis type.
      4) Adjustable Floor Rests and Base Flanges: Steel.
      5) Concrete Inserts: "Universal" or continuous slotted type.
      6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
      7) Riser Clamps: Malleable iron or steel.
      8) Rollers: Cast iron.
      9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
      10) Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered

on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gauge steel. The shield shall be sized for the insulation.

11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.

6. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Penetrations:
   a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Completely fill and seal clearances between raceways and openings with the fire stopping materials.
   b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

B. Piping shall conform to the following:
   1. Domestic Water:
      a. Where possible, grade all lines to facilitate drainage. Provide drain valves at bottom of risers. All unnecessary traps in circulating lines shall be avoided.
      b. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2 TESTS

A. General: Test system either in its entirety or in sections.

B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 690 kPa (100 psi) gage for

two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested.

C. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.

3.3 STERILIZATION

A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.

B. Use either liquid chlorine or hypochlorite for sterilization.

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SECTION 22 11 23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

Hot water circulating pump, hot water recirculation pump.

1.2 RELATED WORK

A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

B. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

C. SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS.
Requirements for commissioning, systems readiness checklist, and training.

D. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:
   1. Pump:
      a. Manufacturer and model.
      b. Operating speed.
      c. Capacity.
      d. Characteristic performance curves.
   2. Motor:
      a. Manufacturer, frame and type.
      b. Speed.
      c. Current Characteristics.
      d. Efficiency.

C. Certified copies of all the factory and construction site test data sheets and reports.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

E. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA):
ICS6-93 (R2006).....Industrial Control and Systems Enclosures
250-08.....Enclosures for Electrical Equipment (1000 Volts Maximum)

C. American Society of Mechanical Engineers (ASME):
Boiler and Pressure Vessel Code: 2010
Section VIII.....Pressure Vessels, Division I and II

D. Underwriters' Laboratories, Inc. (UL):
508-99 (R2008)..... Standards for Industrial Control Equipment

PART 2 - PRODUCTS

2.1 CIRCULATING PUMP

A. Centrifugal, single or multi stage, constructed to prevent contact of water with metal other than nonferrous. Driver shall be electric motor, close coupled or connected by flexible or magnetic coupling. Pump for hot water system shall be designed for 65 degrees C (150 degrees F) water service.

B. Mounting shall be either of the following:
1. In-line mounted.
2. Floor mounted set on common bed plate with drip lip.

C. Casings: Epoxy coated cast iron, bronze, stainless steel, vertically or horizontally split.

D. Impeller: High grade, cast brass or bronze, accurately machined and properly balanced.

E. Motors: Maximum 40 degrees C (104 degrees F) ambient temperature rise, drip proof, for operation with current, voltage, phase and cycle shown in schedule on Electrical drawings, conforming to NEMA 250-Type 4. Size the motor capacity to operate the pump without overloading. In-line pump motors shall not exceed 1800 rpm and shall be provided with spring mountings or equal devices to assure quiet operation. Motors shall be equipped with thermal overload protection. When motor has cooled down it shall re-start automatically if the operating control has been left on and the system requires pump to start.

F. Pump shall operate continuously with "on-off" switch for shut down. In the inlet and outlet piping of the pump, shutoff valves shall be installed to permit service to the pump without draining the system.

G. A check valve shall be installed in the pump discharge piping immediately downstream of the pump

2.2 INLINE HOT WATER RECIRCULATING PUMP

A. Centrifugal in-line horizontal oil lubricated pump designed for quiet operation and 862 kPa (125 psi).

B. Bronze body construction capable of pumping 56 LPM (15 GPM) @ 4.6 Meters of head (15 Feet of head) when drive by 1/4 HP single phase, 120VAC motor. Pump shall be non-overloading at any point on the pump curve.

C. Pump controlled from on/off aquastat located at pump. In addition, the pump shall be provided with "on-off" switch for shut down. In the inlet and outlet piping of the pump shutoff valves shall be installed to permit service to the pump without draining the system. A check valve shall be installed in the pump discharge piping immediately downstream of the pump.

PART 3 - EXECUTION

3.1 STARTUP AND TESTING

A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. System Test: After installation is completed provide an operational test of the completed system including flow rates, pressure compliance, alarms and all control functions.

C. When any defects are detected, correct defects and repeat test.

D. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COTR and Commissioning Agent. Provide a minimum of 7 days prior to notice.

3.2 COMMISSIONING

A. Provide Commissioning Documentation accordance with the requirements of Section 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS for all inspection, startup, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this Section of the specification will be tested as part of a larger system. Refer to Section 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.3 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four hours to instruct VA Personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

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SECTION 22 13 00
FACILITY SANITARY AND VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.

B. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.

C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.

D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Pipe Insulation.

E. Section 07 92 00 Joint Sealants: Sealant products.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data:

1. Piping.
2. Floor Drains.
3. Cleanouts.
4. All items listed in Part 2 - Products.

C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Mechanical Engineers (ASME): (Copyrighted Society)

A112.6.3-01 (R 2007)....Standard for Floor and Trench Drains
A13.1-07.....Scheme for Identification of Piping Systems
B16.3-06.....Malleable Iron Threaded Fittings, Classes 150 and 300.
B16.4-06.....Standard for Grey Iron Threaded Fittings Classes 125 and 250

B16.12-98 (R 2006).....Cast Iron Threaded Drainage Fittings

B16.15-06.....Cast Bronze Threaded Fittings, Classes 125 and 250

C. American Society for Testing and Materials (ASTM):

A47/A47M-99 (R 2004)....Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process

A53/A53M-07.....Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated, Welded and Seamless

A74-06.....Standard Specification for Cast Iron Soil Pipe and Fittings

A183-03.....Standard Specification for Carbon Steel Track Bolts and Nuts

A536-84(R 2004).....Standard Specification for Ductile Iron Castings

B32-08.....Standard Specification for Solder Metal

B75-02.....Standard Specification for Seamless Copper Tube

C564-03a.....Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

D2000-08.....Standard Classification System for Rubber Products in Automotive Applications

D. International Code Council:

IPC-06.....International Plumbing Code

E. Cast Iron Soil Pipe Institute (CISPI):

301-05.....Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

310-04.....Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

F. American Society of Sanitary Engineers (ASSE):

1018-01.....Trap Seal Primer Valves – Potable, Water Supplied

G. Plumbing and Drainage Institute (PDI):

PDI WH-201.....Water Hammer Arrestor

PART 2 - PRODUCTS

2.1 SANITARY WASTE, DRAIN, AND VENT PIPING

A. Cast iron waste, drain, and vent pipe and fittings

1. Cast iron waste, drain, and vent pipe and fittings shall be used for the following applications:
   a. pipe buried in or in contact with earth
   b. sanitary pipe extensions to a distance of approximately 1500 mm (5 feet) outside of the building.
   c. interior waste and vent piping above grade.
2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).
3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A-888, or ASTM A-74.
4. Joints for hubless pipe and fittings shall conform to the manufacturer’s installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM Standard C-564 or be installed with lead and oakum.

2.2 EXPOSED WASTE PIPING

A. Full iron pipe size chrome plated brass piping shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

1. The Pipe shall meet Fed. Spec. WW-P-351, standard weight.
2. The Fittings shall conform to ANSI B16.15, cast bronze threaded fittings with chrome finish, (125 and 250).
3. Nipples shall conform to ASTM B 687, Chromium-plated.
4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

B. In unfinished Rooms such as mechanical Rooms and Kitchens, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph “Sanitary Waste, Drain, and Vent Piping”

can be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 09 91 00, PAINTING.

2.3 SPECIALTY PIPE FITTINGS

A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:

1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
2. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 860 kPa (125 psig) at a minimum temperature of 82°C (180°F). The end connection shall be solder joint copper alloy and threaded ferrous.

C. Dielectric flange insulating kits shall be of non conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F 1545 with a pressure ratings of 2070 kPa (300 psig) at 107°C (225°F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.4 CLEANOUTS

A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); and not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line.

B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or

spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.

C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

2.5 FLOOR DRAINS

A. Type A (FD-A) floor drain shall comply with ANSI A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane

other than for drain opening will not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a 2.2 kg (16-ounce) soft copper membrane, 600 mm (24 inches) square or another approved waterproof membrane shall be provided.

B. Type B (FD-B) floor drain shall comply with ANSI A112.6.3. The type B floor drain shall be constructed of galvanized cast iron with medium duty nickel bronze grate, double drainage pattern, clamping device, without sediment bucket but with secondary strainer in bottom. The grate shall be 175 mm (7 inches) minimum.

C. Type C (FD-C) floor drain shall comply with ANSI A112.6.3. The type C floor drain shall have a cast iron body, double drainage pattern, clamping device, light duty square or round nickel bronze adjustable strainer and grate with vandal proof screws. The grate shall be square, 150 mm (6 inches) minimum.

D. Type V (FD-V) floor drain shall comply with ANSI A112.6.3 The type V floor drain shall have an oval funnel and cast iron body. Funnel strainer shall consist of a slotted cast iron floor-level grate funnel extension. Minimum dimensions as follows:

1. Area of strainer and collar – 23 000 Square mm (36 square inches).
2. Height of funnel – 95 mm (3-7/8 inches).
3. Funnel size - 90 by 225 mm (3-1/2 by 9 inches).

E. Open Sight Drains (OSDs) shall be cast iron, constructed as shown by detail.

2.6 TRAPS

Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as pipe connected to. Slip joints are not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

2.7 TRAP SEAL PRIMER VALVES AND TRAP SEAL PRIMER SYSTEMS

A. Trap Primer (TP-2): The trap seal primer valve shall be hydraulic, supply type with a pressure rating of 5.98 kPa (125 psig) and conforming to standard ASSE 1018.

1. The inlet and outlet connections shall be 15 mm or DN15 (NPS ½ inch)
2. The trap seal primer valve shall be fully automatic with an all brass or bronze body.
3. The trap seal primer valve shall be activated by a drop in building water pressure, no adjustment required.
4. The trap seal primer valve shall include a manifold when serving two, three, or four traps.
5. The manifold shall be omitted when serving only one trap.

2.8 WATERPROOFING

A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

B. Walls: See detail shown on drawings.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.

B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.

C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

D. All pipe runs shall be laid out to avoid interference with other work.

E. The piping shall be installed above accessible ceilings where possible.

F. The piping shall be installed to permit valve servicing or operation.

G. Unless specifically indicated on the drawings, the minimum slope shall be 2% slope.

H. The piping shall be installed free of sags and bends.

I. Seismic restraint shall be installed where required by code.

J. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Cast iron piping shall be installed according to CISPI’s “Cast Iron Soil Pipe and Fittings Handbook,” Chapter IV, “Installation of Cast Iron Soil Pipe and Fittings”

3.2 JOINT CONSTRUCTION

A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI’s “Cast Iron Soil Pipe and Fittings Handbook” for compression joints.

B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI’s “Cast Iron Soil Pipe and Fittings Handbook” for lead and oakum calked joints.

C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI’s “Cast Iron Soil Pipe and Fittings Handbook” for hubless piping coupling joints.

D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service
2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

3.3 SPECIALTY PIPE FITTINGS

A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES:

A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.

B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.

D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:

1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
2. 80 mm or DN 80 (NPS 3 inch): 1500 mm (60 inches) with 13 mm (½ inch) rod.
3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 to NPS 5): 1500 mm (60 inches) with 16 mm (5/8 inch) rod.
4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 inch to NPS 8 inch): 1500 mm (60 inches) with 19 mm (¾ inch) rod.
5. 250 mm or DN250 to 300 mm or DN 300 (NPS 10 inch to NPS 12 inch): 1500 mm (60 inch) with 22 mm (7/8 inch) rod.

E. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.57 m (15 feet).

F. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:

1. Solid or split unplated cast iron.
2. All plates shall be provided with set screws.

3. Height adjustable clevis type pipe hangers.
4. Adjustable floor rests and base flanges shall be steel.
5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
6. Riser clamps shall be malleable iron or steel.
7. Rollers shall be cast iron.
8. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.

G. Miscellaneous materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.

H. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

I. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

J. Piping shall conform to the following:

1. Waste and Vent Drain to main stacks:

Pipe Size	Minimum Pitch
80 mm or DN 80 (3 inches) and smaller	2%
100 mm or DN 100 (4 inches) and larger	1%

2. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

3.5 TESTS

A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.

1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
2. For an air test, an air pressure of 35 kPa (5 psig) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the air test.
3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
4. Final Tests: Either one of the following tests may be used.
   a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
   b. Peppermint Test: Introduce (2 ounces) of peppermint into each line or stack.

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SECTION 28 31 00
FIRE DETECTION, MASS NOTIFICATION, AND ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

A. The project specifications and drawings outline the requirements for a new combination Mass Notification/Emergency Communication and Fire Alarm System (MNEC/FA) for the New Mental Health Complex. System must be a complete solution that is UL approved for both Fire Alarm (UL864) as well as Mass Notification (UL2572). Systems having to use multiple manufacturers with various makes and models of Fire Alarm & Mass Notification equipment will not be accepted as meeting the requirements of this specification. Intent of the project is to have the entire Fire Alarm & Mass Notification System work as one complete system without the need for multiple systems tied together to meet the intended design.

B. Non-coded, UL Listed intelligent analog addressable system, one-way voice communications with multiplexed signal transmission and survivable network nodes.

C. The System supplied under this specification shall utilize node-to-node, direct wired, multi priority peer-to-peer network operations. The system shall utilize independently addressed, input/output modules, audio amplifiers, and voice communications as described in this specification. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, and LCD panels. Each panel shall be an equal, active functional member of the network, which is capable of making all local decisions and generating network tasks to other panels in the event of panel failure or communications failure between panels. Master/slave system configurations shall not be considered as equals.

D. System shall be designed and tested for interior building audibility of 15 dBA-fast over ambient condition and intelligibility. Intelligibility shall be designed and tested to ensure Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 in all areas designated on the drawings to have intelligible audio. All areas required to have intelligibility shall be modeled in a recognized computer modeling program such as EASE by

Renkus-Hienz. All modeling output data shall be submitted to the owner.

1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Requirements for procedures for submittals.

B. Section 07 84 00 - FIRESTOPPING. Requirements for fire proofing wall penetrations.

C. Section 08 71 00 - DOOR HARDWARE. For combination Closer-Holders.

D. Section 21 13 13 - WET-PIPE SPRINKLER SYSTEMS. Requirements for sprinkler systems.

E. Section 26 05 11 – REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for general requirements that are common to more than one section in Division 26.

F. Section 26 05 21 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for conductors and cables.

G. Section 2605 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Requirements for grounding of equipment.

H. Section 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.

I. Section 26 08 00, COMMISSIONING OF ELECTRICAL SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.

1.3 SUBMITTALS

A. General: Submit five (5) copies in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Drawings:

1. Prepare drawings using AutoCAD 2007 Release, or later, software and include all contractors information. Layering shall be by VA criteria as provided by the Contracting Officer’s Technical Representative (COTR). Bid drawing will be provided to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.

2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and

raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.

3. Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, elevator control interface, HVAC shutdown interface, fire extinguishing system interface, and all other fire safety interfaces. Show wiring Styles on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.
4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
5. Two weeks prior to final inspection, the Contractor shall deliver to the COTR three (3) sets of as-built drawings and one (1) set of the as-built drawing computer files (using AutoCAD 2007 or later). As-built drawings (floor plans) shall show all new and/or existing conduit used for the fire alarm system.

C. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
   a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.

b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.
d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.
e. Complete listing of all digitized voice messages.
f. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
g. Include information indicating who will provide emergency service and perform post contract maintenance.
h. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
i. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VAMC and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.
j. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.
k. A print out for all devices proposed on each signaling line circuit with spare capacity indicated.

2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manual to the COTR.
   a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.

b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.
e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.

D. Certifications:
1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer’s representative who makes the certification.
2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

1.4 WARRANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one (1) year from the date of acceptance of the entire installation by the Contracting Officer.

1.5 GUARANTY PERIOD SERVICES

A. Complete inspection, testing, maintenance and repair service for the fire alarm system shall be provided by a factory trained authorized

representative of the manufacturer of the major equipment for a period of five years from the date of acceptance of the entire installation by the Contracting Officer.

B. Contractor shall provide all necessary test equipment, parts and labor to perform required inspection, testing, maintenance and repair.

C. All inspection, testing, maintenance and permanent records required by NFPA 72, and recommended by the equipment manufacturer shall be provided by the contractor. Work shall include operation of sprinkler system alarm and supervisory devices. It shall include all interfaced equipment including but not limited to elevators, HVAC shutdown, and extinguishing systems.

D. Maintenance and testing shall be performed in accordance with NFPA 72. A computerized preventive maintenance schedule shall be provided and shall describe the protocol for preventive maintenance of equipment. The schedule shall include a systematic examination, adjustment and cleaning of all equipment.

E. Non-included Work: Repair service shall not include the performance of any work due to improper use, accidents, or negligence for which the contractor is not responsible.

F. Service and emergency personnel shall report to the Engineering Office or their authorized representative upon arrival at the hospital and again upon the completion of the required work. A copy of the work ticket containing a complete description of the work performed and parts replaced shall be provided to the VA Contracting Officer or his authorized representative.

G. Emergency Service:

1. Warranty Period Service: Service other than the preventative maintenance, inspection, and testing required by NFPA 72 shall be considered emergency call-back service and covered under the warranty of the installation during the first year of the warranty period, unless the required service is a result of abuse or misuse by the Government. Written notification shall not be required for emergency warranty period service and the contractor shall respond as outlined in the following sections on Normal and Overtime Emergency Call-Back Service. Warranty period service can be required during normal or overtime emergency call-back service time periods

at the discretion of the Contracting Officer or his authorized representative.

2. Normal and overtime emergency call-back service shall consist of an on-site response within two hours of notification of a system trouble.
3. Normal emergency call-back service times are between the hours of 7:30 a.m. and 4:00 p.m., Monday through Friday, exclusive of federal holidays. Service performed during all other times shall be considered to be overtime emergency call-back service. The cost of all normal emergency call-back service for years 2 through 5 shall be included in the cost of this contract.
4. Overtime emergency call-back service shall be provided for the system when requested by the Government. The cost of the first 40 manhours per year of overtime call-back service during years 2 through 5 of this contract shall be provided under this contract. Payment for overtime emergency call-back service in excess of the 40 man hours per year requirement will be handled through separate purchase orders. The method of calculating overtime emergency call-back hours is based on actual time spent on site and does not include travel time.

H. The contractor shall maintain a log at each fire alarm control unit. The log shall list the date and time of all examinations and trouble calls, condition of the system, and name of the technician. Each trouble call shall be fully described, including the nature of the trouble, necessary correction performed, and parts replaced.

I. In the event that VA modifies the fire alarm system post-Acceptance but during the five year Guaranty Period Service period, Contractor shall be required to verify that the system, as newly modified or added, is consistent with the manufacturer's requirements; any verification performed will be equitably adjusted under the Changes clause. The post-Acceptance modification or addition to the fire alarm system shall not void the continuing requirements under this contract set forth in the Guarantee Period Service provision for the fire alarm system as modified or added. The contract will be equitably adjusted under the Changes clause for such additional performance.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only and the latest editions of these publication shall be applicable.

B. National Fire Protection Association (NFPA):

NFPA 13 .....Standard for the Installation of Sprinkler Systems

NFPA 14 ..... Standard for the Installation of Standpipes and Hose Systems

NFPA 20 ..... Standard for the Installation of Stationary Pumps for Fire Protection

NFPA 70.....National Electrical Code (NEC).

NFPA 72.....National Fire Alarm Code.

NFPA 90A.....Installation of Air Conditioning and Ventilating Systems.

NFPA 101.....Life Safety Code

C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment Directory

D. Underwriters Laboratories, Inc. (UL): UL 2572, Control and Communication Units for Mass Notification Systems. Control equipment that is not dually UL 864 and 2572 listed are not acceptable.

E. Factory Mutual Research Corp (FM): Approval Guide

F. American National Standards Institute (ANSI):

S3.41.....Audible Emergency Evacuation Signal

G. International Code Council, International Building Code (IBC)

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Manufacturers: The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling fire alarm system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

B. The Contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the

requirements of these Specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.

C. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, and will accommodate the future requirements and operations of the building Owner. All specified operational features must be met without exception.

D. All control panel assemblies and connected (new) field appliances shall be provided by the same System Supplier, and shall be designed and tested to ensure that the system operates as specified. All equipment and components shall be installed in strict compliance with the manufacturer's recommendations.

E. Base of Design: All panels and peripheral devices shall be of the standard product of single manufacturer and shall display the manufacturer’s name of each component. The catalog numbers specified under this section are those of EST, more specifically EST-3 system, (Edwards Systems Technology) by UTC Climate, Controls & Security, Inc. and shall constitute the type, product quality, material and desired operating features. Existing campus wide fire alarm/mass notification system is the EST-3, new equipment provided under this contract shall match existing campus system.

2.2 CONDUIT AND BOXES

A. Conduit shall be in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS and as follows:

1. All new and reused conduit shall be installed in accordance with NFPA 70.
2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
3. All new conduit shall be 19 mm (3/4 inch) minimum.

B. Terminal Boxes, Junction Boxes, and Cabinets:

1. Shall be galvanized steel in accordance with UL requirements.
2. All new and reused boxes shall be sized and installed in accordance with NFPA 70.
3. New and existing covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for

cabinets and terminal boxes. Lettering shall be a minimum of 19 mm (3/4 inch) high.

4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COTR.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

A. Signal priority shall be in accordance with UL 2572 as indicated below:
   1. Mass Notification
   2. Life Safe/Fire Alarm
   3. Other

B. MNEC operation shall be initiated only from the Central Control Station (CCS) or respective building FACP. No automatic operation shall be permitted.
   1. Any operation of MNEC at the building ACP shall be indicated at the CCS.
   2. Any operation of the MNEC from the CCS shall indicate at the FACP that the respective building system is in MNEC mode.
   3. Provide all indicators required by UL 2572 and AHJ.
   4. System operation shall be as specified in UL 2572.
   5. Pre-recorded messages shall be selectable at the CCS and respective FACP locations and shall consist of a minimum of the following:
      a. Lockdown
      b. Weather warning
      c. All Clear
      d. Evacuation
      e. Stand by
      f. Chemical emergency
      g. Test
   6. The system shall be capable of live voice page from the CCS to each building zone. Live voice paging inside the respective building shall be capable of being initiated from the FACP.

C. Fire-alarm signal initiation shall be by one or more of the following devices:
   1. Manual stations.
   2. Heat detectors.
   3. Smoke detectors.
   4. Duct smoke detectors.
   5. Automatic sprinkler system water flow.
   6. Heat detectors in elevator shaft and pit.
D. Fire-alarm signal shall initiate the following actions:
   1. Activate multiple channel pre-recorded voice messages followed by temporal tone.
   2. Continuously operate the visual notification appliances.
   3. Identify alarm at fire-alarm control unit and remote annunciators.
   4. Unlock electric door locks in designated egress paths.
   5. Release fire and smoke doors held open by magnetic door holders.
   6. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
   7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
   8. Recall elevators to primary or alternate recall floors.
   9. Record events in the system memory.
E. Supervisory signal initiation shall be by one or more of the following devices and actions:
   1. Valve supervisory switch.
   2. Elevator shunt-trip supervision.
F. System trouble signal initiation shall be by one or more of the following devices and actions:
   1. Open circuits, shorts, and grounds in designated circuits.
   2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   3. Loss of primary power at fire-alarm control unit.
   4. Ground or a single break in fire-alarm control unit internal circuits.
   5. Abnormal ac voltage at fire-alarm control unit.
   6. Break in standby battery circuitry.
   7. Failure of battery charging circuitry
   8. High or low battery charge.

9. Abnormal position of any switch at fire-alarm control unit or annunciator.

G. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.4 IP NETWORK CAPABILITY FOR FUTURE GROWTH AND EXPANSION

A. For future growth and expansion capability, each ACU/FACP control panel audio source shall have the capability to be connected to the LAN/WAN network interface. Each Network audio connectivity shall consist of a supervised decoder capable of decoding MP3, WMA, G.711 and PCM data streams in either HTTP, UDP or RTP format. Audio decoder shall operate on filtered-regulated 24 VDC power derived from the panel power supply. Power shall supplied directly from the FACP or listed Auxiliary Power Supply, ensuring a reliable and monitored power source.

1. Audio decoder shall be equipped with:
   a. A RCA jack line-level audio output.
   b. RJ45 10/100BASE T Mbit Automatic Ethernet port.
   c. RS232 DB9 male interface capable of 115,200 baud communication.
   d. Normally open relay contact rated at 500 mA @ 24 VDC.
   e. Reset button.
   f. Aluminum case.
   g. Analog audio from the decoder shall connect to the ACU/FACP audio source unit, then to a MN-PASM supervisory module that is monitored by a SIGA-RM1 supervisory module.
   h. Shall be Edwards-EST model MN-FVPN

2.5 FIRE-ALARM CONTROL UNIT

A. The main control panel or remote control panel(s) shall be a multi-processor based networked system designed specifically for detection, and one-way emergency audio communications applications. The control panel(s) shall be listed and approved for the application under the standard(s) as listed. The control panel shall be model Edwards-EST3.

B. The control panel(s) shall include all required hardware, software and site-specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified using software provided by a single supplier. The control panel operational priority

shall assure that life safety takes precedence among the activities coordinated by the control panel.

C. The network of control panels shall include the following features.

1. Ability to download all network applications and firmware from the configuration computer on the network or at any control panel (network node) location.
2. Each control panel (network node) shall have an LCD display with common controls. The display shall be configurable to display the status of any and all combinations of alarm, supervisory, trouble, monitor, or group event messages.
3. Each LCD display on the system shall be capable of being programmed for control functions of any node or the entire network. The LCD display shall reside on the network as a node and continue to operate with multiple faults on the network. An LCD can be programmed to be only operational when a node is operational in stand-alone mode, with a network fault.
4. The system program shall have a minimum of 100 system definable Service Groups to facilitate the testing of installed system based on the physical layout of the system. Service groups that disable entire circuits serving multiple floors or fire zones shall not be considered as equal.
5. Advanced Windows based programming with Program Version Reporting to document any and all changes made during system start-up or system commissioning. Time and date stamps of all modifications made to the program must be included to allow full retention of all previous program version data. The operator display shall clearly identify unacknowledged and acknowledged alarm, supervisory, trouble, and monitor status messages. The system shall provide the ability to download data from the analog/addressable detectors to a PC while the system is on-line and operational in the protected premises. The downloaded data may then be analyzed in a diagnostic program supplied by the system manufacturer.
6. Provide system reports that list a detailed description of the status of system parameters for corrective action or for preventive maintenance. Reports shall be displayed on the operator interface or be capable of being sent to a printer.

7. Provide an authorized operator with the ability to operate or modify system functions such as system time, date, passwords, holiday dates, restart the system and clear the control panel event history file.
8. Provide an authorized operator the ability to perform test functions within the installed system.
9. Supervision of system components, wiring, initiating devices and software shall be provided by the control panel. Failure or fault of system component or wiring shall be indicated by type and location on the LCD display. Software and processor operation shall be independently monitored for failure. The system shall provide fail-safe operation, with multiple-levels of system operation

D. Each network control panel shall be capable of:
1. Supporting up to 2500 intelligent analog/addressable points.
2. Supporting up to ten (10) intelligent addressable loops, each loop supporting 125 detectors and 125 modules, total of 250 points per loop.
3. Supporting network connections up to 63 other control panels and annunciators.
4. Supporting up to 124 (security/access control) Keypad/Displays.
5. Support up ten network digital dialers with Contact ID or SIA format and TAP Pager protocol.
6. Supporting multiple RS-232 communication ports and protocol.
7. Supporting up to 1000 chronological history events.
8. Total network response shall not exceed 3 seconds

E. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, monitor, trouble and component status messages and control menu.
1. The common control switches and with corresponding LEDs provided as minimum will be; Reset, Alarm Silence, Panel Silence, and Drill. It shall be able possible to add additional switches/LEDs as required.
2. The main control panel shall have a display that is a 24 lines by 40 character graphic LCD and backlit when active.

3. Each point shall have a custom event message of up to 40 charters, for a total of 80 characters. In addition instructional text messages shall be supported with a maximum of 2,000 characters each.
4. Provide 8 simultaneous events to be displayed. The first seven (7) highest priority events in addition to the most recent event. The events shall be automatically placed in event types (Alarm, Supervisory, Monitor & Trouble) for easy access and it shall be possible to view the specific event type separately. Having to scroll through a mixed list of event types is not acceptable.
5. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
6. This display shall be an Edwards-EST 3-LCDXL1.
7. Systems not capable of such a display on the main panel faceplate shall include a CRT/Monitor display meeting the above requirements and battery stand-by.

F. Audio One-Way Voice Communications

1. The voice communication system shall be eight (8) channel audio evacuation system, to allow the ability to have eight simultaneous announcements/paging. The audio channels shall be designed as such:
   a. Mass Notification Message (HIGHEST PRIORITY)
   b. Fire Message
   c. Alert Message
   d. Stand-by Message
   e. Elevator Message
   f. Stairwell Message
   g. Security/Weather Threat
   h. Manual Paging
2. The system custom digital voice message shall provide a minimum of **100 minutes** and be created as a .wav file format. All messages shall be able to be created on-site without any special tools or burning of chips. Provide as a minimum one twenty (20) watt supervised audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide an internally generated local 3-3-3, 1000 Hz temporal pattern output upon loss of the audio signal

from the one-way emergency audio control unit, during an alarm condition.

3. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall be a supervised, dedicated, selectable 25/70 Vrms output.
4. Provide a standby audio amplifier per node that will automatically sense the failure of any primary amplifier installed in the same panel and replace the function of the failed amplifier.

G. Provide an Emergency Voice Communication System with the following design features:
1. An audio control unit with Microphone for Paging.
2. Provide 3-position switch for each evacuation signaling zone and “All-Call”, with "Page FIRE", "Auto" and “Page ALERT” positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow.
3. These LED's shall illuminate to indicate respectively:
a. Evacuation signals activated (red),
b. Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).

H. Provide 2-position switch for manually activate pre-recorded voice messages, with “Message Name" positions identified and one LED status indicators, one red. Provide minimum of 12 selector switches.
1. These LED's shall illuminate to indicate respectively:
a. Message activated (red)

I. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions

J. Circuits Requirements:
1. Signaling Line Circuits for Network Communications:
a. Class A, Style 7.
2. Signaling Line Circuits for Intelligent Analog Addressable Loop:
a. Class B, Style 4.
b. No more than 100 detectors or 100 modules installed on a loop.
3. Initiating Device Circuit:

a. Class B, Style B

4. Notification Appliance Circuits:
   a. Class B, Style Y.
   b. Maximum circuit loading to 2 amps for visuals.
5. Activation of alarm notification appliances, smoke control, elevator recall and other functions shall occur within 3 seconds after the activation of an initiating device.

K. Smoke-Alarm Verification:
1. Initiate an audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

L. Elevator Recall:
1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
   a. Elevator lobby detectors except the lobby detector on the designated floor.
   b. Smoke detector in elevator machine room.
   c. Smoke detectors in elevator hoistway.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
   a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

M. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

N. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their

current status and sensitivity settings, and change to alternate settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

O. Digital Alarm Communicator Transmitter: The system shall have an integrated off premise communications capability using a digital alarm communications transmitter (DACT) for sending system events to multiple central monitoring station (CMS) receivers. The system shall provide the CMS(s) with point identification of system events using 4/2, 3/1, Contact ID or SIA DCS protocols. The dialer shall have the capability to support up to 255 individual accounts and to send account information to eight (8) different receivers, each having a primary and secondary telephone access number. System events shall be capable of being directed to one or more receivers depending on event type or location as specified by the system designed. In the event of a panel CPU failure during a fire alarm condition, the DACT degraded mode shall transmit a general fire alarm signal to the CMS.

1. Digital data transmission shall include the following (Contact ID). Systems not capable of providing a dialer that is part of the main Fire Alarm Panel and/or providing Contact ID as part of the reporting method will not be listed as acceptable to meeting the intent of these specifications.
   a. Address of the alarm-initiating device.
   b. Loss of ac supply or loss of power.
   c. Low battery.
   d. Abnormal test signal.
   e. Communication bus failure
2. Shall be Edwards-EST, model 3-MODCOM.

P. Alpha-Numerical Pager Interface: The system shall have the capability to support and transmit an alphanumeric system activity message, by event, by point descriptor to a commercial paging system of the owner’s choice, using TAP Pager protocol.

1. Shall be Edwards-EST, model 3-MODCOM/P

Q. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, shall be powered by nominal 24-V dc source.

R. Secondary Power: Shall provide 24 hours supervisory and 15 minutes of alarm with batteries, automatic battery charger, and automatic transfer switch.

2.6 REMOTE ANNUNCIATOR

A. Annunciator shall match those of fire-alarm control unit LCD display functions for alarm, supervisory, monitor and trouble indications and common system controls including; acknowledging, silencing, resetting, and testing. Include a remote microphone for remote paging.

1. This display shall be Edwards-EST, model 3-LCDXL1 or 3-LCDANN

2.7 NAC POWER SUPPLY:

A. The NAC power supply shall be independent unit that will provide power to visual strobe notification appliances. It shall be possible to configure the NAC’s to follow the main panel’s NAC or activate from intelligent synchronized modules. The booster NAC’s must be configurable to operate independently at any one of the following rates: continuous synchronized, or 3-3-3 temporal. Fault conditions on the power supply shall not impede alarm activation of host NAC circuits or other power supplies. The NAC power supply must be able to provide concurrent power for notification devices, security devices, access control equipment and auxiliary devices such as door holders. All the NAC Power Supplies shall be synchronized. The power supply shall support up to 24 amp hour batteries.

1. Power supply shall be minimum of 10 amps and UL 864 Listed.
2. Four independent 3amp NAC circuits. Each being configurable as auxiliary power.
3. All circuits shall be synchronized.
4. Shall be Edwards-EST, model BPS10A or APS10A

2.8 INTELLIGENT ANALOG SYSTEM SMOKE DETECTORS

A. General Requirements for Intelligent Analog Detectors

1. Integral Microprocessor: All decisions are made at the detector determining if the device is in the alarm or trouble condition.
2. Non-Volatile Memory: Permanently stores serial number, and type of device. Automatically updates historic information including hours of operation, last maintenance date, number of alarms and troubles,

time of last alarm and analog signal patterns for each sensing element just before last alarm.

3. Electronic Addressing: Permanently stores programmable system address. It shall be possible to address each intelligent module without the use of DIP or rotary switches. Devices using switches for addressing shall not be acceptable. Devices which utilize any special tools to program after the initial installation will not meet the intent of the specifications. The end-user should be able to replace any faulty detector with a new detector that is kept in stock at the facility without the need to adjust any dip switches, rotary dials or by the use of a handheld programming tool program the device. A new detector when installed should automatically program with the address, message and functions of the previously replaced detector.
4. Automatic Device Mapping: Each detector transmits wiring information regarding its location with respect to other devices on the circuit, creating an As-Built wiring diagram. This will also provide enhanced supervision of the device physical location and the device message shall reside with the location and not the device address. Devices installed in the wrong location will always report the correct message of the physical location. Systems not capable of providing internal as-built mapping will be considered as meeting the intent of this specification.
5. Sensitivity Range: Each analog addressable smoke detector's sensitivity shall be capable of being programmed individually as: most sensitive, more sensitive, normal, less sensitive or least sensitive. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. It shall be possible to program control panel activity to each level.
6. Pre-Alarm: Detector stores 20 pre-alarm sensitivity values to alert local personnel prior to the sensor reaching a full evacuation sensitivity. Sensitivity values can be set in 5% increments.
7. Environmental Compensation: The detector's sensing element reference point shall automatically adjust, compensating for background environmental conditions such as dust, temperature, and pressure. Periodically, the sensing element real-time analog value shall be

compared against its reference value. The detector shall provide a maintenance alert signal when the detector reaches 75% (Dirty) to 99% (More Dirty) compensation has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.

8. Twin Status LEDs: Flashing Green LED shows normal; flashing RED shows alarm state; steady RED and steady GREEN show alarm state in stand-alone mode, visible from any direction.
9. UL Sensitivity Testing: The detector shall utilize a supervised microprocessor that is capable of monitoring the sensitivity of the detector. If the detector sensitivity shifts outside of the UL limits, a trouble signal is sent to the panel.
10. Device Replacement: The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced. System shall display an off-normal condition until the proper detector type has been installed or a change in the application program profile has been made.

B. Intelligent Photoelectric Detector

1. Provide intelligent analog addressable photoelectric smoke detectors at the locations shown on the drawings.
2. Provide Edwards-EST, model SIGA-PS.

C. Fixed Temperature Heat Detector

1. Provide intelligent fixed temperature heat detectors at the locations shown on the drawings. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The heat detector shall have a nominal alarm point rating of 135°F (57°C). The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.
2. Provide GE-EST, model SIGA-HFS.

D. Detector Base Types

1. Provide standard detector mounting bases suitable for mounting on 1-gang, or 4″ octagon box and 4″ square box. The base shall, contain no electronics and support all series detector types. Bases with electronics or dip-switches are not acceptable.
   a. Provide Edwards-EST, model SIGA-SB or SB4.

E. Intelligent Duct Smoke Detector - Photoelectric

1. Provide intelligent photoelectric duct smoke detector at the locations shown on the drawings.
   a. One form C auxiliary alarm relay rated at 2amps @ 30Vdc.
   b. The operating range shall be 100ft/min to 4,000ft/min air velocity and temperature range of –20 to 158°F.
   c. Sample tube can be installed with or without the cover place and be rotated in 45 degree increments to ensure proper alignment with duct airflow.
   d. Local magnet-activated test switch.
   e. Each and every duct detector shall be installed and testing in accordance with manufacturer’s instructions. This specifically includes pressure differential, velocity and humidity testing. Said test results shall be documented and submitted to the owner.
   f. Provide Edwards-EST, model SIGA-SD
2. Provide remote test station with Alarm LED and Key Switch.
   a. Provide Edwards-EST, model SD-TRK.
3. Relay Fan Shutdown: Rated to interrupt fan motor control circuit. Furnish and install separate device for each motor start. Connect to motor start as required for fan shutdown during alarm condition.
   a. Provide Edwards-EST, model SIGA-CR.

F. Beam Smoke Detectors

1. Provide reflective beam type smoke detectors at the locations shown on the drawings. This detector shall consist of an integrated transmitter and receiver capable of being powered separately or together.
2. The detector shall operate in either a short range of 15 to 160 ft. or a long range of 160 to 330 ft. The detector shall feature a bank of alignment LEDs on both the receiver and transmitter to ensure proper alignment without the use of special tools.

3. The detector shall utilize an automatic gain control to compensate for gradual signal deterioration from dirt accumulation on lenses. The beam smoke detectors shall be powered from the system control panel. Testing shall be carried out using calibrated test filters.
4. Provide a remote key activated remote test station.
   a. Provide Edwards Beam Smoke Detector, model EC-50R or EC-100R with EC-LLT Test Station.

2.9 INTELLIGENT MODULES

A. It shall be possible to address each intelligent module without the use of DIP or rotary switches. Devices using switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller.
   1. Integral Microprocessor: All decisions are made at the module determining if the device is alarm or trouble condition.
   2. Non-Volatile Memory: Permanently stores serial number, and type of device. Automatically updates historic information including hours of operation, number of alarms and troubles, time of last alarm.
   3. Automatic Device Mapping: Each detector transmits wiring information regarding its location with respect to other devices on the circuit, creating an As-Built wiring diagram. This will also provide enhanced supervision of the device physical location. The device message shall reside with the location and not the device address. Devices installed in the wrong location will always report the correct message of the physical location.
   4. Twin Status LEDs: The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status.
   5. Input and output circuit wiring shall be supervised for open and ground faults.
   6. Two styles of modules shall be available, those designed for gang box mounting, and where multiple modules are required in a single location, plug in modules shall be provided with a Universal Input/Output motherboard.
B. Intelligent Input Module: The Input Module shall provide one or two supervised Class B input circuit capable of a minimum of 4

personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2-1/2" deep 1-gang boxes and 1-1/2" deep 4″ square boxes with 1-gang covers. The single input module shall support the following circuit types:

1. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
2. Normally-Open Alarm Delayed Latching (Waterflow Switches)
3. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
4. Normally-Open Active Latching (Supervisory, Tamper Switches)
   a. Provide Edwards-EST model SIGA-CT1 or CT2 or SIGA-MCT2

C. Intelligent Relay Module. Provide addressable control relay circuit modules shall provide one (1) form C dry relay contacts rated at 24Vdc @ 2 amps (pilot duty) to control external appliances or equipment. The position of the relay contact shall be confirmed by the system firmware. The module shall be suitable for mounting on North American 2-1/2" deep 1-gang boxes and 1-1/2" deep 4″ square boxes with 1-gang covers.

1. Provide Edwards-EST, model SIGA-CR or SIGA-MCR.

D. NAC Control Module: Provide intelligent NAC control module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. The gang box - mounted version shall be suitable for mounting in North American 2 ½″ (64mm) deep 2-gang boxes and 1 ½″ (38mm) deep 4″ square boxes with 2-gang covers, or European 100mm square boxes. The plug-In version shall plug into a universal multi-module motherboard. The NAC control module shall support the following operations:

1. 24volt NAC circuit
2. Audio notification circuit 25v or 70v
3. Telephone Power Selector with Ring Tone (Firefighter’s Telephone)
4. Visual Synchronized Output to Genesis appliances or to NAC Power Supply.
   a. Provide Edwards-EST, model SIGA-CC1 or –CC1S or SIGA-MCC1 or MCC1S.

E. FA Elevator Interface Cabinet

1. Provide red metal cabinet enclosure with word FIRE in white letters on the cover. Inside will be four intelligent relays (Primary Recall, Alternate Recall, Fire Hat and Shunt Trip), one monitor

input (Shunt Trip AC Power Supervision) and 120vac relay (Shunt Trip AC Power Supv).

2. Label all the relays and input modules for the function.
3. Provide Edwards-EST, model MFC-A with SIGA-UIO6, -MCR, MCT2 and MR-101.

2.10 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. The manual pull station will have an intelligent module integral of the unit.
3. Station Reset: key operated switch shall match the control panel key.
4. Manual pull stations that initiated an alarm condition by opening the unit are not acceptable.
5. Provide Edwards-EST, model SIGA-278.

2.11 NOTIFICATION APPLIANCES

A. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers’ instructions. Systems shall use one wall mounted location with one installed electrical back box to support a dual lens Fire Alarm & Mass Notification Strobe as well as a Speaker. Systems not having the capability of supporting one wall location for the Speaker & dual strobe lenses will be considered as not meeting the intent of this specification.

B. Notification Appliances – Visual (Fire – Evacuation and ALERT – Mass Notification)

1. Provide wall or ceiling mounted clear lens strobes with white body and “FIRE” markings. Strobes shall provide a smooth light

distribution pattern field selectable candela 15 cd, 30 cd, 75 cd, and 110 cd flash output rating, UL1971 listed with in-out screw terminals shall be provided for wiring. The strobe (15, 30, 75, 110) candela rating shall be view from the side window to verify the setting. All strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules. The strobes shall mount to one-gang electrical box.

2. The device shall have plastic protective cover for during installation.
3. The actual candela setting on the visual shall be marked on the appliance.
4. Notification Appliances – Visual (ALERT – Mass Notification)
   a. Provide wall or ceiling mounted amber colored lens strobe with white body and “ALERT” markings. Amber strobe shall provide a smooth light distribution pattern field selectable candela 15 cd, 30 cd, 75 cd, and 110 cd flash output rating UL1638 listed, with in-out screw terminals shall be provided for wiring. The strobe (A, B, C, D) candela rating shall be view from the side window to verify the setting. All strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules. The strobes shall mount to electrical box
   b. Provide Amber Strobe adapter plate that will allow G4 Speaker-Strobe. The amber strobe shall be located directly below the Fire clear lens strobe.
   c. The device shall have plastic protective cover for use during installation.
5. Provide Edwards-EST, model Genesis G1A or G4E Strobe Expander Series appliances.

D. Notification Appliance - 4" Cone Speaker

1. Speakers shall have a 4" Mylar cone, paper cones shall not accept as equal. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 70V systems. The actual speaker wattage & strobe candela setting shall be viewable

from the device window to verify the wattage setting, without removing the device. To make any changes to the speaker wattage will only require the removal of the cover plate.

2. At the 2-watt setting, the speaker shall provide a 90 dBA sound output over a frequency range of 400-4000 Hz. as measured in reverberation room per UL-1480.
3. Combination speaker strobes shall meet both sections of above.
4. The device shall have plastic protective cover for use during installation.
5. The actual wattage setting on the speaker shall be marked on the face of the appliance.
6. Provide Edwards-EST, model Genesis Series devices.

2.12 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
   2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   3. Rating: 120-V ac, 24-V ac or dc.
   4. Provide Edwards-EST, model 1500 series or DH Series.

2.13 INSPECTION BAR CODES

A. Inspection bar codes shall be installed on all initiating devices, annunciators, control panels and power supplies.

B. Inspection bar codes used by the system must utilize Code 3 of 9 or other approved format, and contain a minimum of eight (8) digits that comprise a unique serial identifier within the Web-based Reporting System. There shall be no duplication of serial numbers. Serial number shall be printed below the bar code for identification purposes.

C. Inspection bar codes shall be limited in size to no more than 2″ (5cm) in width, and 3/8″ (2 cm), in height and shall include a Mylar® or other protective coating to protect the bar code from fading due to sunlight or exposure.

D. Inspection bar codes shall be installed on each device in such a manner as to require that scanning of the bar code take place no further than 12″ from the device during inspection.

2.14 WIRE AND CABLE

A. Signaling Line Circuits – Network Data: Twisted pair, not less than No. 18 AWG or as recommended by the manufacturer.

B. Signaling Line Circuits – Intelligent Loop: Non-Twisted pair, not less than No. 16 AWG or as recommended by the manufacturer.

1. Circuit Integrity Cable: Provide as required to meet NFPA or Local Code requirements.
2. CI Cable shall meet article 760, power limited fire alarm service.

C. Notification Appliance Circuits:

1. Audio: Twisted pair shielded, not less than No. 16 AWG or as recommended by the manufacturer.
2. Visual: Non-Twisted pair, not less than No. 12 AWG or as recommended by the manufacturer.

D. 120 VAC circuits

1. Minimum 10 AWG for panel power circuits. Minimum 12 AWG for all other circuits.
2. Sharing of neutrals is prohibited. Each circuit shall have its own dedicated neutral conductor.

E. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.

2.15 INSTRUCTION CHART:

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame with a backplate. Install the frame in a conspicuous location observable from each control unit where operations are performed. The card shall show those steps to be taken by an operator when a signal is received under all conditions, normal, alarm, supervisory, and trouble. Provide an additional copy with the binder for the input output matrix for the sequence of operation. The instructions shall be approved by the COTR before being posted.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with NEC 760, NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS , Section 26 05 21, LOW-

VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.

B. All conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.

C. All new and reused exposed conduit shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.

D. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations to be approved by the COTR.

E. Strobes shall be flush wall mounted with the bottom of the unit located 2,000 mm (80 inches) above the floor or 150 mm (6 inches) below ceiling, whichever is lower. Locate and mount to maintain a minimum 900 mm (36 inches) clearance from side obstructions.

F. Manual pull stations shall be installed not less than 1050 mm (42 inches) or more than 1200 mm (48 inches) from finished floor to bottom of device and within 1500 mm (60 inches) of a stairway or an exit door.

G. Where possible, locate water flow and pressure switches a minimum of 300 mm (12 inches) from a fitting that changes the direction of the flow and a minimum of 900 mm (36 inches) from a valve.

H. Mount valve tamper switches so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.

I. Connect flow and tamper switches installed under Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS.

J. Connect combination closer-holders installed under Section 08 71 00, DOOR HARDWARE.

K Any low-voltage copper wiring that leaves the protection of a building shall be provided with a system manufacturer specified UL 497B listed transient protection devices where the circuit leaves the building and where it enters the next building.

L. Equipment Mounting: Install MNEC/FA control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.

M. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

N. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
5. HVAC: Locate detectors not closer than 5 feet from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

O. Duct Smoke Detectors: Comply with NFPA72 and NFPA90A. Install sampling tubes so they extend the full width of duct.

P. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

Q. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

R. MNEC/FA Control Units: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

S. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 TYPICAL OPERATION

A. Activation of any manual pull station, water flow or pressure switch, heat detector, kitchen hood suppression system, gaseous suppression system, or smoke detector shall cause the following operations to occur:

1. For sprinkler protected buildings, flash strobes continuously only in the zone of alarm.
2. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control unit in Building.

3. Release only the magnetic door holders in the smoke zone after the alert signal.
4. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
5. Unlock the electrically locked exit doors within the zone of alarm.

B. Heat detectors in elevator machine rooms shall, in addition to the above functions, disconnect all power to all elevators served by that machine room after a time delay. The time delay shall be programmed within the fire alarm system programming and be equal to the time it takes for the car to travel from the highest to the lowest level, plus 10 seconds.

C. Smoke detectors in the primary elevator lobbies of Building shall, in addition to the above functions, return all elevators in the bank to the secondary floor.

D. Smoke detectors in the remaining elevator lobbies, elevator machine room, or top of hoistway shall, in addition to the above functions, return all elevators in the bank to the primary floor.

E. Operation of a smoke detector at a corridor door used for automatic closing shall also release only the magnetic door holders on that floor.

F. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.

G. Operation of any sprinkler or standpipe system valve supervisory switch, high/low air pressure switch, or fire pump alarm switch shall cause a system supervisory condition.

H. Alarm verification shall not be used for smoke detectors installed for the purpose of early warning.

3.3 TESTS

A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COTR.

B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COTR. When any defects are detected, make

repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COTR, the contractor may request a final inspection.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
4. Open each alarm initiating and notification circuit to see if trouble signal actuates.
5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.4 FINAL INSPECTION AND ACCEPTANCE

A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.

B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

3.5 INSTRUCTION

A. The manufacturer's authorized representative shall provide instruction and training to the VA as follows:

1. Six one-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. Two sessions at the start of installation, two sessions at the completion of installation and two sessions 3 months after the completion of installation.

2. Four two-hour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and two sessions 3 months after the completion of installation.
3. Three eight-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one eight-hour refresher session 3 months after the completion of installation.

B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a troubleshooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.

C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

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SECTION 22 13 33
PACKAGED, SUBMERSIBLE SEWERAGE PUMP UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

Packaged submersible centrifugal sewerage pump units. See schedule on Drawings for pumps and capacity and heads.

1.2 RELATED WORK

A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

B. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

C. Section 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.

D. Section 26 29 11 - LOW-VOLTAGE MOTOR STARTERS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Pump:
   a. Manufacturer and model.
   b. Operating speed.
   c. Capacity.
   d. Characteristic performance curves.
2. Motor:
   a. Manufacturer.
   b. Speed.
   c. Current Characteristics and W (HP).
   d. Efficiency.

C. Certified copies of all the factory and construction site test data sheets and reports.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:

1. Include complete list indicating all components of the system.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

E. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and

dated on the date of completion, in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA):
ICS6-93 (R2006).....Industrial Control and Systems Enclosures
250—2008.....Enclosures for Electrical Equipment (1000 Volts Maximum)

C. Underwriters' Laboratories, Inc. (UL):
508-99 (R2008).....Standards For Safety Industrial Control Equipment

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SEWERAGE PUMP UNITS

A. Duplex Centrifugal, submersible pumps, designed for 60 degrees C (140 degrees F) maximum water service. Driver shall be electric motor with rigid type support. Systems to include two or more pumps as required by Contract Documents. Where hazardous environment condition exists, explosion proof pumps shall be installed.
   1. Pump housings may be cast iron, bronze, or stainless steel. Cast iron housings for submersible pumps shall be epoxy coated.

B. Impeller: Brass or bronze, non-clog, to accommodate 50 mm (2”) solids.

C. Shaft: Bronze, stainless steel or other approved corrosion-resisting metal.

D. Bearings: As required to hold alignment, anti-friction type for thrust, permanently lubricated.

E. Motor: Maximum 40 degrees C (104 degrees F) ambient temperature rise, completely enclosed, voltage and phase as shown in schedule on Electrical drawings conforming to NEMA 250-Type 6P. Size the motor capacity to operate pump without overloading the motor at any point on the pump curve. Refer to Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

F. Starting Switch: Manually-operated, tumbler type, as specified in Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

G. Automatic Control and Level Alarm: Provide a control panel in a NEMA 1 enclosure for indoor areas. The controls shall be suitable for operation with the electrical characteristics listed on the Electrical drawings. The control panel shall have a level control system with

switches to start and stop pumps automatically, and to activate a high water alarm. The level control system will include sensors in the sump that detect the level of the liquid. The sensors may be float type switches, ultrasonic level sensors, transducers, or other appropriate equipment. The high water alarm shall have a red beacon light at the control panel and a buzzer, horn, or bell. The alarm shall have a silencing switch. Provide auxiliary contacts for remote alarming to the Energy Control Center and BAC net compatible open-protocol type interface to DDC Controls System. The circuitry of the control panel shall include:

1. Power switch to turn on/off the automatic control mechanism
2. HOA switches to manually override automatic control mechanism
3. Run lights to indicate when pumps are powered up
4. Level status lights to indicate when water in sump has reached the predetermined on/off and alarm levels
5. Magnetic motor contactors
6. Disconnect/breaker for each pump
   - Automatic motor overload protection

H. For a duplex system, provide an alternating relay to automatically alternate leadoff and standby duties of each pump of a duplex unit at the end of each pumping cycle. Standby pump shall start when water level in sump rises to a predetermined level that indicates excessive inflow or failure of the lead pump.

I. Sensors that detect the level of water in the sump shall be so arranged as to allow the accumulation of enough volume of liquid below the normal on level that the pump will run for a minimum cycle of one minute. Sensors shall be located to activate the alarm adequately before the water level rises to the inlet pipe.

J. Provide two separate power supplies to the control panel, one for the control/alarm circuitry and one for power to the pump motors. Each power supply is to be fed from its own breaker so that if a pump overload trips a breaker, the alarm system will still function. Each power supply is to be wired in its own conduit. Wiring from the sump to the control panel shall have separate conduits for the pump power and for the sensor switches. All conduits are to be sealed at the basin and at the control panel to prevent the intrusion of moisture and of flammable and/or corrosive gases.

K. Sump: Provide fiberglass basin with gas tight covers. Covers shall have a manhole with a bolted cover of minimum size to inspect and service the pumps, vent connection, and openings for pumps and controls.

L. Provide a union, check and ball valve in the discharge from each pump.

M. Removal/Disconnect System: Where indicated on drawings, a removal/disconnect system shall be provided where sump depth, pump size or other conditions make removal of the pump unusually difficult or unsafe the system will consist of a discharge fitting mounted on vertical guide rails attached to the sump. The pump shall be fitted with an adapter fitting that easily connects to/disconnects from the discharge fitting as the pump is raised from or lowered into the sump. The discharge piping will connect to the discharge fitting so that it is not necessary to disconnect any piping in order to remove the pump. Where the sump depth is greater than five feet or other conditions exist to make the removal of the pump difficult or hazardous, the system shall include a rail guided quick disconnect apparatus to allow the pump to be pulled up out of the sump without workers entering the sump and without disconnecting the piping. System to be compatible with and furnished by pump manufacturer.

PART 3 - EXECUTION

3.1 STARTUP AND TESTING

A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. The tests shall include system capacity, and all control and alarm functions.

C. When any defects are detected, correct defects and repeat test.

D. The commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COTR, Commissioning Agent and local municipal authorities where applicable. Provide a minimum of 7 days prior to notice.

3.2 COMMISSIONING

A. Provide commissioning documentation accordance with the requirements of Section 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS for all inspection, startup, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 22 08 00 –

COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.3 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four hours to instruct VA Personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

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SECTION 22 14 00
FACILITY STORM DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

This section describes the requirements for storm drainage systems, including piping and all necessary accessories as designated in this section.

1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.

B. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.

C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.

D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Pipe Insulation.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Piping.
2. Roof Drains.
3. Cleanouts.
4. All items listed in Part 2 - Products.

C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI).

C. American Society of Mechanical Engineers (ASME): (Copyrighted Society)

A112.21.2m-83.....Roof Drains

A13.1-07.....Scheme for Identification of Piping Systems

B16.3-06.....Malleable Iron Threaded Fittings, Classes 150 and 300. B16.9-07 Factory-Made Wrought Steel Butt welding Fittings

B16.11-05.....Forged Steel Fittings, Socket-Welding and Threaded B16.12-98 (R 2006) Cast Iron Threaded Drainage Fittings

B16.15-06).....Cast Bronze Threaded Fittings, Class 125 and 250

B16.18-01 (R 2005).....Cast Copper Alloy Solder-Joint Pressure Fittings

B16.22-01 (R 2005).....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

D. American Society for Testing and Materials (ASTM):

A47-99 (R 2004).....Standard Specification for Steel Sheet, Aluminum Coated, by the Hot-Dip Process

A53-07.....Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless

A74-06.....Standard Specification for Cast Iron Soil Pipe and Fittings

A183-03).....Standard Specification for Carbon Steel Track Bolts and Nuts

A312-03.....Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe

A536-84(R 2004).....Standard Specification for Ductile Iron Castings

A733-03.....Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

B32-04.....Standard Specification for Solder Metal

B61-08.....Standard Specification for Steam or Bronze Castings

B62-02.....Standard Specification for Composition Bronze or Ounce Metal Castings

B75-02.....Standard Specification for Seamless Copper Tube

B88-03.....Standard Specification for Seamless Copper Water Tube

B306-02.....Standard Specification for Copper Drainage Tube (DWV)

B584-08.....Standard Specification for Copper Alloy Sand Castings for General Applications

B687-99.....Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

C564-06a.....Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

D2000-08.....Standard Classification System for Rubber Products in Automotive Applications

D4101-07.....Standard Specification for Propylene Plastic Injection and Extrusion Materials

D2447-03.....Standard Specification for Polyethylene (PE) Plastic Pipe, Schedule 40 and 80, Based on Outside Diameter

D2564-04e1.....Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

D2665-07.....Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

E. American Welding Society (AWS):

A5.8-04.....Specification for Filler Metals for Brazing and Braze Welding

F. International Code Council (ICC):

IPC-06.....International Plumbing Code

G. Cast Iron Soil Pipe Institute (CISPI):

301-05.....Hubless Cast Iron Soil and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

310-04.....Couplings for Use in Connection with Hubless Cast Iron Soil and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

H. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-72-99.....Standard for Ball Valves with Flanged or Butt Welding For General Purpose

SP-110-96.....Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

PART 2 - PRODUCTS

2.1 STORM WATER DRAIN PIPING

A. Cast Iron Storm Pipe and Fittings:

1. Cast iron storm pipe and fittings shall be used for the following applications:
   a. Pipe buried in or in contact with earth.
   b. Extension of pipe to a distance of approximately 1500 mm (5 feet) outside of building walls.
   c. Interior storm piping above grade.
   d. All mechanical equipment rooms or other areas containing mechanical air handling equipment.
2. The cast iron storm Pipe shall be bell and spigot, or hubless (plain end or no-hub) as required by selected jointing method.
3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A-888, or ASTM A-74.
4. Joints for hubless pipe and fittings shall conform to the manufacturer’s installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM Standard C-564 or be installed with leak and oakum.

2.2 SPECIALTY PIPE FITTINGS

A. Transition pipe couplings shall join piping with small differences in outside diameters or be of different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear erring and corrosion resistant metal tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:

1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
2. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F 477 or ASTM D5926.
3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 860 kPa (125 psig) at a minimum temperature of 82°C (180°F). The end connection shall be solder joint copper alloy and threaded ferrous.

C. Dielectric flange insulating kits shall be of non conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

D. The dielectric nipples shall be electroplated steel nipple comply with ASTM F 1545 with a pressure ratings of 2070 kPa (300 psig) at 107°C (225°F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.3 CAST IRON BOOT ADAPTORS

Cast iron boot adaptors, installed by this Contractor, as directed by the Architect, shall be furnished by the Plumbing Contractor. Final sealed connections between downspouts and the boots shall be made under this Contract. Cast iron boot adaptors shall be as manufactured by Zurn Industries, or approved equal, of appropriate dimensions to suit the type and size downspouts involved.

2.4 CLEANOUTS

A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. A minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged storm sewer line.

B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic

tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts where shall be provided where indicated on the drawings and at each building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty.

C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel bronze square frame and stainless steel cover with minimum opening of 150 mm by 150 mm (6 inch by 6 inch) shall be provided at each wall cleanout.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.5 WATERPROOFING

A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproofed caulked joint shall be provided at the top hub.

B. Walls: See detail shown on drawings.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. The pipe installation shall comply with the requirements of the International code and these specifications.

B. Branch piping shall be installed from the piping system and connect to all drains and outlets.

C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

D. All pipe runs shall be laid out to avoid interference with other work.

E. The piping shall be installed above accessible ceilings to allow for ceiling panel removal.

F. Unless otherwise stated on the documents, minimum horizontal slope shall be one inch for every1.22 m (4 feet) of pipe length.

G. The piping shall be installed free of sags and bends.

H. Seismic restraint shall be installed where required by code.

I. Changes in direction for storm drainage piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep ¼ bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and 1/8 bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Buried storm drainage piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer’s written instruction for use of lubricants, cements, and other installation requirements.

K. Caste iron piping shall be installed according to CISPI’s “Cast Iron Soil Pipe and Fittings Handbook,” Chapter IV, “Installation of Cast Iron Soil Pipe and Fittings”

L. Aboveground copper tubing shall be installed according to CDA’s “Copper Tube Handbook”.

M. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

3.2 JOINT CONSTRUCTION

A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI’s “Cast Iron Soil Pipe and Fittings Handbook” for compression joints.

B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI’s “Cast Iron Soil Pipe and Fittings Handbook” for lead and oakum calked joints.

C. Hubless, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.

D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service
2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.

F. for PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

3.3 SPECIALTY PIPE FITTINGS

A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES:

A. All piping shall be supported according to the International plumbing code, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications.

B. Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.

D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:

1. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
2. NPS 3 (DN 80): 1500 mm (60 inches) with 13 mm (1/2 inch) rod.
3. NPS 4 to NPS 5 (DN 100 to DN 125): 1500 mm (60 inches) with 16 mm (5/8 inch) rod.
4. NPS 6 to NPS 8 (DN 150 to DN 200): 1500 mm (60 inches) with 19 mm (3/4 inch) rod.
5. NPS 10 to NPS 12 (DN 250 to DN 300): 1500 mm (60 inches) with 22 mm (7/8 inch) rod.

E. The maximum support spacing for horizontal plastic shall be 1.22 m (4 feet).

F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.57 m (15 feet).

G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, Wall and Ceiling Plates shall have the following characteristics:

1. Solid or split unplated cast iron.
2. All plates shall be provided with set screws.
3. Height adjustable clevis type pipe hangers.
4. Adjustable Floor Rests and Base Flanges shall be steel.
5. Hanger Rods shall be low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
6. Riser Clamps shall be malleable iron or steel.
7. Roller shall be cast iron.
8. Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gage steel. The shield shall be sized for the insulation.

H. Miscellaneous Materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.

I. Cast escutcheon with set screw shall be installed at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

J. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
2. Water proofing: At floor penetrations, Clearances around the pipe shall be completely sealed and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

K. Piping shall conform to the following:

1. Storm Water Drain and Vent Drain to main stacks:

Pipe Size	Minimum Pitch
80 mm (3 inches) and smaller	2%
100 mm (4 inches) (4 inches) and larger	1%

3.5 TESTS

A. Storm sewer system shall be tested either in its entirety or in sections.

B. Storm Water Drain tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.

1. If entire system is tested with water, tightly close all openings in pipes except the highest opening, and fill system with water to point of overflow. If system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the

system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.

2. For an air test, an air pressure of 35 kPa (5 psi) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the test.
3. Final Tests: Either one of the following tests may be used.
   a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
   b. Peppermint Test: Introduce .06 liters (2 ounces) of peppermint into each line or stack.

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SECTION 22 14 29
SUMP PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

Sump pumps.

1.2 RELATED WORK

A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

B. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

C. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Pump:
   a. Stancor Oil Minder Model No. SE-50, or approved equal.
   b. 3600 RPM.
   c. Maximum flow 74 GPM.
   d. 20 GPM @ 30 FT/HD, 35 GPM @ 25 FT/HD.
2. Motor:
   a. Stancor.
   b. 3600 RPM.
   c. 1 PH, 60, 115V, 8 Amp, .5 HP.

C. Certified copies of all the factory and construction site test data sheets and reports.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:

1. Include complete connection which indicates all components of the system.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA):
ICS6-93 (R2001).....Industrial Control and Systems Enclosures

250-03.....Enclosures for Electrical Equipment (1000 Volts Maximum)

C. Underwriters' Laboratories, Inc. (UL):
508-99 (R2002).....Safety Industrial Control Equipment

PART 2 - PRODUCTS

2.1 SUMP PUMP

A. Submersible pump, designed for 37 degrees C (100 degrees F) maximum hot water service. Driver shall be electric motor. Support shall be substantial rigid type. Provide perforated, nonferrous suction trainer. Systems may include one, two, or more pumps with alternator as required by conditions:
   1. Pump housings may be cast iron, bronze, or stainless steel. Cast iron housings for submersible pumps shall be epoxy coated.
B. Impeller: Brass or bronze.
C. Shaft: Bronze, stainless steel or other approved corrosion-resisting metal.
D. Bearings: As required to hold shaft alignment, anti-friction type for thrust. For vertical sump pumps, if bearings for shaft in sump require lubrication, provide a method to lubricate bearings without opening the sump or removing the pump.
E. Characteristics: Head capacity characteristics shall not permit overloading at any point of the curve.
F. Motor: Maximum 40 degrees C ambient temperature rise, completely enclosed, voltage and phase as shown in schedule on Electrical drawings conforming to NEMA 250 -Type 4. Motor capacity to operate pump without overloading the motor. Refer to Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
G. Starting Switch: Manually-operated, tumbler type, as specified in Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
H. Automatic Control and Level Alarm: Furnish a control panel in a Nema 1 enclosure for indoors or in a Nema 4X enclosure for outdoors. The controls shall be suitable for operation with the electrical characteristics listed on the Electrical drawings. The control panel shall have a level control system with switches to start and stop pumps automatically, and to activate a high water alarm. The level control system will include sensors in the sump that detect the level of the liquid. The sensors may be float type switches, ultrasonic level sensors, transducers, or other appropriate equipment. The high water alarm shall have a red beacon light at the control panel and a buzzer,

horn, or bell. The alarm shall have a silencing switch. Provide auxiliary contacts for remote alarming to the Energy Control Center (ECC). The circuitry of the control panel shall include:

- -power switch to turn on/off the automatic control mechanism
- -HOA switches to manually override automatic control mechanism
- -run lights to indicate when pumps are powered up
- -level status lights to indicate when water in sump has reached the predetermined on/off and alarm levels
- -magnetic motor contactors
- -disconnect/breaker for each pump
- -automatic motor overload protection

1. Sensors that detect the level of water in the sump shall be so arranged as to allow the accumulation of enough volume of liquid below the normal on level that the pump will run for a minimum cycle of one minute. Sensors shall be located to activate the alarm adequately before the water level rises to the inlet pipe.
2. Provide two separate power supplies to the control panel, one for the control/alarm circuitry and one for power to the pump motors. Each power supply is to be fed from its own breaker so that if a pump overload trips a breaker, the alarm system will still function. Each power supply is to be wired in its own conduit.
3. Wiring from the sump to the control panel shall have separate conduits for the pump power and for the sensor switches. All conduits are to be sealed at the basin and at the control panel to prevent the intrusion of moisture and of flammable and/or corrosive gases.

I. Sump: Furnish cast iron or fiberglass basin with gas tight covers. Cover shall have 280 mm by 380 mm (11-inch by 15-inch) manhole with bolted cover, vent connection, openings for pumps and controls. Sump shall be sized to allow an adequate volume of water to accumulate for a minimum one minute cycle of pump operation.

J. Provide a check valve and gate valve in the discharge of each pump. Where a submersible pump is installed, drill a 3/16” diameter vent hole in the piping below the check valve beneath the cover of the sump, to expel any air entrapped beneath the check valve.

K. Removal/Disconnect System: In a system utilizing a submersible pump, where sump depth, pump size, or other conditions make removal of the pump unusually difficult or unsafe, a removal/disconnect system shall be provided. The system will consist of a discharge fitting mounted on vertical guide rails attached to the sump. The pump shall be fitted with an adapter fitting that easily connects to/disconnects from the

discharge fitting as the pump is raised from or lowered into the sump. The discharge piping will connect to the discharge fitting so that it is not necessary to disconnect any piping in order to remove the pump. Where the sump depth is greater than five feet or other conditions exist to make the removal of the pump difficult or hazardous, the system shall include a rail guided quick disconnect apparatus to allow the pump to be pulled up out of the sump without workers entering the sump and without disconnecting the piping.

PART 3 - EXECUTION

3.1 TEST

A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test.

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SECTION 22 14 29
SUMP PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

Sump pumps.

1.2 RELATED WORK

A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

B. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

C. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Pump:

a. Stancor Oil Minder Model No. SE-50, or approved equal.

b. 3600 RPM.

c. Maximum flow 74 GPM.

d. 20 GPM @ 30 FT/HD, 35 GPM @ 25 FT/HD.

2. Motor:

a. Stancor.

b. 3600 RPM.

c. 1 PH, 60, 115V, 8 Amp, .5 HP.

C. Certified copies of all the factory and construction site test data sheets and reports.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:

1. Include complete connection which indicates all components of the system.

2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

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2.1 SUMP PUMP

A. Submersible pump, designed for 37 degrees C (100 degrees F) maximum hot water service. Driver shall be electric motor. Support shall be substantial rigid type. Provide perforated, nonferrous suction trainer. Systems may include one, two, or more pumps with alternator as required by conditions:

1. Pump housings may be cast iron, bronze, or stainless steel. Cast iron housings for submersible pumps shall be epoxy coated.

B. Impeller: Brass or bronze.

C. Shaft: Bronze, stainless steel or other approved corrosion-resisting metal.

D. Bearings: As required to hold shaft alignment, anti-friction type for thrust. For vertical sump pumps, if bearings for shaft in sump require lubrication, provide a method to lubricate bearings without opening the sump or removing the pump.

E. Characteristics: Head capacity characteristics shall not permit overloading at any point of the curve.

F. Motor: Maximum 40 degrees C ambient temperature rise, completely enclosed, voltage and phase as shown in schedule on Electrical drawings conforming to NEMA 250 -Type 4. Motor capacity to operate pump without overloading the motor. Refer to Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

G. Starting Switch: Manually-operated, tumbler type, as specified in Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

H. Automatic Control and Level Alarm: Furnish a control panel in a Nema 1 enclosure for indoors or in a Nema 4X enclosure for outdoors. The controls shall be suitable for operation with the electrical characteristics listed on the Electrical drawings. The control panel shall have a level control system with switches to start and stop pumps automatically, and to activate a high water alarm. The level control system will include sensors in the sump that detect the level of the liquid. The sensors may be float type switches, ultrasonic level sensors, transducers, or other appropriate equipment. The high water alarm shall have a red beacon light at the control panel and a buzzer, horn, or bell. The alarm shall have a silencing switch. Provide auxiliary contacts for remote alarming to the Energy Control Center (ECC). The circuitry of the control panel shall include:

-power switch to turn on/off the automatic control mechanism

-HOA switches to manually override automatic control mechanism

-run lights to indicate when pumps are powered up

-level status lights to indicate when water in sump has reached the predetermined on/off and alarm levels

-magnetic motor contactors

-disconnect/breaker for each pump

-automatic motor overload protection

1. Sensors that detect the level of water in the sump shall be so arranged as to allow the accumulation of enough volume of liquid below the normal on level that the pump will run for a minimum cycle of one minute. Sensors shall be located to activate the alarm adequately before the water level rises to the inlet pipe.

2. Provide two separate power supplies to the control panel, one for the control/alarm circuitry and one for power to the pump motors. Each power supply is to be fed from its own breaker so that if a pump overload trips a breaker, the alarm system will still function. Each power supply is to be wired in its own conduit.

3. Wiring from the sump to the control panel shall have separate conduits for the pump power and for the sensor switches. All conduits are to be sealed at the basin and at the control panel to prevent the intrusion of moisture and of flammable and/or corrosive gases.

I. Sump: Furnish cast iron or fiberglass basin with gas tight covers. Cover shall have 280 mm by 380 mm (11-inch by 15-inch) manhole with bolted cover, vent connection, openings for pumps and controls. Sump shall be sized to allow an adequate volume of water to accumulate for a minimum one minute cycle of pump operation.

J. Provide a check valve and gate valve in the discharge of each pump. Where a submersible pump is installed, drill a 3/16” diameter vent hole in the piping below the check valve beneath the cover of the sump, to expel any air entrapped beneath the check valve.

K. Removal/Disconnect System: In a system utilizing a submersible pump, where sump depth, pump size, or other conditions make removal of the

pump unusually difficult or unsafe, a removal/disconnect system shall be provided. The system will consist of a discharge fitting mounted on vertical guide rails attached to the sump. The pump shall be fitted with an adapter fitting that easily connects to/disconnects from the discharge fitting as the pump is raised from or lowered into the sump. The discharge piping will connect to the discharge fitting so that it is not necessary to disconnect any piping in order to remove the pump. Where the sump depth is greater than five feet or other conditions exist to make the removal of the pump difficult or hazardous, the system shall include a rail guided quick disconnect apparatus to allow the pump to be pulled up out of the sump without workers entering the sump and without disconnecting the piping.

PART 3 - EXECUTION

3.1 TEST

A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test.

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SECTION 22 34 00
FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 DESCRIPTION:

This section describes the requirements for installing a complete domestic gas fired hot water heating system ready for operation including water heaters, thermometers, and all necessary accessories, connections, and equipment.

1.2 RELATED WORK:

A. Section 09 91 00, PAINTING: Preparation and finish painting.
B. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
C. Section 22 11 23, DOMESTIC WATER PUMPS: Circulating Pump.
D. Section 22 07 11, PLUMBING INSULATION: Heater Insulation.
E. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING..
F. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING.
G. Section 22 11 00, FACILITY WATER DISTRIBUTION: Piping, Fittings, Valves and Gages.

1.3 QUALITY ASSURANCE:

A. Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for efficiency performance:
   1. ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings” for commercial water heaters.”
B. Electrical components, devices and accessories shall be listed and label as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application.
C. ASME code construction shall be a vessel fabricated in compliance with the ASME boiler and Pressure Vessel Code: Section VIII, Division 1.
D. Fabricate and label equipment components that will be in contract with potable water to comply with NSF 61, “Drinking Water System Components – Health Effects”
E. the gas fired domestic water heater shall conform to Section 13 05 41 on Seismic restraint requirements, withstanding Seismic movement without separation of any parts from the equipment when subjected to a Seismic event.

1.4 SUBMITTALS:

A. Submit manufacturer’s literature and data pertaining to the water heater in properly bound package, in accordance with Section 01 33 23,

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Include the following as a minimum:

1. Water Heaters.
2. Pressure and Temperature Relief Valves.
3. Thermometers.
4. Pressure Gages.
5. Vacuum Breakers.

B. For each natural gas fired domestic hot water heater type and size, the following characteristics shall be submitted:

1. Rated Capacities
2. Operating characteristics
3. Electrical characteristics
4. Furnished specialties and accessories
5. A form U-1 or other documentation stating compliance with the ASME Boiler and Pressure Vessel code.

C. Shop drawings shall include wiring diagrams for power, signal and control functions.

D. Seismic qualification certificates shall be submitted that details equipment anchorage components identifies equipment center of gravity with mounting and anchorage provisions, and whether the seismic qualification certificate is based on an actual test or calculations.

E. The domestic water heater shall be certified and labeled by a testing agency.

1.5. APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society Of Sanitary Engineering (ASSE):

1005.....Performance Requirements for Water Heater Drain Valves, 20 mm (3/4 inch) size

C. American National Standard Institute (ANSI):

Z21.10.1-06.....Gas Water Heaters Volume 1, Storage Water Heaters with Input Ratings of 75000 Btu per hour or less.

Z21.10.3-04.....Gas Water Heaters, Volume III, Storage Water Heaters with Input Ratings above 75000 Btu per hour, circulating and instantaneous.

Z21.15A-01.....Manually Operated Gas Valves for Appliances, Appliance connector Valves, and Hose End Valves

Z21.18-07.....Gas appliance Pressure Regulators

Z21.20-05.....Automatic Gas Ignition Systems and Components

Z21.21-05.....Automatic Valves for Gas Appliance

Z21.22B-01.....Relief Valves for Hot Water Supply systems

D. American Society of Mechanical Engineers (ASME):

B1.20.1-83(R 2006).....Pipe Threads, General Purpose(Inch)

B16.5-03.....Standard for Pipe Flanges and Flanged Fittings: NPS ¾ through NPS 24.

B16.24-06.....Cast Copper Alloy Pipe Flanges and Flanged Fittings: classes 150, 300, 400, 600, 900, 1500, and 2500.

PTC 25.3-02.....Pressure Relief Devices

Section IV-07.....Boiler and Pressure Vessel Code; Section IV, Recommended Rules for the Care and Operation of Heating Boilers

Section VIII D1-07.....Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels Division 1 –Basic Coverage

E. National Fire Protection Association (NFPA)

54-09.....National Fuel Gas Code

F. Underwriters Laboratories, Inc. (UL):

1.6 AS-BUILT DOCUMENTATION

A. The electronic documentation and copies of the Operations and Maintenance Manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template made available for review and included as part of the Operations and Maintenance Manual or closeout documentation. All available accessibility functions listed in the Voluntary Accessibility Template shall be enabled in the prepared electronic files. As Adobe Acrobat is a common industry format for such documentation, following the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge is recommended.”

B. Four sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

C. Four sets of operation and maintenance data updated to include submittal review comments shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

PART 2 - PRODUCTS

2.1 POWER VENT, GAS FIRED, STORAGE DOMESTIC WATER HEATERS:

A. The gas fired domestic water heater shall comply with ANSI Z21.10.3.

B. The water heater design shall provide a combustion efficiency of at least 95 percent at operating conditions.

C. The tank Construction shall be ASME code Steel, glass lined, with 1035 kPa (160 psig) working pressure rating.

D. The tapping (Fittings) shall be factory fabricated of materials compatible with the tank and in accordance with appropriate ASME standards for piping connection, pressure and temperature relief valve, pressure gauge, thermometer, drain valve, anode rods and controls. The tappings shall be:

1. 50-mm or DN50 (2 inch) and smaller: Threaded ends according to ASME B1.20.1.
2. 65 mm or (DN65) (2 1/2-inch) and larger: Flanged ends according to ASME B16.5 for steel and stainless steel flanges, and according to ASME B 16.24.

E. The natural gas-fired burner shall include the following:

1. Thermostatic adjustment.
2. Designed for use with power vent heaters
3. High temperature limit and low water cutoff devices for safety controls.

4. Automatic ignition in accordance with ANSI Z21.20.
5. Automatic damper in accordance with ANSI Z21.66. The automatic dampers shall be mechanically activated, automatic vent damper device with size matching draft hood for 300,000 BTUH and below.

F. Temperature Setting shall be set for a maximum water temperature of 55°C (130°F).

G. The insulation shall surround the entire storage tank except connection and controls and shall comply with ASHRAE 90.1.

H. The jacket shall be steel with enameled finish.

I. The drain valve shall be corrosion resistant metal complying with ASSE 1005.

J. The power vent system shall be interlocked with the burner.

K. Combination Pressure and Temperature relief Valve: ANSI Z21.22 rated, constructed of all brass or bronze with a self-closing reseating valve.

2.2 DOMESTIC HOT WATER COMPRESSION TANKS

A. A steel pressure rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as scheduled. The air pre charge shall be set to minimum system operating pressure at tank.

B. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.

C. The interior finish shall comply with NSF 61 barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.

D. The air charging valve shall be factory installed.

2.3 HEAT TRAPS

Heat traps shall be installed in accordance with ASHRAE 90.1, latest edition.

2.4 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

The combination temperature and pressure relief valves shall be ASME rated and stamped and include a relieving capacity at least as great as the heat input and include a pressure setting less than the water heater’s working pressure rating.

2.5 GAS SHUTOFF VALVES

A. The gas shutoff valve shall be manually operated conforming to ANSI Z21.15.

B. In high Seismic areas, an earthquake shear valve shall be installed.

2.6 GAS PRESSURE REGULATORS

The gas pressure regulator shall be appliance type, pressure rating matching inlet natural gas supply temperature, and conforming to ANSI Z21.18.

2.7 AUTOMATIC GAS VALVES

The automatic gas valves shall be appliance type, electrically operated, on-off automatic control, and conforming to ANSI Z21.21.

2.8 THERMOMETERS:

The thermometers shall be straight stem, iron case, red reflecting mercury thermometer or red liquid-filled thermometers, approximately 175 mm (7 inches) high, 4 to 115°C (40 to 240°F).

PART 3 - EXECUTION

3.1 INSTALLATION:

A. The water heaters shall be installed on concrete bases. Refer to Specification Section 03 30 00, CAST-IN-PLACE CONCRETE and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING
B. The water heaters shall be installed level and plumb.
C. The water heaters shall be installed and connected in accordance with manufacturer’s written instructions.
D. All pressure and temperature relief valves discharge shall be piped to a nearby floor drains.
E. Thermometers shall be installed on the water heater inlet and outlet piping.
F. Vent piping from gas-train pressure regulators and valves shall be piped to the outside of building and shall conform to NFPA 54.
G. The thermostats shall be set for a maximum setting of 54°C (130°F).
H. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.
I. All manufacturer's required clearances shall be maintained.
J. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by positive air gap into a floor drain.
K. Piping type heat traps shall be installed on the inlet and outlet piping of the electric domestic hot water heater storage tanks.
L. Water heater drain piping shall be installed as indirect waste to spill by positive air gap into open drains or over floor drains. Hose end

drain valves shall be installed at low points in water piping for natural gas fueled domestic hot water heaters without integral drains.

M. The type B combustion vent shall be installed and sized according to the water heaters recommendations and extended through the roof or wall as allows by the local fuel gas code or NFPA 54.

3.2 LEAKAGE TEST:

Before piping connections are made, the water heaters shall be test at a hydrostatic pressure of 1375 kPa (200 psi) and 1654 kPa (240 psi) for a unit with a MAWP of 1103 kPa (160 psi). Correct If any leakage is found on the water heater, the water heater shall be replaced with a new unit at no additional cost to the VA.

3.3 PERFORMANCE TEST:

All of the remote water outlets shall be tested to ensure a minimum of 49°C (120°F) and a maximum of 54°C (130°F) water flow at all times. If necessary, all corrections shall be made to balance the return water system or reset the thermostat to make the system comply with design requirements.

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SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories.

1.2 RELATED WORK

A. Sealing between fixtures and other finish surfaces: Section 07 92 00, JOINT SEALANTS.

B. Flush panel access doors: Section 08 31 13, ACCESS DOORS AND FRAMES.

C. Through bolts: Section 10 21 13, TOILET COMPARTMENTS.

D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

E. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submit plumbing fixture information in an assembled brochure, showing cuts and full detailed description of each fixture.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standard Institute (ANSI):
The American Society of Mechanical Engineers (ASME):
A112.6.1M-02(R2008).....Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
A112.19.1M-08 .....Enameled Cast Iron Plumbing Fixtures
A112.19.2M-03.....Vitreous China Plumbing Fixtures
A112.19.3-2001(R2008)...Stainless Steel Plumbing Fixtures (Designed for Residential Use)

C. American Society for Testing and Materials (ASTM):
A276-2010 .....Stainless and Heat-Resisting Steel Bars and Shapes
WW-P-541-E/GEN .....Plumbing Fixtures with Amendment 1

D. National Association of Architectural Metal Manufacturers (NAAMM): NAAMM AMP 500-505
   Metal Finishes Manual (1988)
E. American Society of Sanitary Engineers (ASSE):
   1016-05.....Performance Requirements for Individual Thermostatic, Pressure Balancing and Combination Pressure Balancing and Thermostatic Control Valves for Individual Fixture Fittings
F. National Sanitation Foundation (NSF)/American National Standards Institute (ANSI):
   61-2009 .....Drinking Water System Components-Health Effects
G. American with Disabilities Act (A.D.A) Section 4-19.4 Exposed Pipes and Surfaces
H. Environmental Protection Agency EPA PL 93-523 1974; A 1999) Safe Drinking Water Act.
I. International Building Code, ICC IPBC 2009.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL

A. Corrosion-resistant Steel (CRS):
   1. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
   2. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.
B. Die-cast zinc alloy products are prohibited.

2.2 STOPS

A. Provide lock-shield loose key or screw driver pattern angle stops, straight stops or stops integral with faucet, with each compression type faucet whether specifically called for or not, including sinks in wood and metal casework, laboratory furniture and pharmacy furniture. Locate stops centrally above or below fixture in accessible location.
B. Furnish keys for lock shield stops to the COTR.
C. Supply from stops not integral with faucet shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.
D. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.
E. Psychiatric Area: Provide stainless steel drain guard for all lavatories not installed in casework.

2.3 ESCUTCHEONS

Heavy type, chrome plated, with set screws. Provide for piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

2.4 LAMINAR FLOW CONTROL DEVICE

A. Smooth, bright stainless steel or satin finish, chrome plated metal laminar flow device shall provide non-aeration, clear, coherent laminar flow that will not splash in basin. Device shall also have a flow control restrictor and have vandal resistant housing.

B. Flow Control Restrictor:

1. Capable of restricting flow from 95 ml/s to 110 ml/s (1.5 gpm to 1.7 gpm) for lavatories; 125 ml/s to 140 ml/s (2.0 gpm to 2.2 gpm) for sinks P-505 through P-520, P-524 and P-528; and 170 ml/s to 190 ml/s (2.75 gpm to 3.0 gpm) for dietary food preparation and rinse sinks or as specified.
2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 170 kPa and 550 kPa (25 psi and 80 psi).
3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-cleaning action, and is capable of easy manual cleaning.

2.5 CARRIERS

A. ASME/ANSI A112.6.1M, with adjustable gasket faceplate chair carriers for wall hung closets with auxiliary anchor foot assembly, hanger rod support feet, and rear anchor tie down. Fixtures listed as Bariatric shall be provided with a carrier rated for 1000 lbs.

B. Where water closets, lavatories or sinks are installed back-to-back and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers. The drainage fitting of the back to back carrier shall be so constructed that it prevents the discharge from one fixture from flowing into the opposite fixture.

2.6 WATER CLOSETS

A. (P-103) Water Closet (Wall Hung, ASME/ANSI A112.19.2M, Figure 9) office and industrial, elongated bowl, siphon jet 4 L (1.28 gallons) per flush, wall outlet. Top of rim shall be 14 inches above finished floor.

1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.

2. Fittings and Accessories: Gaskets - neoprene; bolts with chromium plated caps nuts and washers.
3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, solar sensor operated, with battery backup, (1.28 gallon) per flush with maximum 10 percent variance, 25 mm (1 inch) screwdriver back check angle stop with vandal resistant cap, adjustable tailpiece, a high back pressure vacuum breaker, spud coupling for 38 mm (1 1/2 inches) top spud, wall and spud flanges, and sweat solder adapter with cover tube and set screw wall flange. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass. Seat bumpers shall be integral part of flush valve. Set centerline of inlet 292 mm (11-1/2 inches) above rim.

B. (P-114) Bariatric Wall Mounted Water Closet ANSI 112.19.2M, Fully enclosed floor mounted with integral seat , siphon jet, 14 gage type 304 stainless steel construction with white enviro-glaze coating and hinged seat with cover, flush valve operated, top of rim 457 mm (18 inches) above floor. Rated for bariatric use. Carrier shall be 1000 lbs. rated for bariatric fixture.
1. Fittings and Accessories: Gaskets-neoprene, bolts with chromium plated cap nuts and washers.
2. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, solar sensor operated, with battery backup, (1.28 gallon) per flush with maximum 10 percent variance, 25 mm (1 inch) screwdriver back check angle stop with vandal resistant cap, adjustable tailpiece, a high back pressure vacuum breaker, spud coupling for 38 mm (1 1/2 inches) top spud, wall and spud flanges, and sweat solder adapter with cover tube and set screw wall flange. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass. Seat bumpers shall be integral part of flush valve. Set centerline of inlet 292 mm (11-1/2 inches) above rim.

2.7 URINALS

A. (P-201) Urinal (Wall Hung, ANSI A112.19.2M, Figure 30) bowl with integral flush distribution, wall to front of flare 356 mm (14 inches). Wall hung with integral trap, siphon jet flushing action 4 L (.125 gallons) per flush with 50 mm (2 inches) back outlet and 19 mm (3/4 inch) top inlet spud.
1. Support urinal with chair carrier and install with rim 600 mm (24 inches) above finished floor.

2. Flushing Device: Large chloramines resistant diaphragm, semi-red brass body, solar operated with battery backup, active infrared sensor for automatic operation, water saver design .125 gallon per flush, 19 mm (3/4 inch) capped screwdriver angle stop valve. Set centerline of inlet 292 mm (11 1/2 inches) above urinal. Valve body, cover, tailpiece, and control stop shall be in conformance with ASTM alloy classification for semi-red brass.

B. (P-202) Urinal (Wheelchair, Wall Hung, ANSI A112.19.2M, Figure 30) bowl with integral flush distribution, wall to front of flare 356 mm (14 inches). Wall hung with integral trap, siphon jet flushing action 4 L (.125 gallon per flush) with 51 mm (2 inches) back outlet and 19 mm (3/4 inch) top inlet spud.

1. Support urinal with chair carrier and install with rim 381 mm (15 inches) above finished floor.
2. Flushing Device: Large chloramines resistant diaphragm, semi-red brass body, solar operated with battery backup, active infrared sensor for automatic operation, water saver design .125 gallon per flush, 19 mm (3/4 inch) capped screwdriver angle stop valve. Set centerline of inlet 292 mm (11 1/2 inches) above urinal. Valve body, cover, tailpiece, and control stop shall be in conformance with ASTM alloy classification for semi-red brass.

2.8 LAVATORIES

A. Dimensions for lavatories are specified, Length by width (distance from wall) and depth.

B. Brass components in contact with water shall contain no more than 3 percent lead content by dry weight.

C. (P-418) Lavatory (Sensor Control, Gooseneck Spout, ASME/ANSI A112.19.2M, Figure 16) straight back, approximately 508 mm by 457 mm (20 inches by 18 inches) and a 102 mm (4 inches) minimum apron, first quality vitreous china with punching for gooseneck spout. Set rim 864 mm (34 inches) above finished floor.

1. Faucet: Solid cast brass construction, chrome plated, gooseneck spout with outlet 102 mm to 127 mm (4 inches to 5 inches) above rim. Electronic sensor operated, 102 mm (4 inches) center set mounting, battery operated electronic module, solid brass hot-cold water mixer adjusted from top deck with barrier free design control handle. Provide laminar flow control device. Breaking the light beam shall activate the water flow. Flow shall stop when user moves away from light beam.

2. Drain: Cast or wrought brass with flat grid strainer with offset tailpiece, brass, chrome plated.
3. Stops: Angle type. See paragraph 2.2.Stops
4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches) P-trap. Adjustable with connected elbow and 17 gage tubing extension to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to wall.
5. Provide cover for drain, stops and trap per A.D.A 4-19.4.

2.9 SINKS AND LAUNDRY TUBS

A. Dimensions for sinks and laundry tubs are specified, length by width (distance from wall) and depth.

B. (P-502) Service Sink (Corner, Floor Mounted) stain resistant terrazzo, 711 mm by 711 mm by 305 mm (28 inches by 28 inches by 12 inches) with 152 mm (6 inches) drop front. Terrazzo, composed of marble chips and white Portland cement, shall develop compressive strength of 20684 kPa (3000 psi) seven days after casting. Provide extruded aluminum cap on front side.
   1. Faucet: Solid brass construction, combination faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear, integral stops, mounted on wall above sink. Spout shall have a pail hook, 19 mm (3/4 inch) hose coupling threads, vacuum breaker, and top or bottom brace to wall. Four-arm handles on faucets shall be cast, formed, or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a smooth bright finish. Provide 914 mm (36 inches) hose with wall hook. Centerline of rough in is 1219 mm (48 inches) above finished floor.
   2. Drain: Seventy six millimeter (3 inches) cast brass drain with nickel bronze strainer.
   3. Trap: P-trap, drain through floor.

C. (P-524) Sink, (CRS, Double Compartment, Counter Top, ASME/ANSI A112.19.3M, Kitchen Sinks, Figure 6) self rimming, approximately 838 mm by 559 mm (33 inches by 22 inches) with two compartments inside dimensions approximately 343 mm by 406 mm by 191 mm (13 1/2 inches by 16 inches by 7 1/2 inches), minimum 20 gage CRS. Corners and edges shall be well rounded.
   1. Faucet: Kitchen sink, solid brass construction, swing spout, chrome plated copper alloy with spray and hose.
   2. Drain: Drain plug with cup strainer, stainless steel.

3. Trap: Cast copper alloy, 38 mm (1 1/2 inches) P-trap with cleanout plug, continuous drain with wall connection and escutcheon.
4. Provide cover for drain, stops and trap per A.D.A 4-19.4.

2.10 DISPENSER, DRINKING WATER

A. Standard rating conditions: 10 degrees C (50 degrees F) water with 27 degrees C (80 degrees F) inlet water temperature and 32 degrees C (90 degrees F) ambient air temperature.

B. (P-609) Electric Water Cooler: Mechanically cooled, self contained, wheel chair, bubbler style fully exposed dual height stainless steel fountain, recessed in wall refrigeration system, stainless steel grille, stainless steel support arm, wall mounting box, energy efficient cooling system consisting of a hermetically sealed reciprocating type compressor, 115v, 60 Hz, single phase, fan cooled condenser, permanently lubricated fan motor. Set highest bubbler 1016 mm (40 inches) above finished floor.

2.11 SHOWER BATH FIXTURE

A. (P-701) Shower Bath Fixture (Detachable, Wall Mounted, Concealed Supplies, Type T/P Combination Valve):
1. Shower Installation: Wall mounted detachable spray assembly, 600 mm (24 inch) wall bar, elevated vacuum breaker, supply elbow and flange and valve. All external trim, chrome plated metal.
2. Shower Head Assembly: Plastic shower head with flow control to limit discharge to 160 ml/s (2.5 gpm), 1524 mm (60 inches) length of rubber lined CRS, chrome plated metal flexible, or white vinyl reinforced hose and supply wall elbow. Design showerhead to fit in palm of hand. Provide CRS or chrome plated metal wall bar with an adjustable swivel hanger for showerhead. Fasten wall bar securely to wall for hand support.
3. Valves: Type T/P combination thermostatic and pressure balancing, with chrome plated metal lever type operating handle adjustable for rough-in variations and chrome plated metal or CRS face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be 13 mm (1/2 inch) IPS. Provide external screwdriver check stops, vacuum breaker and temperature limit stops. Set stops for a maximum temperature of 40 degrees C (105 degrees F). All exposed fasteners shall be vandal resistant. Valve shall provide a minimum of 160 ml/s at 310 kPa (2.5 gpm at 45 psi) pressure drop.

2.12 HYDRANT, HOSE BIBB AND MISCELLANEOUS DEVICES

A. (P-801) Wall Hydrant: Cast bronze non-freeze hydrant with detachable T-handle. Brass operating rod within casing of bronze pipe of sufficient length to extend through wall and place valve inside building. Brass valve with coupling and union elbow having metal-to-metal seat. Valve rod and seat washer removable through face of hydrant; 19 mm (3/4 inch) hose thread on spout; 19 mm (3/4 inch) pipe thread on inlet. Finish may be rough; exposed surfaces shall be chrome plated. Set not less than 457 mm (18 inches) nor more than 914 mm (36 inches) above grade. On porches and platforms, set approximately 762 mm (30 inches) above finished floor. Provide integral vacuum breaker which automatically drains when shut off.

B. (P-802) Hose Bibb (Combination Faucet, Wall Mounted to Exposed Supply Pipes): Cast or wrought copper alloy, combination faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear, mounted on wall 914 mm (36 inches) above floor to concealed supply pipes. Provide faucet without top or bottom brace and with 19 mm (3/4 inch) hose coupling threads on spout, integral stops and vacuum breaker. Design valves with valve disc arranged to eliminate rotation on seat. Four-arm handles on faucets shall be cast, formed or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a bright finish.

C. (P-804) Hose Bibb (Single Faucet, Wall Mounted to Concealed Supply Pipe): Cast or wrought copper alloy, single faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear, mounted on wall 914 mm (36 inches) above floor to concealed supply pipe. Provide faucet with 19 mm (3/4 inch) hose coupling thread on spout and vacuum breaker. Four-arm handle on faucet shall be cast, formed or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a bright finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed as specified under Section 07 92 00, JOINT SEALANTS.

B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts

and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.

C. Through Bolts: For free standing marble and metal stud partitions refer to Section 10 21 13, TOILET COMPARTMENTS.

D. Toggle Bolts: For hollow masonry units, finished or unfinished.

E. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 6 mm (1/4 inch) diameter bolts, and to extend at least 76 mm (3 inches) into masonry and be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.

F. Power Set Fasteners: May be used for concrete walls, shall be 6 mm (1/4 inch) threaded studs, and shall extend at least 32 mm (1 1/4 inches) into wall.

G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.

H. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.

I. Do not use aerators on lavatories and sinks.

3.2 CLEANING

At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS for all inspection, startup, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

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SECTION 23 05 11
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. Definitions:

1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
2. Option or optional: Contractor's choice of an alternate material or method.
3. RE: Resident Engineer
4. COTR: Contracting Officer’s Technical Representative.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.

D. Building Components for Attachment of Hangers: Section 05 31 00, STEEL DECKING,

E. Section 05 50 00, METAL FABRICATIONS.

F. Section 07 84 00, FIRESTOPPING.

G. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

H. Section 07 92 00, JOINT SEALANTS.

I. Section 09 91 00, PAINTING.

J. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

K. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 QUALITY ASSURANCE

A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC construction, as applicable.

B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

C. Equipment Vibration Tolerance:
   1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.
   2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.
D. Products Criteria:
   1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions.
   2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
   3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the Resident Engineer (RE)/Contracting Officers Technical Representative (COTR).
   4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
   5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
   6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
   7. Asbestos products or equipment or materials containing asbestos shall not be used.

E. Equipment Service Organizations:
   1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located reasonably close to the site.
F. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
   1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
   2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
   3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
G. Execution (Installation, Construction) Quality:
   1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the RE/COTR for resolution. Provide written hard copies or computer files of manufacturer’s installation instructions to the RE/COTR at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
   2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract drawings to the RE/COTR for resolution.
   3. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and with requirements in the individual specification sections.

B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.

C. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

D. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

E. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

F. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.

G. Samples: Samples will not be required, except for insulation or where materials offered differ from specification requirements. Samples shall be accompanied by full description of characteristics different from specification. The Government, at the Government’s expense, will perform evaluation and testing if necessary. The Contractor may submit samples of additional material at the Contractor's option; however, if additional samples of materials are submitted later, pursuant to Government request, adjustment in contract price and time will be made as provided in the GENERAL CONDITIONS.

H. Layout Drawings:

1. Submit complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Refer to the GENERAL CONDITIONS.

2. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items

requiring access for operations and maintenance. Provide detailed layout drawings of all piping and duct systems.

3. Do not install equipment foundations, equipment or piping until layout drawings have been approved.
4. In addition, for HVAC systems, provide details of the following:
   a. Mechanical equipment rooms.
   b. Interstitial space.
   c. Hangers, inserts, supports, and bracing.
   d. Pipe sleeves.
   e. Duct or equipment penetrations of floors, walls, ceilings, or roofs.

I. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
   1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the Resident Engineer.
   2. Submit electric motor data and variable speed drive data with the driven equipment.
   3. Equipment and materials identification.
   4. Fire-stopping materials.
   5. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
   6. Wall, floor, and ceiling plates.

J. HVAC Maintenance Data and Operating Instructions:
   1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
   2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

K. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Air Conditioning and Refrigeration Institute (ARI):
   430-99.....Central Station Air-Handling Units

C. American National Standard Institute (ANSI):
   B31.1-2004.....Power Piping

D. Rubber Manufacturers Association (ANSI/RMA):
IP-20-2007.....Drives Using Classical V-Belts and Sheaves
IP-21-1991(1997).....Drives Using Double-V (Hexagonal) Belts
IP-22-2007.....Drives Using Narrow V-Belts and Sheaves

E. Air Movement and Control Association (AMCA):
410-96.....Recommended Safety Practices for Air Moving Devices

F. American Society of Mechanical Engineers (ASME):
Section IX-2007.....Welding and Brazing Qualifications
Code for Pressure Piping:
B31.1-2004.....Power Piping, with Amendments

G. American Society for Testing and Materials (ASTM):
A36/A36M-05.....Carbon Structural Steel
A575-96(2002).....Steel Bars, Carbon, Merchant Quality, M-Grades R (2002)
E84-07.....Standard Test Method for Burning Characteristics of Building Materials
E119-07.....Standard Test Method for Fire Tests of Building Construction and Materials

H. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
SP-58-2002.....Pipe Hangers and Supports-Materials, Design and Manufacture
SP 69-2003.....Pipe Hangers and Supports-Selection and Application
SP 127-2001.....Bracing for Piping Systems, Seismic – Wind – Dynamic, Design, Selection, Application

J. National Electrical Manufacturers Association (NEMA):
MG-1-2006.....Motors and Generators

K. National Fire Protection Association (NFPA):
70-08.....National Electrical Code
90A-02.....Installation of Air Conditioning and Ventilating Systems
101-06.....Life Safety Code

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and

material. The Contractor is solely responsible for the protection of such equipment and material against any damage.

2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the RE/COTR. Such repair or replacement shall be at no additional cost to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
4. Boilers shall be left clean following final internal inspection by Government insurance representative or inspector.
5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Provide maximum standardization of components to reduce spare part requirements.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be products of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 BELT DRIVES

A. Type: ANSI/RMA standard V-belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.

B. Dimensions, rating and selection standards: ANSI/RMA IP-20 and IP-21.

C. Minimum Horsepower Rating: Motor horsepower plus recommended ANSI/RMA service factor (not less than 20 percent) in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact.

D. Maximum Speed: 25 m/s (5000 feet per minute).

E. Adjustment Provisions: For alignment and ANSI/RMA standard allowances for installation and take-up.

F. Drives may utilize a single V-Belt (any cross section) when it is the manufacturer's standard.

G. Multiple Belts: Matched to ANSI/RMA specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.

H. Sheaves and Pulleys:

1. Material: Pressed steel, or close grained cast iron.
2. Bore: Fixed or bushing type for securing to shaft with keys.
3. Balanced: Statically and dynamically.
4. Groove spacing for driving and driven pulleys shall be the same.
5. Minimum Diameter of V-Belt Sheaves (ANSI/RMA recommendations)in millimeters and inches:

Fractional Horsepower		Standard		High Capacity	
Cross Section	Min. od mm (in)	Cross Section	Min. od mm (in)	Cross Section	Min. od mm (in)
2L	20 (0.8)	A	83 (3.25)	3V	67 (2.65)
3L	38 (1.5)	B	146 (5.75)	4V	180 (7.10)
4L	64 (2.5)	C	239 (9.40)	5V	318 (12.50)
5L	89 (3.5)	D	345 (13.60)		
		E	554 (21.80)		

I. Drive Types, Based on ARI 435:
   1. Provide adjustable-pitch or fixed-pitch drive as follows:
      a. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
      b. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.
   2. Provide fixed-pitch drives for drives larger than those listed above.
   3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.

2.4 DRIVE GUARDS

A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory fabricated air handling unit casings.

B. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 6 mm (1/4-inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

C. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, non-resonant. Guard shall be an assembly of minimum 22-gage sheet steel and expanded or perforated metal to permit observation of belts. 25 mm (one-inch) diameter hole shall be provided at each shaft centerline to permit speed measurement.

D. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.

E. Access for Speed Measurement: 25 mm (One inch) diameter hole at each shaft center.

2.5 LIFTING ATTACHMENTS

Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.6 ELECTRIC MOTORS

A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT; Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS; and, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient motors as scheduled. Unless otherwise specified for a particular application use electric motors with the following requirements.

B. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).

C. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

D. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees centigrade (104 degrees F); minimum horsepower as shown on drawings; maximum horsepower in normal operation not to exceed nameplate rating without service factor.

E. Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Government.
2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
   a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.

b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.

c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.

4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.

5. Motors utilized with variable frequency drives shall be rated “inverter-ready” per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.

F. Motor Efficiency and Power Factor: All motors, when specified as “high efficiency” by the project specifications on driven equipment, shall conform to efficiency and power factor requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as “NEMA premium efficient” and the requirements generally exceed those of the Energy Policy Act of 1992 (EPACT). Motors not specified as “high efficiency” shall comply with EPACT.

G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

2.7 VARIABLE SPEED MOTOR CONTROLLERS

A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for specifications.

B. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. air handlers, fans, pumps, shall be product of a single manufacturer.

C. Motors shall be energy efficient type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.

D. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system.

2.8 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING. Provide labeling of all piping systems including direction of flow.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.

C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.

D. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.

E. Valve Tags and Lists:

1. HVAC: Provide for all valves other than for equipment in Section 23 82 00, CONVECTION HEATING AND COOLING UNITS.
2. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm(1/4-inch) for service designation on 19 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
3. Valve lists: Typed or printed plastic coated card(s), sized 216 mm(8-1/2 inches) by 280 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

2.9 FIRESTOPPING

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork. Refer to Section 23 07 11, HVAC INSULATION, for firestop pipe and duct insulation.

2.10 GALVANIZED REPAIR COMPOUND

Mil. Spec. DOD-P-21035B, paint form.

2.11 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

B. Supports for Roof Mounted Items:

1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gauge), with integral baseplate, continuous welded corner seams, factory installed 50 mm by 100 mm (2 by 4) treated wood nailer, 1.3 mm (18 gauge) galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum height 280 mm (11 inches). For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
2. Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.

C. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.

D. Attachment to Concrete Building Construction:

1. Concrete insert: MSS SP-58, Type 18.
2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the Resident Engineer for each job condition.
3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (four inches) thick when approved by the Resident Engineer for each job condition.

E. Attachment to Steel Building Construction:

1. Welded attachment: MSS SP-58, Type 22.
2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23mm (7/8-inch) outside diameter.

F. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING.

G. Attachment to Wood Construction: Wood screws or lag bolts.

H. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

I. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.
   1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
   2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2-inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

J. Supports for Piping Systems:
   1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
   2. Piping Systems except High and Medium Pressure Steam (MSS SP-58):
      a. Standard clevis hanger: Type 1; provide locknut.
      b. Riser clamps: Type 8.
      c. Wall brackets: Types 31, 32 or 33.
      d. Roller supports: Type 41, 43, 44 and 46.
      e. Saddle support: Type 36, 37 or 38.
      f. Turnbuckle: Types 13 or 15. Preinsulate.
      g. U-bolt clamp: Type 24.
      h. Copper Tube:
         1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non adhesive isolation tape to prevent electrolysis.
         2) For vertical runs use epoxy painted or plastic coated riser clamps.
         3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
         4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.

j. Piping with Vertical Expansion and Contraction:

1) Movement up to 20 mm (3/4-inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.

2) Movement more than 20 mm (3/4-inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.

3. Convertor and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.

K. Pre-insulated Calcium Silicate Shields:

1. Provide 360 degree water resistant high density 965 kPa (140 psi) compressive strength calcium silicate shields encased in galvanized metal.

2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.

3. Shield thickness shall match the pipe insulation.

4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.

a. Shields for supporting chilled or cold water shall have insulation that extends a minimum of 1 inch past the sheet metal. Provide for an adequate vapor barrier in chilled lines.

b. The pre-insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields may have one or more of the following features: structural inserts 4138 kPa (600 psi) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear plates welded to the bottom sheet metal jacket.

5. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

2.12 PIPE PENETRATIONS

A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.

B. To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.

2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Resident Engineer.

D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.

G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.

H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.13 SPECIAL TOOLS AND LUBRICANTS

A. Furnish, and turn over to the RE/COTR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the Resident Engineer.

D. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.14 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

2.15 ASBESTOS

Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Submit the drawings for review as required by Part 1. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the

floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.

D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

E. Cutting Holes:

1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by RE/COTR where working area space is limited.
2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by RE/COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to RE/COTR for approval.
3. Do not penetrate membrane waterproofing.

F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.

G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

H. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.

I. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Resident Engineer. Damaged or defective items in the opinion of the Resident Engineer, shall be replaced.
2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

J. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

K. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

L. Install steam piping expansion joints as per manufacturer’s recommendations.

M. Work in Existing Building:

1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the Resident Engineer. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the Resident Engineer for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After Resident Engineer's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.

N. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.

O. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling

under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Para. 3.1 apply.

C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

3.3 RIGGING

A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.

B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.

C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.

D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.

E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

F. Rigging plan and methods shall be referred to RE/COTR for evaluation prior to actual work.

G. Restore building to original condition upon completion of rigging work.

3.4 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the RE/COTR.

B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.

C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.

D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69. Provide additional supports at valves, strainers, and other heavy components. Provide a support within one foot of each elbow.

E. HVAC Vertical Pipe Supports:

1. Up to 150 mm (6-inch pipe), 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.
2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.

F. Overhead Supports:

1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
3. Tubing and capillary systems shall be supported in channel troughs.

G. Floor Supports:

1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 150 mm (6 inches) on all sides. Refer to

structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.

3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.

3.6 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
2. Material And Equipment Not To Be Painted Includes:
   a. Motors, controllers, control switches, and safety switches.
   b. Control and interlock devices.
   c. Regulators.
   d. Pressure reducing valves.
   e. Control valves and thermostatic elements.
   f. Lubrication devices and grease fittings.
   g. Copper, brass, aluminum, stainless steel and bronze surfaces.
   h. Valve stems and rotating shafts.
   i. Pressure gauges and thermometers.
   j. Glass.
   k. Name plates.
3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
6. Paint shall withstand the following temperatures without peeling or discoloration:

7. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

3.7 IDENTIFICATION SIGNS

A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16-inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.

B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.

C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.8 MOTOR AND DRIVE ALIGNMENT

A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.

B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

3.9 LUBRICATION

A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.

B. Equip all devices with required lubrication fittings or devices. Provide a minimum of one liter (one quart) of oil and 0.5 kg (one pound) of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to RE/COTR in unopened containers that are properly identified as to application.

C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.

D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.10 STARTUP AND TEMPORARY OPERATION

Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.11 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the RE/COTR.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

3.12 INSTRUCTIONS TO VA PERSONNEL

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

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SECTION 23 05 12
GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies the furnishing, installation and connection of motors for HVAC equipment.

1.2 RELATED WORK:

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one Section of Division 26.

B. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS: Starters, control and protection for motors.

C. Section 26 24 19, MOTOR-CONTROL CENTERS: Multiple motor control assemblies, which include motor starters.

D. Other sections specifying motor driven equipment in Division 23.

1.3 SUBMITTALS:

A. In accordance with Section, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting details, materials, horsepower, RPM, enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.

C. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and application data.

D. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certification to the Resident Engineer:

1. Certification that the motors have been properly applied, installed, adjusted, lubricated, and tested.

1.4 APPLICABLE PUBLICATIONS:

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Electrical Manufacturers Association (NEMA):
MG 1-98.....Motors and Generators
MG 2-01.....Safety Standard and Guide for Selection, Installation and Use of Electric Motors and Generators

C. National Fire Protection Association (NFPA):
70-02.....National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 MOTORS:

A. For alternating current, fractional and integral horsepower motors, NEMA Publications MG 1 and MG 2 shall apply.

B. Voltage ratings shall be as follows:
1. Single phase:
a. Motors connected to 120-volt systems: 115 volts.
b. Motors connected to 208-volt systems: 200 volts.
c. Motors connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
2. Three phase:
a. Motors connected to 208-volt systems: 200 volts.
b. Motors, less than 74.6 kW (100 HP), connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.

C. Number of phases shall be as follows:
1. Motors, less than 373 W (1/2 HP): Single phase.
2. Motors, 373 W (1/2 HP) and larger: 3 phase.
3. Exceptions:
a. Hermetically sealed motors.
b. Motors for equipment assemblies, less than 746 W (one HP), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

D. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation.

E. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.

F. Motor Enclosures:
1. Shall be the NEMA types shown on the drawings for the motors.

2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types, which are most suitable for the environmental conditions where the motors are being installed.
3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.

G. Additional requirements for specific motors, as indicated in other sections, shall also apply.

H. Energy-Efficient Motors (Motor Efficiencies): All permanently wired polyphase motors of 746 Watts or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 746 Watts or more with open, drip-proof or totally enclosed fan-cooled enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

Minimum Efficiencies Open Drip-Proof				**Minimum Efficiencies Totally Enclosed Fan-Cooled**			
Rating kW (HP)	**1200 RPM**	**1800 RPM**	**3600 RPM**	**Rating kW (HP)**	**1200 RPM**	**1800 RPM**	**3600 RPM**
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%
93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%
112 (150)	95.4%	95.8%	94.1%	112 (150)	95.8%	95.8%	95.0%
149.2 (200)	95.4%	95.8%	95.0%	149.2 (200)	95.8%	96.2%	95.4%

I. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM.

J. Premium efficiency motors shall be used where energy cost/kW x (hours use/year) > 50.

PART 3 - EXECUTION

3.1 INSTALLATION:

Install motors in accordance with manufacturer’s recommendations, the NEC, NEMA, as shown on the drawings and/or as required by other sections of these specifications.

3.2 FIELD TESTS

Megger all motors after installation, before start-up. All shall test free from grounds.

- - - E N D - - -

SECTION 23 05 41
NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

Noise criteria, vibration tolerance and vibration isolation for HVAC and plumbing work.

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete inertia bases.

B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.

C. D. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS: Requirements for optional Air Handling Unit internal vibration isolation.

E. Section 23 31 00, HVAC DUCTS AND CASINGS: requirements for flexible duct connectors, and sound attenuators .

F.SECTION 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: requirements for sound and vibration tests.

1.3 QUALITY ASSURANCE

A. Refer to article, QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Noise Criteria:

1. Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed following NC levels:

TYPE OF ROOM	NC LEVEL
Audio Speech Pathology	25
Audio Suites	25
Auditoriums, Theaters	35
Bathrooms and Toilet Rooms	40
Chapels	35
Conference Rooms	35
Corridors (Nurse Stations)	40
Corridors(Public)	40
Dining Rooms, Food Services/ Serving	35
Examination Rooms	35

Gymnasiums	50
Kitchens	50
Laboratories	45
Laundries	50
Lobbies, Waiting Areas	40
Locker Rooms	50
Offices, large open (3 or more occupants)	40
Offices, small private (2 or fewer occupants)	35
Operating Rooms	40
Patient Rooms	35
Phono/ Cardiology	25
Recreation Rooms	50
Shops	50
SPD	35
Therapeutic Pools	45
Treatment Rooms	35
Warehouse	50
X-Ray & general Work Rooms	40

2. For equipment which has no sound power ratings scheduled on the plans, the contractor shall select equipment such that the foregoing noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in accordance with ASHRAE Fundamentals Handbook, Chapter 7, Sound and Vibration.
3. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as, furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.

4. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.

D. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.

1.4 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Vibration isolators:
   a. Floor mountings
   b. Hangers
   d. Thrust restraints
2. Bases.
3. Seismic restraint provisions and bolting.
4. Acoustical enclosures.

C. Isolator manufacturer shall furnish with submittal load calculations for selection of isolators, including supplemental bases, based on lowest operating speed of equipment supported.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

2005.....Fundamentals Handbook, Chapter 7, Sound and Vibration

C. American Society for Testing and Materials (ASTM):

A123/A123M-02.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A307-04.....Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

D2240-05.....Standard Test Method for Rubber Property - Durometer Hardness

D. Manufacturers Standardization (MSS):

SP-58-02.....Pipe Hangers and Supports-Materials, Design and Manufacture

E. Occupational Safety and Health Administration (OSHA):

29 CFR 1910.95.....Occupational Noise Exposure

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to minimum requirements indicated herein and in the schedule on the drawings.

B. Elastometric Isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness of 60 durometer and have a straight-line deflection curve.

C. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.

D. Color code isolators by type and size for easy identification of capacity.

2.2 VIBRATION ISOLATORS

A. Floor Mountings:

1. Double Deflection Neoprene (Type N): Shall include neoprene covered steel support plated (top and bottom), friction pads, and necessary bolt holes.
2. Spring Isolators (Type S): Shall be free-standing, laterally stable and include acoustical friction pads and leveling bolts. Isolators shall have a minimum ratio of spring diameter-to-operating spring height of 1.0 and an additional travel to solid equal to 50 percent of rated deflection.
3. Spring Isolators with Vertical Limit Stops (Type SP): Similar to spring isolators noted above, except include a vertical limit stop to limit upward travel if weight is removed and also to reduce movement and spring extension due to wind loads. Provide clearance around restraining bolts to prevent mechanical short circuiting.

4. Pads (Type D), Washers (Type W), and Bushings (Type L): Pads shall be felt, cork, neoprene waffle, neoprene and cork sandwich, neoprene and fiberglass, neoprene and steel waffle, or reinforced duck and neoprene. Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 345 kPa (50 pounds per square inch).

B. Hangers: Shall be combination neoprene and springs unless otherwise noted and shall allow for expansion of pipe.

1. Combination Neoprene and Spring (Type H): Vibration hanger shall contain a spring and double deflection neoprene element in series. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
2. Spring Position Hanger (Type HP): Similar to combination neoprene and spring hanger except hanger shall hold piping at a fixed elevation during installation and include a secondary adjustment feature to transfer load to spring while maintaining same position.
3. Neoprene (Type HN): Vibration hanger shall contain a double deflection type neoprene isolation element. Hanger rod shall be separated from contact with hanger bracket by a neoprene grommet.
4. Spring (Type HS): Vibration hanger shall contain a coiled steel spring in series with a neoprene grommet. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
5. Hanger supports for piping 50 mm (2 inches) and larger shall have a pointer and scale deflection indicator.

C. Thrust Restraints (Type THR): Restraints shall provide a spring element contained in a steel frame with neoprene pads at each end attachment. Restraints shall have factory preset thrust and be field adjustable to allow a maximum movement of 6 mm (1/4 inch) when the fan starts and stops. Restraint assemblies shall include rods, angle brackets and other hardware for field installation.

2.3 BASES

A. Rails (Type R): Design rails with isolator brackets to reduce mounting height of equipment and cradle machines having legs or bases that do not require a complete supplementary base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension but not less than 100 mm (4 inches). Where rails are used with neoprene mounts for small fans or close coupled pumps, extend rails to compensate overhang of housing.

B. Integral Structural Steel Base (Type B): Design base with isolator brackets to reduce mounting height of equipment which require a complete supplementary rigid base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension, but not less than 100 mm (four inches).

C. Inertia Base (Type I): Base shall be a reinforced concrete inertia base. Pour concrete into a welded steel channel frame, incorporating prelocated equipment anchor bolts and pipe sleeves. Level the concrete to provide a smooth uniform bearing surface for equipment mounting. Provide grout under uneven supports. Channel depth shall be a minimum of 1/12 of longest dimension of base but not less than 150 mm (six inches). Form shall include 13-mm (1/2-inch) reinforcing bars welded in place on minimum of 203 mm (eight inch) centers running both ways in a layer 40 mm (1-1/2 inches) above bottom. Use height saving brackets in all mounting locations. Weight of inertia base shall be equal to or greater than weight of equipment supported to provide a maximum peak-to-peak displacement of 2 mm (1/16 inch).

2.4 SOUND ATTENUATING UNITS

Refer to specification Section 23 31 00, HVAC DUCTS AND CASINGS.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Vibration Isolation:

1. No metal-to-metal contact will be permitted between fixed and floating parts.
2. Connections to Equipment: Allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections, and other items made to rotating or reciprocating equipment (pumps, compressors, etc.) which rests on vibration isolators, shall be

isolated from building structure for first three hangers or supports.

3. Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive rigid alignment with provision for adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling, and bolting.
4. Provide heat shields where elastomers are subject to temperatures over 38 degrees C (l00 degrees F).
5. Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.
6. Non-rotating equipment such as heat exchangers and convertors shall be mounted on isolation units having the same static deflection as the isolation hangers or support of the pipe connected to the equipment.

B. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.

3.2 ADJUSTING

A. Adjust vibration isolators after piping systems are filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4inch (6-mm) movement during start and stop.

D. Adjust active height of spring isolators.

E. Torque anchor bolts according to equipment manufacturer's recommendations to resist seismic forces.

- - - E N D - - -

SELECTION GUIDE FOR VIBRATION ISOLATORS

EQUIPMENT		ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
		BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
REFRIGERATION MACHINES																
ABSORPTION		---	D	---	---	SP	1.0	---	SP	1.0	---	SP	1.7	---	SP	1.7
PACKAGED HERMETIC		---	D	---	---	SP	1.0	---	SP	1.7	---	SP	1.7	R	SP	2.5
OPEN CENTRIFUGAL		B	D	---	B	SP	1.0	---	SP	1.7	B	SP	1.7	B	SP	3.5
RECIPROCATING:																
500 - 750 RPM		---	D	---	---	SP	1.7	R	SP	1.7	R	SP	2.5	R	SP	3.5
751 RPM & OVER		---	D	---	---	SP	1.0	---	---	1.7	R	SP	2.5	R	SP	2.5
COMPRESSORS AND VACUUM PUMPS																
UP THROUGH 1-1/2 HP		---	D,L, W	---	----	D,L, W	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---
2 HP AND OVER:																
500 - 750 RPM		---	D	---	---	S	1.7	---	S	2.5	---	S	2.5	---	S	2.5
750 RPM & OVER		---	D	---	---	S	1.0	---	S	1.7	---	S	2.5	---	S	2.5
PUMPS																
CLOSE COUPLED	UP TO 1-1/2 HP	---	---	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---

EQUIPMENT		ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
		BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
	2 HP & OVER	---	---	---	I	S	1.0	I	S	1.0	I	S	1.7	I	S	1.7
BASE MOUNTED	UP TO 10 HP	---	---	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---
	15 HP THRU 40 HP	I	S	1.0	I	S	1.0	I	S	1.7	I	S	1.7	I	S	1.7
	50 HP & OVER	I	S	1.0	I	S	1.0	I	S	1.7	I	S	2.5	I	S	2.5
ROOF VENTILTORS																
ABOVE OCCUPIED AREAS:																
5 HP & OVER		---	---	---	CB	S	1.0	CB	S	1.0	CB	S	1.0	CB	S	1.0
CENTRIFUGAL BLOWERS																
UP TO 50 HP:																
UP TO 200 RPM		B	N	0.3	B	S	2.5	B	S	2.5	B	S	3.5	B	S	3.5
201 - 300 RPM		B	N	0.3	B	S	1.7	B	S	2.5	B	S	2.5	B	S	3.5
301 - 500 RPM		B	N	0.3	B	S	1.7	B	S	1.7	B	S	2.5	B	S	3.5
501 RPM & OVER		B	N	0.3	B	S	1.0	B	S	1.0	B	S	1.7	B	S	2.5
60 HP & OVER:																
UP TO 300 RPM		B	S	1.7	I	S	2.5	I	S	3.5	I	S	3.5	I	S	3.5

EQUIPMENT	ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
301 - 500 RPM	B	S	1.7	I	S	1.7	I	S	2.5	I	S	3.5	I	S	3.5
501 RPM & OVER	B	S	1.0	I	S	1.7	I	S	1.7	I	S	2.5	I	S	2.5
COOLING TOWERS															
UP TO 500 RPM	---	---	---	---	SP	1.0	---	SP	1.7	---	SP	2.5	---	SP	3.5
501 RPM & OVER	---	---	---	---	SP	1.0	---	SP	1.0	---	SP	1.7	---	SP	2.5
INTERNAL COMBUSTION ENGINES															
UP TO 25 HP	I	N	0.3	I	N	0.3	I	S	1.7	I	S	2.5	I	S	2.5
30 THRU 100 HP	I	N	0.3	I	N	1.7	I	S	2.5	I	S	3.5	I	S	3.5
125 HP & OVER	I	N	0.3	I	N	2.5	I	S	3.5	I	S	4.5	I	S	4.5
AIR HANDLING UNIT PACKAGES															
SUSPENDED:															
UP THRU 5 HP	---	---	---	---	H	1.0	---	H	1.0	---	H	1.0	---	H	1.0
7-1/2 HP & OVER:															
UP TO 500 RPM	---	---	---	---	H, THR	1.7	---	H, THR	1.7	---	H, THR	1.7	---	H, THR	1.7
501 RPM & OVER	---	---	---	---	H, THR	1.0	---	H, THR	1.0	---	H,THR	1.7	---	H,THR	1.7
FLOOR MOUNTED:															
UP THRU 5 HP	---	D	---	---	S	1.0	---	S	1.0	---	S	1.0	---	S	1.0

EQUIPMENT	ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
7-1/2 HP & OVER:															
UP TO 500 RPM	---	D	---	R	S, THR	1.7	R	S, THR	1.7	R	S, THR	1.7	R	S, THR	1.7
501 RPM & OVER	---	D	---	---	S, THR	1.0	---	S, THR	1.0	R	S, THR	1.7	R	S, THR	1.7
IN-LINE CENTRIFUGAL AND VANE AXIAL FANS, FLOOR MOUNTED: (APR 9)															
UP THRU 50 HP:															
UP TO 300 RPM	---	D	---	R	S	2.5	R	S	2.5	R	S	2.5	R	S	3.5
301 - 500 RPM	---	D	---	R	S	1.7	R	S	1.7	R	S	2.5	R	S	2.5
501 - & OVER	---	D	---	---	S	1.0	---	S	1.0	R	S	1.7	R	S	2.5
60 HP AND OVER:															
301 - 500 RPM	R	S	1.0	R	S	1.7	R	S	1.7	R	S	2.5	R	S	3.5
501 RPM & OVER	R	S	1.0	R	S	1.7	R	S	1.7	R	S	1.7	R	S	2.5

NOTES:

1. Edit the Table above to suit where isolator, other than those shown, are used, such as for seismic restraints and position limit stops.
2. For suspended floors lighter than 100 mm (4 inch) thick concrete, select deflection requirements from next higher span.
3. For separate chiller building on grade, pump isolators may be omitted.
4. Direct bolt fire pumps to concrete base. Provide pads (D) for domestic water booster pump package.
5. For projects in seismic areas, use only SS & DS type isolators and snubbers.
6. For floor mounted in-line centrifugal blowers (ARR 1): use "B" type in lieu of "R" type base.
7. Suspended: Use "H" isolators of same deflection as floor mounted.

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:
   1. Planning systematic TAB procedures.
   2. Design Review Report.
   3. Systems Inspection report.
   4. Duct Air Leakage test report.
   5. Systems Readiness Report.
   6. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
   7. Vibration and sound measurements.
   8. Recording and reporting results.

B. Definitions:
   1. Basic TAB used in this Section: Chapter 37, "Testing, Adjusting and Balancing" of ASHRAE Handbook, "HVAC Applications".
   2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
   3. AABC: Associated Air Balance Council.
   4. NEBB: National Environmental Balancing Bureau.
   5. Hydronic Systems: Includes chilled water and heating hot water // and glycol-water systems.
   6. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
   7. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

1.2 RELATED WORK

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General Mechanical Requirements.

B. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise and Vibration Requirements.

C. Section 23 07 11, HVAC INSULATION: Piping and Equipment Insulation.

D. Section 23 36 00, AIR TERMINAL UNITS: Terminal Units Performance.

E. Section 23 31 00, HVAC DUCTS AND CASINGS: Duct Leakage.

F. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Controls and Instrumentation Settings.

1.3 QUALITY ASSURANCE

A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Qualifications:

1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.

2. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the Resident Engineer and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency’s review shows unsatisfactory work performed by the predecessor agency.

3. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the Resident Engineer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by

the TAB specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.

4. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Resident Engineer. The responsibilities would specifically include:
   a. Shall directly supervise all TAB work.
   b. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC or NEBB.
   c. Would follow all TAB work through its satisfactory completion.
   d. Shall provide final markings of settings of all HVAC adjustment devices.
   e. Permanently mark location of duct test ports.
5. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing.

C. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.

D. Tab Criteria:
1. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and requirements stated herein shall be the basis for planning, procedures, and reports.
2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.

a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 0 percent to plus l0 percent.
b. Air terminal units (maximum values): Minus 2 percent to plus l0 percent.
c. Exhaust hoods/cabinets: 0 percent to plus l0 percent.
d. Minimum outside air: 0 percent to plus 10 percent.
e. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 2 percent to plus l0 percent except if the air to a space is 100 CFM or less the tolerance would be 0 to plus 5 percent.
f. Heating hot water pumps and hot water coils: Minus 5 percent to plus 5 percent.
g. Chilled water pumps: 0 percent to plus 5 percent.
h. Chilled water coils: 0 percent to plus 5 percent.

3. Systems shall be adjusted for energy efficient operation as described in PART 3.
4. Typical TAB procedures and results shall be demonstrated to the Resident Engineer for one air distribution system (including all fans, three terminal units, three rooms) and one hydronic system (pumps and three coils) as follows:
   a. When field TAB work begins.
   b. During each partial final inspection and the final inspection for the project if requested by VA.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Submit names and qualifications of TAB agency and TAB specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.
C. For use by the Resident Engineer staff, submit one complete set of applicable AABC or NEBB publications that will be the basis of TAB work.
D. Submit Following for Review and Approval:
   1. Design Review Report within 90 days for conventional design projects after the system layout on air and water side is completed by the Contractor.

2. Systems inspection report on equipment and installation for conformance with design.
3. Duct Air Leakage Test Report.
4. Systems Readiness Report.
5. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.

E. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area.

1.5 APPLICABLE PUBLICATIONS

A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.

B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

2003.....HVAC Applications ASHRAE Handbook, Chapter 37, Testing, Adjusting, and Balancing and Chapter 47, Sound and Vibration Control

C. Associated Air Balance Council (AABC):

2002.....AABC National Standards for Total System Balance

D. National Environmental Balancing Bureau (NEBB):

7th Edition 2005 .....Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

1st Edition 1994 .....Procedural Standards for the Measurement and Assessment of Sound and Vibration

2nd Edition 1999 .....Procedural Standards for Building Systems Commissioning

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

3rd Edition 2002 .....HVAC SYSTEMS-Testing, Adjusting and Balancing

PART 2 - PRODUCTS

2.1 PLUGS

Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

See Section 23 07 11, HVAC INSULATION. Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to TAB Criteria in Article, Quality Assurance.

B. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

3.2 DESIGN REVIEW REPORT

The TAB Specialist shall review the Contract Plans and specifications and advise the Resident Engineer of any design deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.3 SYSTEMS INSPECTION REPORT

A. Inspect equipment and installation for conformance with design.

B. The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.

C. Reports: Follow check list format developed by AABC, NEBB or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

3.4 DUCT AIR LEAKAGE TEST REPORT

See paragraphs "Duct leakage Tests and Repairs" in Section 23 31 00, HVAC DUCTS AND CASINGS for TAB agency’s role and responsibilities in witnessing, recording and reporting of deficiencies.

3.5 SYSTEM READINESS REPORT

A. Inspect each System to ensure that it is complete including installation and operation of controls.

B. Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB are installed. Provide a report to the Resident Engineer.

3.6 TAB REPORTS

A. Submit an intermediate report for 25 percent of systems and equipment tested and balanced to establish satisfactory test results.

B. The TAB contractor shall provide raw data immediately in writing to the Resident Engineer if there is a problem in achieving intended results before submitting a formal report.

C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated and re-submitted for approval.

D. Do not proceed with the remaining systems until intermediate report is approved by the Resident Engineer.

3.7 TAB PROCEDURES

A. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.

B. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

C. Coordinate TAB procedures with any phased construction completion requirements for the project. Provide TAB reports for each phase of the project prior to partial final inspections of each phase of the project.

D. Allow sufficient time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.

E. Air Balance and Equipment Test: Include air handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets.

1. Artificially load air filters by partial blanking to produce air pressure drop of at least 90 percent of the design final pressure drop.

2. Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements, are specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
3. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.
4. Variable air volume (VAV) systems:
   a. Coordinate TAB, including system volumetric controls, with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
   b. Section 23 36 00, AIR TERMINAL UNITS, specifies that maximum and minimum flow rates for air terminal units (ATU) be factory set. Check and readjust ATU flow rates if necessary. Balance air distribution from ATU on full cooling maximum scheduled cubic meters per minute (cubic feet per minute). Reset room thermostats and check ATU operation from maximum to minimum cooling, to the heating mode, and back to cooling. Record and report the heating coil leaving air temperature when the ATU is in the maximum heating mode.
5. Record final measurements for air handling equipment performance data sheets.

F. Water Balance and Equipment Test: Include circulating pumps, convertorsand coils:
1. Adjust flow rates for equipment. Set coils to values on equipment submittals, if different from values on contract drawings.
2. Primary-secondary (variable volume) systems: Coordinate TAB with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Balance systems at design water flow and then verify that variable flow controls function properly.
3. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating and cooling coils, and for convertors. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.

3.8 VIBRATION TESTING

A. Furnish instruments and perform vibration measurements as specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT. Field vibration balancing is specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Provide measurements for all rotating HVAC equipment of 373 watts (1/2 horsepower) and larger, including pumps, fans and motors.

B. Record initial measurements for each unit of equipment on test forms and submit a report to the Resident Engineer. Where vibration readings exceed the allowable tolerance Contractor shall be directed to correct the problem. The TAB agency shall verify that the corrections are done and submit a final report to the Resident Engineer.

3.9 SOUND TESTING

A. Perform and record required sound measurements in accordance with Paragraph, QUALITY ASSURANCE in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

   1. Take readings in rooms, approximately ten percent of all rooms. The Resident Engineer may designate the specific rooms to be tested.

B. Take measurements with a calibrated sound level meter and octave band analyzer of the accuracy required by AABC or NEBB.

C. Sound reference levels, formulas and coefficients shall be according to ASHRAE Handbook, "HVAC Applications", Chapter 46, SOUND AND VIBRATION CONTROL.

D. Determine compliance with specifications as follows:

   1. When sound pressure levels are specified, including the NC Criteria in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT:

      a. Reduce the background noise as much as possible by shutting off unrelated audible equipment.

      b. Measure octave band sound pressure levels with specified equipment "off."

      c. Measure octave band sound pressure levels with specified equipment "on."

      d. Use the DIFFERENCE in corresponding readings to determine the sound pressure due to equipment.

DIFFERENCE:	0	1	2	3	4	5 to 9	10 or More
FACTOR:	10	7	4	3	2	1	0

Sound pressure level due to equipment equals sound pressure level with equipment "on" minus FACTOR.

e. Plot octave bands of sound pressure level due to equipment for typical rooms on a graph which also shows noise criteria (NC) curves.

2. When sound power levels are specified:
   a. Perform steps 1.a. thru 1.d., as above.
   b. For indoor equipment: Determine room attenuating effect, i.e., difference between sound power level and sound pressure level. Determined sound power level will be the sum of sound pressure level due to equipment plus the room attenuating effect.
   c. For outdoor equipment: Use directivity factor and distance from noise source to determine distance factor, i.e., difference between sound power level and sound pressure level. Measured sound power level will be the sum of sound pressure level due to equipment plus the distance factor. Use 10 meters (30 feet) for sound level location.
3. Where sound pressure levels are specified in terms of dB(A), measure sound levels using the "A" scale of meter. Single value readings will be used instead of octave band analysis.

E. Where measured sound levels exceed specified level, the installing contractor or equipment manufacturer shall take remedial action approved by the Resident Engineer and the necessary sound tests shall be repeated.

3.10 MARKING OF SETTINGS

Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the Resident Engineer.

3.11 IDENTIFICATION OF TEST PORTS

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation.

All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

- - - E N D - - -

SECTION 23 07 11
HVAC INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field applied insulation for thermal efficiency and condensation control for
   1. HVAC piping, ductwork and equipment.

B. Definitions
   1. ASJ: All service jacket, white finish facing or jacket.
   2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
   3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
   4. Concealed: Ductwork and piping above ceilings and in chases, interstitial space, and pipe spaces.
   5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including mechanical, and electrical equipment rooms or exposed to outdoor weather. Attics and crawl spaces where air handling units are located are considered to be mechanical rooms. Shafts, chases, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
   6. FSK: Foil-scrim-kraft facing.
   7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees F);HVAC and plumbing equipment or piping handling media above 41 degrees C (105 degrees F); and piping media and equipment 32 to 230 degrees C(90 to 450 degrees F)
   8. Density: kg/m^3 - kilograms per cubic meter (Pcf - pounds per cubic foot).
   9. Runouts: Branch pipe connections up to 25-mm (one-inch) nominal size to fan coil units or reheat coils for terminal units.
   10. Thermal conductance: Heat flow rate through materials.
      a. Flat surface: Watt per square meter (BTU per hour per square foot).
      b. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).

11. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
12. HWH: Hot water heating supply.
13. HWHR: Hot water heating return.
14. HW: Hot water.
15. CH: Chilled water supply.
16. CHR: Chilled water return.
17. GWS: Glycol water supply.
18. GWR: Glycol water return.
19. RS: Refrigerant suction.

1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.

B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.

C. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING: Piping and equipment.

D. Section 23 21 13, HYDRONIC PIPING: Chilled water piping.

E. Section 23 31 00, HVAC DUCTS AND CASINGS: Ductwork, plenum and fittings.

1.3 QUALITY ASSURANCE

A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Criteria:

1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

> **4.3.3.1** Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.2 or 4.3.3.1.3, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. *(See 4.2.4.2.)*

4.3.3.1.2 The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

4.3.3.1.3 Smoke detectors required by 6.4.4 shall not be required to meet flame spread index or smoke developed index requirements.

4.3.3.2 Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, Standard for Safety Factory-Made Air Ducts and Air Connectors, shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

(1) UL 181A, Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors

(2) UL 181B, Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors

4.3.3.3 Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.3.4 Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

4.3.3.5* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

4.3.3.6 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

4.3.10.2.6 Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

4.3.10.2.6.2 Pneumatic tubing for control systems shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1820, Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.

4.3.10.2.6.3 Nonferrous fire sprinkler piping shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1887, Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.

4.3.10.2.6.4 Optical-fiber and communication raceways shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 2024, Standard for Safety Optical-Fiber Cable Raceway.

4.3.10.2.6.5 Loudspeakers and recessed lighting fixtures, including their assemblies and accessories, shall be permitted in the ceiling cavity plenum where listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a peak heat release rate of 100 kW or less when tested in accordance with UL 2043, Standard for Safety Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

4.3.10.2.6.7 Smoke detectors shall not be required to meet the provisions of this section.

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

(1) Not exceeding a 25.4 mm (1 in.) average clearance on all sides

(2) Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*

2. Test methods: ASTM E84, UL 723, or NFPA 255.
3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For

domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
   a. Insulation materials: Specify each type used and state surface burning characteristics.
   b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
   c. Insulation accessory materials: Each type used.
   d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
   e. Make reference to applicable specification paragraph numbers for coordination.

C. Samples:

1. Each type of insulation: Minimum size 100 mm (4 inches) square for board/block/ blanket; 150 mm (6 inches) long, full diameter for round types.
2. Each type of facing and jacket: Minimum size 100 mm (4 inches square).
3. Each accessory material: Minimum 120 ML (4 ounce) liquid container or 120 gram (4 ounce) dry weight for adhesives / cement / mastic.

1.5 STORAGE AND HANDLING OF MATERIAL

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. Federal Specifications (Fed. Spec.):

L-P-535E (2)-91.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.

C. Military Specifications (Mil. Spec.):

MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation

MIL-A-24179A (1)-87.....Adhesive, Flexible Unicellular-Plastic Thermal Insulation

MIL-C-19565C (1)-88.....Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier

MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

D. American Society for Testing and Materials (ASTM):

A167-99.....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

B209-04.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C411-97.....Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation

C449-00.....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

C533-04.....Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

C534-05.....Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

C547-06.....Standard Specification for Mineral Fiber pipe Insulation

C552-03.....Standard Specification for Cellular Glass Thermal Insulation

C553-02.....Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C585-90.....Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System) R (1998)

C612-04.....Standard Specification for Mineral Fiber Block and Board Thermal Insulation

C1126-04.....Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation

C1136-06.....Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

D1668-97a (2006).....Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing

E84-06.....Standard Test Method for Surface Burning Characteristics of Building Materials

E119-05a.....Standard Test Method for Fire Tests of Building Construction and Materials

E136-04.....Standard Test Methods for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C (1380 F)

E. National Fire Protection Association (NFPA):

90A-02.....Installation of Air Conditioning and Ventilating Systems

101-06.....Life Safety Code

251-06.....Standard methods of Tests of Fire Endurance of Building Construction Materials

255-06.....Standard Method of tests of Surface Burning Characteristics of Building Materials

F. Underwriters Laboratories, Inc (UL):

723.....UL Standard for Safety Test for Surface Burning Characteristics of Building Materials with Revision of 08/03

G. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS):

SP58-2002.....Pipe Hangers and Supports Materials, Design, and Manufacture

PART 2 - PRODUCTS

2.1 MINERAL FIBER

A. ASTM C612 (Board, Block), Class 1 or 2, k = 0.037 Watt per meter, per degree C (0.26), external insulation for temperatures up to 204 degrees C (400 degrees F).

B. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density 16 kg/m^3 (1 pcf), k = 0.045 (0.31) Class B-5, Density 32 kg/m^3 (2 pcf), k = 0.04 (0.27), for use at temperatures up to 204 degrees C (400 degrees F)

C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) for use at temperatures 230 degrees C (450 degrees F).

2.2 RIGID CELLULAR PHENOLIC FOAM

A. Preformed (molded) pipe insulation, ASTM C1126, type III, grade 1, k = 0.021(0.15), for temperatures up to 121 degrees C (250 degrees F) with vapor retarder and all service jacket with polyvinyl chloride premolded fitting covering.

B. Equipment and Duct Insulation, ASTM C 1126, type II, grade 1, k = 0.021 (0.15), for temperatures up to 121 degrees C (250 degrees F) with rigid cellular phenolic insulation and covering, vapor retarder and all service jacket.

2.3 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

A. ASTM C177, C518, k = 0.039 Watt per meter, per degree C (0.27), at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required.

2.4 CALCIUM SILICATE

A. Preformed pipe Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.

B. Premolded Pipe Fitting Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.

C. Equipment Insulation: ASTM C533, Type I and Type II

D. Characteristics:

Insulation Characteristics		
ITEMS	**TYPE I**	**TYPE II**
Temperature, maximum degrees C (degrees F)	649 (1200)	927 (1700)
Density (dry), Kg/m^3 (lb/ ft3)	232 (14.5)	288 (18)
Thermal conductivity: Min W/ m K (Btu in/h ft^2 degrees F)@ mean temperature of 93 degrees C (200 degrees F)	0.059 (0.41)	0.078 (0.540)
Surface burning characteristics: Flame spread Index, Maximum	0	0
Smoke Density index, Maximum	0	0

2.5 INSULATION FACINGS AND JACKETS

A. Vapor Retarder, higher strength with low water permeance $\underline{=}$ 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.

B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 5 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 100 mm (4 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.

C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.

D. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.

E. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.

F. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.

2.6 PIPE COVERING PROTECTION SADDLES

A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m^3 (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long
200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m^3 (3.0 pcf).

C. Boiler Plant Pipe supports: MSS SP58, Type 39. Apply at all pipe support points, except where MSS SP58, Type 3 pipe clamps provided as part of the support system.

2.7 ADHESIVE, MASTIC, CEMENT

A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.

B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.

C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.

D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.

E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.

F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.

G. Other: Insulation manufacturers' published recommendations.

2.8 MECHANICAL FASTENERS

A. Pins, anchors: Welded pins, or metal or nylon anchors with tin-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.

B. Staples: Outward clinching monel or stainless steel.

C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.

D. Bands: 20 mm (3/4 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.9 REINFORCEMENT AND FINISHES

A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).

B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.

C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.

D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.

E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.

F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.10 FIRESTOPPING MATERIAL

Other than pipe and duct insulation, refer to Section 07 84 00 FIRESTOPPING.

2.11 FLAME AND SMOKE

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the Resident Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.

B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.

C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

E. Construct insulation on parts of equipment such as chilled water pumps and heads of chillers, convertors and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.

F. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.

G. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

H. HVAC work not to be insulated:

1. Internally insulated air handling units.
2. Relief air ducts (Economizer cycle exhaust air).
3. Exhaust air ducts and plenums, and ventilation exhaust air shafts.
4. Equipment: Expansion tanks, flash tanks, hot water pumps, and buffer tanks.
5. In hot piping: Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.

I. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

J. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

K. Firestop Pipe and Duct insulation:

1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
   a. Pipe risers through floors
   b. Pipe or duct chase walls and floors
   c. Smoke partitions
   d. Fire partitions

3.2 INSULATION INSTALLATION

A. Mineral Fiber Board:

1. Faced board: Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.
2. Plain board:
   a. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 225 mm (9 inches) on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.
   b. For hot equipment: Stretch 25 mm (1 inch) mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 6 mm (1/4 inch) thick, trowel led to a smooth finish.
   c. For cold equipment: Apply meshed glass fabric in a tack coat 1.5 to 1.7 square meter per liter (60 to 70 square feet per gallon) of vapor mastic and finish with mastic at 0.3 to 0.4 square meter per liter (12 to 15 square feet per gallon) over the entire fabric surface.
   d. Chilled water pumps: Insulate with removable and replaceable 1 mm thick (20 gage) aluminum or galvanized steel covers lined with insulation. Seal closure joints/flanges of covers with gasket

material. Fill void space in enclosure with flexible mineral fiber insulation.

3. Exposed, unlined ductwork and equipment in unfinished areas, mechanical and electrical equipment rooms and attics, and duct work exposed to outdoor weather:
   a. 50 mm (2 inch) thick insulation faced with ASJ (white all service jacket): Supply air duct.
   b. 40 mm (1-1/2 inch) thick insulation faced with ASJ: Return air duct.
   c. Outside air intake ducts: 25 mm (one inch) thick insulation faced with ASJ.
4. Cold equipment: 40 mm (1-1/2inch) thick insulation faced with ASJ.
   a. Chilled water pumps, chemical feeder pot or tank.
   b. Pneumatic, cold storage water and surge tanks.
5. Hot equipment: 40 mm (1-1/2 inch) thick insulation faced with ASJ.
   a. Convertors, air separators, and buffer tank.
   b. Reheat coil casing and separation chambers on steam humidifiers located above ceilings.

B. Flexible Mineral Fiber Blanket:
1. Adhere insulation to metal with 100 mm (4 inch) wide strips of insulation bonding adhesive at 200 mm (8 inches) on center all around duct. Additionally secure insulation to bottom of ducts exceeding 600 mm (24 inches) in width with pins welded or adhered on 450 mm (18 inch) centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.
2. Supply air ductwork to be insulated includes main and branch ducts from AHU discharge to room supply outlets, and the bodies of ceiling outlets to prevent condensation. Insulate sound attenuator units, coil casings and damper frames. To prevent condensation insulate trapeze type supports and angle iron hangers for flat oval ducts that are in direct contact with metal duct.
3. Concealed supply air ductwork.
   a. Above ceilings at a roof level: 50 mm (2 inch) thick insulation faced with FSK.

b. Above ceilings for other than roof level: 40 mm (1 ½ inch) thick insulation faced with FSK.

4. Concealed return air duct above ceilings at a roof level, unconditioned areas, and in chases with external wall or containing steam piping; 40 mm (1-1/2 inch) thick, insulation faced with FSK. Concealed return air ductwork in other locations need not be insulated.
5. Return air duct in interstitial spaces: 40 mm (1-1/2 inch thick insulation faced with FSK.
6. Concealed outside air duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.

C. Molded Mineral Fiber Pipe and Tubing Covering:

1. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
2. Contractor's options for fitting, flange and valve insulation:
   a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
   b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
   c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.

d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).

3. Nominal thickness in millimeters and inches specified in table below, for piping above ground:

Nominal Thickness of Molded Mineral Fiber Insulation				
Nominal Pipe Size, millimeters (inches):	25 (1) & below	32- 75 (1-1/4-3)	100-150 (4-6)	200 (8) and above
a. 38-99 degrees C (100-211 degrees F) (HWH, HWHR, GWS, GWR)	25 (1.0)	40 (1.5)	50 (2.0)	50 (2.0)
1. Runouts to fan coil units //	15 (0.5)	-	-	-
2. Runouts to air terminal unit reheat coils	15 (0.5)	-	-	-

D. Rigid Cellular Phenolic Foam:

1. Rigid closed cell phenolic insulation may be provided for piping, ductwork and equipment for temperatures up to 121 degrees C (250 degrees F).
2. Note the NFPA 90A burning characteristics requirements of 25/50 in paragraph 1.3.B
3. Provide secure attachment facilities such as welding pins.
4. Apply insulation with joints tightly drawn together
5. Apply adhesives, coverings, neatly finished at fittings, and valves.
6. Final installation shall be smooth, tight, neatly finished at all edges.
7. Minimum thickness in millimeters (inches) specified in table below, for piping above ground:

Nominal Thickness of Rigid Closed-Cell Phenolic Foam Insulation					
Nominal Pipe Size millimeters (inches):	25 (1) & below	32-75 (1 1/4-3)	100-150 (4-6)	200-300 (8-12)	350 (14) & above
a. 4-16 degrees C (40-60 degrees F), CH, CHR,.	20 (0.75)	20 (0.75)	25 (1)	40 (1.5)	50 (2.0)

8. Condensation control insulation: Minimum 20 mm (0.75 inch) thick for all pipe sizes.
   a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.
9. Condensation control insulation: Minimum 20 mm (0.75 inch) thick for all pipe sizes.
   a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet.

E. Flexible Elastomeric Cellular Thermal Insulation:
1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
2. Pipe and tubing insulation:
   a. Use proper size material. Do not stretch or strain insulation.
   b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
   c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.

3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
4. Pipe insulation: nominal thickness in millimeters (inches as specified in table below for piping above ground:

Nominal Thickness of Flexible Elastomeric Cellular Insulation				
Nominal Pipe Size millimeters (inches)	25 (1) & below	32-75 (1 1/4-3)	100-150 (4-6)	200 (8)
a. 4-16 degrees C (40-60 degrees F) (CH, CHR, RS for DX Refrigeration)	25 (1.0)	40 (1.5)	-	-

5. Minimum 20 mm (0.75 inch) thick insulation for pneumatic control lines for a minimum distance of 6 m (20 feet) from discharge side of the refrigerated dryer.
6. Use Class S (Sheet), 20 mm (3/4 inch) thick for the following:
   a. Chilled water pumps

- - - E N D - - -

SECTION 23 08 00

COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. This Section includes requirements for commissioning the HVAC systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

C. The commissioning activities have been developed to support the United States Green Building Council (USGBC) LEED™ rating program and to support delivery of project performance in accordance with the Contract Documents developed with the approval of the VA.

1. Commissioning activities and documentation for the LEED™ section on “Energy and Atmosphere” prerequisite of “Fundamental Building Systems Commissioning”.
2. Commissioning activities and documentation for the LEED™ section on “Energy and Atmosphere” requirements for the “Enhanced Building System Commissioning” credit.

3. Activities and documentation for the LEED™ section on “Measurement and Verification” requirements for the Measurement and Verification credit.

D. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the VA’s Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following HVAC systems will be commissioned:

1. Air Handling Systems (including terminal units and energy recovery units)
2. Air Handling Systems (Fans, motors, Variable Speed Drives, cooling coils and control valves, heating coils and control valves, filters, dampers, safeties such as smoke detectors or freezestats and damper end switches, controls, gages, and vibration isolation).
4. Heating Hot Water Systems (Boilers, controls, instrumentation and gages, flues, heating water pumps and motors, Variable Speed Drives, mixing valves).
6. Chilled Water Systems (Chilled water pumps and motors, Variable Speed Drives, chiller motor/compressor, controls, instrumentation and safeties, isolation valves, blending valves, side stream water cleaners/scrubbers/filters).
7. Condenser Water Systems for Chillers (Condenser water pumps and motors, Variable Speed Drives, cooling tower fans, cooling tower sump level controls, open-circuit water treatment system, water treatment injection pumps and motors, water treatment controls, cooling tower basin heaters and controls, side stream water cleaners/scrubbers/filters, tower bypass valves).

8. Exhaust Fans (Fan, motor, Variable Speed Drives, controls and safeties).
10. Direct Digital Control System (BACnet or similar Local Area Network (LAN), Operator Work Station hardware and software, building controller hardware and software, terminal unit controller hardware and software, all sequences of operation, system accuracy and response time).
11. HVAC Water Treatment Systems (Closed circuits – including shot feeders and final water analysis, open circuits – including water analysis, chemical/biocide tanks, injection piping, chemical/biocide pumps and motors, controls, water meter, and automatic blowdown).

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the

Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.2 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF VA PERSONNEL

A. Training of the VA’s operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Resident

Engineer after submission and approval of formal training plans.

Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 23 Sections for additional Contractor training requirements.

----- END -----

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 – GENERAL

1.1 DESCRIPTION

A. The control system(s) shall be as indicated on the project documents, point list, drawings and described in these specifications. This scope of work shall include a complete and working system including all engineering, programming, controls and installation materials, installation labor, commissioning and start-up, training, final project documentation and warranty.

B. Engineering Control Center (ECC) shall include:
   1. Ethernet, IP Supervisory Network.
   2. Graphic Operational Interface.
   3. Software Configuration Tools (SCT).
   4. Scheduling and Alarm Management software.
   5. Local BACnet IP and MS/TP networks.
   6. Network Area Controllers (NAC).
   7. Data and File Server (DFS).
   8. Unitary Control Units (UCU).
   9. BACnet Compliant Application Controllers and field devices.
   10. Connected I/O devices.
   11. Third party system Data Integration.

C. The Controls Contractor’s work shall include all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, Project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, Warranty, specified services and items required by the Contract for the complete and fully functional Controls Systems.

D. Following control devices and systems shall be used to provide the functional requirements of HVAC equipment and systems.
   1. Direct Digital Control (DDC) of HVAC equipment and systems with electric or electronic positioning of valves and dampers.

2. Terminal units including VAV Boxes, Fan Powered Boxes, Unit Heaters, Cabinet Unit Heaters, and similar units for control of room environment conditions may be equipped with integral controls furnished and installed by the equipment manufacturer or field mounted. Refer to equipment specifications and as indicated in project documents.

E. Connect the new work to the existing ECC system or operator workstation manufactured by Delta Controls "OrcaWeb". The controls for this project must be capable of interfacing with the existing system including graphics and control through the existing front end system. The existing CPU/Monitor, printer, and other peripherals may be used to form a single operator workstation. New system including interface to existing systems and equipment shall operate and function as one complete system including one database of control point objects and global control logic capabilities. All new controllers must be able to be programed through the Existing Delta Controls OrcaWeb Control system. Facility operators shall have complete operations and control capability over all systems, new and existing including; monitoring, trending, graphing, scheduling, alarm management, global point sharing, global strategy deployment, graphical operations interface and custom reporting as specified. Modify the existing ECC, if necessary, to accommodate the additional control points.

F. The control subcontractor shall supply as required, all necessary hardware equipment and software packages to interface between any existing and new system Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices, hardware and software points provided. Network area controllers are same as remote controller units (RCU).

G. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. Temperature Controls contractor shall provide controllers for each mechanical system. In the event of a network communication failure, or the loss of any other controller, the control system shall continue to operate independently. Failure of the ECC shall have no effect on the field controllers, including those involved with global strategies.

H. All controllers shall communicate. The Router or System Level Controller shall reside on the BACnet/IP Ethernet (ISO 8802-3) local

area network, and provide information via standard BACnet object types and application services.

I. The intent of this specification is to provide a peer-to peer networked, stand-alone, distributed control system. The ECC requires using American Society of Heating and Refrigerating Engineers/American National Standards Institute (ASHRAE/ANSI) Standard 135(BACnet) protocol.

J. Power wiring shall not be run in conduit with communications trunk wiring or signal or control wiring operating at 100 volts or less.

1.2 RELATED WORK

A. Section 28 31 00, FIRE DETECTION AND ALARM.

B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.

D. Section 23 36 00, AIR TERMINAL UNITS.

E. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

F. Section 23 31 00, HVAC DUCTS AND CASINGS.

G. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

H. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

I. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

J. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).

K. Section 26 27 26, WIRING DEVICES.

1.3 DEFINITION

A. Algorithm: A logical procedure for solving a recurrent mathematical problem; A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.

B. ACU: Auxiliary Control Unit (ACU) used for controls of air handling units, reports to RCU.

C. Analog: A continuously varying signal value (e.g., temperature, current, velocity etc.

D. BACnet: Building Automation Control Network Protocol, ASHRAE Standard 135.

E. Baud: It is a signal change in a communication link. One signal change can represent one or more bits of information depending on type of transmission scheme. Simple peripheral communication is normally one

bit per Baud. (e.g., Baud rate = 78,000 Baud/sec is 78,000 bits/sec, if one signal change = 1 bit).

F. Binary: A two-state system where a high signal level represents an "ON" condition and an "OFF" condition is represented by a low signal level.

G. BMP or bmp: Suffix, computerized image file, used after the period in a DOS-based computer file to show that the file is an image stored as a series of pixels.

H. Bus Topology: A network topology that physically interconnects workstations and network devices in parallel on a network segment.

I. Control Unit (CU): Generic term for any controlling unit, stand-alone, microprocessor based, digital controller residing on secondary LAN or Primary LAN, used for local controls or global controls. In this specification, there are three types of control units are used; Unitary Control Unit (UCU), Auxiliary Control Unit (ACU), and Remote Control Unit (RCU).

J. Deadband: A temperature range over which no heating or cooling is supplied, i.e., 22-25 degrees C (72-78 degrees F), as opposed to a single point change over or overlap).

K. Diagnostic Program: A software test program, which is used to detect and report system or peripheral malfunctions and failures. Generally, this system is performed at the initial startup of the system.

L. Direct Digital Control (DDC): Microprocessor based control including Analog/Digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices in order to achieve a set of predefined conditions.

M. Distributed Control System: A system in which the processing of system data is decentralized and control decisions can and are made at the subsystem level. System operational programs and information are provided to the remote subsystems and status is reported back to the Engineering Control Center. Upon the loss of communication with the Engineering Control center, the subsystems shall be capable of operating in a stand-alone mode using the last best available data.

N. Download: The electronic transfer of programs and data files from a central computer or operation workstation with secondary memory devices to remote computers in a network (distributed) system.

O. DXF: An AutoCAD 2-D graphics file format. Many CAD systems import and export the DXF format for graphics interchange.

P. Electrical Control: A control circuit that operates on line or low voltage and uses a mechanical means, such as a temperature sensitive bimetal or bellows, to perform control functions, such as actuating a switch or positioning a potentiometer.

Q. Electronic Control: A control circuit that operates on low voltage and uses a solid-state components to amplify input signals and perform control functions, such as operating a relay or providing an output signal to position an actuator.

R. Engineering Control Center (ECC): The centralized control point for the intelligent control network. The ECC comprises of personal computer and connected devices to form a single workstation.

S. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.

T. Firmware: Firmware is software programmed into read only memory (ROM) chips. Software may not be changed without physically altering the chip.

U. FTT-10: Echelon Transmitter-Free Topology Transceiver.

V. GIF: Abbreviation of Graphic interchange format.

W. Graphic Program (GP): Program used to produce images of air handler systems, fans, pumps, and building spaces. These images can be animated and/or color-coded to indicate operation of the equipment.

X. Graphic Sequence of Operation: It is a graphical representation of the sequence of operation, showing all inputs and output logical blocks.

Y. I/O Unit: The section of a digital control system through which information is received and transmitted. I/O refers to analog input (AI, digital input (DI), analog output (AO) and digital output (DO). Analog signals are continuous and represent temperature, pressure, flow rate etc, whereas digital signals convert electronic signals to digital pulses (values), represent motor status, filter status, on-off equipment etc.

Z. I/P: Internet Protocol-global network, connecting workstations and other host computers, servers etc. to share the information.

AA. JPEG: A standardized image compression mechanism stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard.

BB. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.

CC. LonMark: An association comprising of suppliers and installers of LonTalk products. The Association provides guidelines for the implementation of the LonTalk protocol to ensure interoperability through Standard implementation.

DD. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a “Neuron Chip” for communication.

EE. LonWorks: Network technology developed by the Echelon Corporation.

FF. Network: A set of computers or other digital devices communicating with each other over a medium such as wire, coax, fiber optics cable etc.

GG. Network Area Controller: Digital controller, supports a family of auxiliary control units and unitary control units, and communicates with peer-to-peer network for transmission of global data.

HH. Network Repeater: A device that receives data packet from one network and rebroadcasts to another network. No routing information is added to the protocol.

II. MS/TP: Master-slave/token-passing.

JJ. Operating system (OS): Software, which controls the execution of computer application programs.

KK. PCX: File type for an image file. When photographs are scanned onto a personal computer they can be saved as PCX files and viewed or changed by a special application program as Photo Shop.

LL. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.

MM. Peer-to-Peer: A networking architecture that treats all network stations as equal partners.

NN. PICS: Protocol Implementation Conformance Statement.

OO. UCU: Unitary Control Unit, digital controller, dedicated to a specific piece of equipment, such as VAV boxes, heat exchangers etc.

1.4 QUALITY ASSURANCE

A. Criteria:

1. The Controls and Instrumentation System Contractor shall be a primary equipment manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Facility Management Systems of similar size, scope and complexity to the EEC specified in this Contract. Distributors, manufacturer’s representatives and wholesalers will not be acceptable.
2. Single Source Responsibility of subcontractor: The Contractor shall obtain hardware and software supplied under this Section and delegates the responsibility to a single source controls installation subcontractor. The controls subcontractor shall be responsible for the complete design, installation, and commissioning of the system. The controls subcontractor shall be in the business of design, installation and service of such building automation control systems similar in size and complexity.
3. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer’s latest standard design and have been tested and proven in actual use.
4. The controls subcontractor shall provide a list of no less than ten similar projects which have building control systems as specified in this Section. These projects must be on-line and functional such that the Department of Veterans Affairs (VA) representative would observe the control systems in full operation.
5. The controls subcontractor shall have (minimum of three years) experience in design and installation of building automation systems similar in performance to those specified in this Section. Provide evidence of experience by submitting resumes of the project manager, the local branch manager, project engineer, the application engineering staff, and the electronic technicians who would be involved with the supervision, the engineering, and the installation of the control systems. Training and experience of these personnel shall not be less than three years. Failure to disclose this information will be a ground for disqualification of the supplier.

6. The controls subcontractor shall have in-place facility within 50 miles with technical staff, spare parts inventory for the next five (5) years, and necessary test and diagnostic equipment to support the control systems.
7. Provide a competent and experienced Project Manager employed by the Controls Contractor. The Project Manager shall be supported as necessary by other Contractor employees in order to provide professional engineering, technical and management service for the work. The Project Manager shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling and related decisions on behalf of the Controls Contractor.

B. Codes and Standards:
1. All work shall conform to the applicable Codes and Standards.
2. Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.
3. Peer-to-peer controllers, unitary controllers shall conform to the requirements of UL 916, Category PAZX.

1.5 PERFORMANCE

A. The system shall conform to the following:
1. Graphic Display: The system shall display up to 4 graphics on a single screen with a minimum of (20) dynamic points per graphic. All current data shall be displayed within (10) seconds of the request.
2. Graphic Refresh: The system shall update all dynamic points with current data within (10) seconds. Data refresh shall be automatic, without operator intervention.
3. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be (10) seconds. Analog objects shall start to adjust within (3) seconds.
4. Object Scan: All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or work-station will be current, within the prior (10) seconds.
5. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed (10) seconds.

6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every (5) seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Performance: Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every five (5) seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciations: All workstations on the network shall receive alarms within (5) seconds of each other.

9. Reporting Accuracy: Listed below are minimum acceptable reporting accuracies for all values reported by the specified system:

Measured Variable	**Reported Accuracy**
Space temperature	±0.5 degrees C (±1 degrees F)
Ducted air temperature	±1.0 degrees C [±2 degrees F]
Outdoor air temperature	±1.0 degrees C [±2 degrees F]
Water temperature	±0.5 degrees C [±1 degrees F]
Relative humidity	±2 percent RH
Water flow	±5 percent of full scale
Air flow (terminal)	±10 percent of reading
Air flow (measuring stations)	±5 percent of reading
Air pressure (ducts)	±25 Pa [±0.1 "W.G.]
Air pressure (space)	±3 Pa [±0.001 "W.G.]
Water pressure	±2 percent of full scale *Note 1
Electrical Power	5 percent of reading

Note 1: for both absolute and differential pressure

1.6 WARRANTY

A. Labor and materials for control systems shall be warranted for a period as specified under Warranty in FAR clause 52.246-21.
B. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no cost or reduction in service to the owner. The system includes all computer equipment, transmission equipment, and all sensors and control devices.

C. The on-line support service shall allow the Controls supplier to dial out over telephone lines to monitor and control the facility's building automation system. This remote connection to the facility shall be within two (2) hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekend and holidays. If the problem cannot be resolved with on-line support services, the Controls supplier shall dispatch the qualified personnel to the job site to resolve the problem within 24 hours after the problem is reported.

D. Controls and Instrumentation subcontractor shall be responsible for temporary operations and maintenance of the control systems during the construction period until final commissioning, training of facility operators and acceptance of the project by VA.

1.7 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's literature and data for all components including the following:

1. A wiring diagram for each type of input device and output device including DDC controllers, modems, repeaters, etc. Diagram shall show how the device is wired and powered, showing typical connections at the digital controllers and each power supply, as well as the device itself. Show for all field connected devices, including but not limited to, control relays, motor starters, electric or electronic actuators, and temperature pressure, flow and humidity sensors and transmitters.
2. A diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and the associated point names.
3. Control dampers and control valves schedule, including the size and pressure drop.
4. Installation instructions for smoke dampers and combination smoke/fire dampers, if furnished.
5. Catalog cut sheets of all equipment used. This includes, but is not limited to DDC controllers, panels, peripherals, airflow measuring stations and associated components, and auxiliary control devices such as sensors, actuators, and control dampers. When manufacturer's

cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted. Each submitted piece of literature and drawings should clearly reference the specification and/or drawings that it supposed to represent.

6. Sequence of operations for each HVAC system and the associated control diagrams. Equipment and control labels shall correspond to those shown on the drawings.
7. Color prints of proposed graphics with a list of points for display.
8. Furnish PICS for each BACNET compliant device.

C. Product Certificates: Compliance with Article, QUALITY ASSURANCE.

D. As Built Control Drawings:

1. Furnish three (3) copies of as-built drawings for each control system. The documents shall be submitted for approval prior to final completion.
2. Furnish one (1) stick set of applicable control system prints for each mechanical system for wall mounting. The documents shall be submitted for approval prior to final completion.
3. Furnish one (1) CD-ROM in CAD DWG and/or .DXF format for the drawings noted in subparagraphs above.

E. Operation and Maintenance (O/M) Manuals):

1. Submit in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS.
2. Include the following documentation:
   a. General description and specifications for all components, including logging on/off, alarm handling, producing trend reports, overriding computer control, and changing set points and other variables.
   b. Detailed illustrations of all the control systems specified for ease of maintenance and repair/replacement procedures, and complete calibration procedures.
   c. One copy of the final version of all software provided including operating systems, programming language, operator workstation software, and graphics software.
   d. Complete troubleshooting procedures and guidelines for all systems.
   e. Complete operating instructions for all systems.

f. Recommended preventive maintenance procedures for all system components including a schedule of tasks for inspection, cleaning and calibration. Provide a list of recommended spare parts needed to minimize downtime.

g. Licenses, guaranty, and other pertaining documents for all equipment and systems.

h. Training Manuals: Submit the course outline and training material to the Owner for approval three (3) weeks prior to the training to VA facility personnel. These persons will be responsible for maintaining and the operation of the control systems, including programming. The Owner reserves the right to modify any or all of the course outline and training material.

F. Submit Performance Report to Resident Engineer prior to final inspection.

1.8 INSTRUCTIONS

A. Instructions to VA operations personnel: Perform in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS, and as noted below.

1. First Phase: Formal instructions to the VA facilities personnel for a total of 16 hours, conducted sometime between the completed installation and prior to the performance test period of the control system, at a time mutually agreeable to the Contractor and the VA.
2. Second Phase: This phase of training shall comprise of on the job training during start-up, checkout period, and performance test period. VA facilities personnel will work with the Contractor’s installation and test personnel on a daily basis during start-up and checkout period. During the performance test period, controls subcontractor will provide 8 hours of instructions to the VA facilities personnel.
3. The O/M Manuals shall contain approved submittals as outlined in Article 1.7, SUBMITTALS. The Controls subcontractor will review the manual contents with VA facilities personnel during second phase of training.
4. Training by independent or franchised dealers who are not direct employees of the controls supplier will not be acceptable.

1.9 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)

A. The ECC and peripheral devices and system support equipment shall be designed to operate in ambient condition of 20 to 35 degrees C (65 to 90 degrees F) at a relative humidity of 20 to 80 percent non-condensing.

B. The CUs and associated equipment used in controlled environment shall be mounted in NEMA 1 enclosures for operation at 0 to 50 degrees C (32 to 122 degrees F) at a relative humidity of 10 to 90 percent non-condensing.

C. The CUs used outdoors shall be mounted in NEMA 4 waterproof enclosures, and shall be rated for operation at –40 to 65 degrees C (-40 to 150 degrees F).

D. All electronic equipment shall operate properly with power fluctuations of plus 10 percent to minus 15 percent of nominal supply voltage.

E. Sensors and controlling devices shall be designed to operate in the environment, which they are sensing or controlling.

1.10 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
Standard 135-04.....BACNET Building Automation and Control Networks

C. Federal Communication Commission (FCC):
Rules and Regulations Title 47 Chapter 1-2001 Part 15..Radio Frequency Devices.

D. Institute of Electrical and Electronic Engineers (IEEE):
802.3-05.....Information Technology-Telecommunications and Information Exchange between Systems-Local and Metropolitan Area Networks- Specific Requirements-Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access method and Physical Layer Specifications

E. Instrument Society of America (ISA):
7.0.01-1996.....Quality Standard for Instrument Air

F. National Fire Protection Association (NFPA):
70-05.....National Electric Code

90A-02.....Standard for Installation of Air-Conditioning and Ventilation Systems

G. Underwriter Laboratories Inc (UL):

94-06.....Tests for Flammability of Plastic Materials for Parts and Devices and Appliances

294-05.....Access Control System Units

486A/486B-04-.....Wire Connectors

555S-03.....Standard for Smoke Dampers

916-Rev 2-04.....Energy Management Equipment

PART 2 – PRODUCTS

2.1 CONTROLS SYSTEM ARCHITECTURE

A. General

1. The Controls Systems shall consist of multiple Nodes and associated equipment connected by industry standard digital and communication network arrangements.
2. The Operator Workstations, Servers and principal network computer equipment shall be standard products of recognized major manufacturers available through normal PC and computer vendor channels – not "Clones" assembled by a third-party subcontractor.
3. Provide licenses for all software residing on and used by the Controls Systems and transfer these licenses to the Owner prior to completion.
4. The networks shall, at minimum, comprise, as necessary, the following:
   a. Operator Workstations – fixed and portable as required by the Specifications.
   b. Network computer processing, data storage and communication equipment including Servers and digital data processors.
   c. Routers, bridges, switches, hubs, modems, interfaces and the like communication equipment.
   d. Active processing network area controllers connected to programmable field panels and controllers together with their power supplies and associated equipment.
   e. Addressable elements, sensors, transducers and end devices.
   f. Third-party equipment interfaces as required by the Contract Documents.

g. Other components required for a complete and working Control Systems as specified.

B. The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards and to meet all requirements of the Contract Documents.

C. Network Architecture

1. The Controls Systems Application network shall utilize an open architecture capable of each and all of the following:
   a. Utilizing standard Ethernet communications and operate at a minimum speed of 10/100 Mb/sec.
   b. Connecting via BACNET with ANSI/ASHRAE Standard 135.
2. The networks shall utilize only copper and optical fiber communication media as appropriate and shall comply with applicable codes, ordinances and regulations
3. All necessary telephone lines, ISDN lines and internet Service Provider services and connections will be provided by the owner.
4. The Controls Contractor shall provide the IT interfacing equipment and shall coordinate on configuration and interfacing arrangements with the Data Cabling System contractor. The Controls Contractor shall coordinate IT equipment interfacing with the Data Cabling Systems contractor. This IT equipment shall be provided by the Data Cabling systems contractor directly at that contractor’s cost. The Controls Contractor shall provide all IT interfacing equipment and cabling to a detail coordinated with the Owner.

D. Third Party Interfaces:

1. The Controls Systems shall include necessary hardware, equipment and software to allow data communications between the Controls Systems and building systems supplied by other trades.
2. The other manufacturers and contractors supplying other associated systems and equipment will provide their necessary hardware, software and start-up at their cost and will cooperate fully with the Controls Contractor in a timely manner and at their cost to ensure complete functional integration.

E. Servers:

1. All New work must natively interface with the existing Delta Controls OrcaWeb Server.

2. Equip these Server(s) with the same software Tool Set that is located in the Network Area Controllers for system configuration and custom logic definition and color graphic configuration.
3. Access to all information on the Controls Systems Server(s) shall be through the same browser Operator Interface functionality used to access individual nodes. When logged onto a Server the Operator will be able to also interact with any Controls As required for the functional operation of the Controls Systems, the Controls Contractor shall provide all necessary digital processor programmable Server(s). These Server(s) shall be utilized for Controls Systems Application configuration, for archiving, reporting and trending of data, for Operator transaction archiving and reporting, for network information management, for alarm annunciation, for Operator Interface tasks, for Controls Application management and the like. These Server(s) shall utilize IT industry standard data base platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE) or approved equal.

2.2 DIRECT DIGITAL CONTROLLERS

A. (NAC) Network Area Controllers shall be stand-alone, multi-tasking, multi-user, real-time digital processor complete with all hardware, software, and communications interfaces, power supplies. The Controls System shall be designed and implemented entirely for use and operation on the Internet. NACs shall have access to data within the industry standard IT network to the Data Server and other NACs as needed to accomplish required global control strategies.

1. NACs shall provide both standalone and networked direct digital control of mechanical and electrical building system controllers as required by the Specifications. The primary NAC shall support a minimum of [5,000] field points together with all associated features, sequences, schedules, applications required for a fully functional distributed processing operation.
2. NACs shall monitor and report communication status to the Controls Systems Application. The Controls Systems shall provide a system advisory upon communication failure and restoration.
3. All NACs on the network shall be equipped with all software functionality necessary to operate the complete user interface,

including graphics, via a Browser connected to the Node on the network or directly via a local port on the NAC.

4. All NAC shall be provided with face mounted LED type annunciation to continually display its operational mode, power and communications.
5. The controllers shall reside on the BACnet Ethernet (ISO 8802-3) local area network and provide Read (Initiate) and Write (Execute) services as defined in Clauses 15.5 and 15.8, respectively of ASHRAE Standard 135, to communicate BACnet objects. Objects supported shall include: Analog input, analog output, analog value, binary input, binary output, binary value, multistate value, program object, and device.
6. Each NAC shall be provided with the necessary un-interruptible power facilities to ensure its continued normal operation during periods of line power outages of, at minimum, 1-minute duration. Normal functionality shall include all normal software processing, communication with powered field devices and network communications with other powered Controls Systems NAC, Data Servers and OWS. Each NAC shall report its communication status to the Application. The Application shall provide a system advisory upon communication failure and restoration. Each NAC shall retain program, control algorithms, and setpoint information in non-volatile memory in the event of a power failure, and shall return to normal operation upon restoration of power.
7. Each NAC shall have sufficient memory to support its operating system, database, and program requirements, including the following:
   a. Device and network management.
   b. Data sharing.
   C. Alarm and event management including custom alarm messages for each level alarm for the points noted in the I/O Schedule.
   d. Energy management.
   e. Historical trend data for points specified.
   f. Maintenance report.
   g. Scheduling.
   h. Dial up and network communications.
   i. Manual override monitoring.
8. Each NAC shall support firmware upgrades without the need to replace hardware and shall have a minimum of 15 percent spare capacity of

secondary system controllers, point capacity and programming functions.

9. Each NAC shall continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure shall assume the predetermined failure mode.
10. Each NAC shall monitor the status of all overrides and inform the operator that automatic control has inhibited, and allow the operator to manually override automatic or centrally executed command.
11. Provide the capability to generate and modify the Controls Systems Application software-based sequences, database elements, associated operational definition information and user-required revisions to same at any designated Workstation together with the means to download same to the associated System Controllers.
12. In the event of loss of normal power, there shall be orderly shutdown of the controllers to prevent the loss of database or software programming. When power is restored flash memory, battery backup or super capacitor will be automatically loaded into non-volatile flash memory and shall be incorporated for all programming data.

B. Auxiliary Control Units (ACUs) shall be stand-alone, multi-tasking, multi-user, real time digital processor complete with all hardware, software and communication interfaces, power supplies, and input/output modular devices.

1. ACUs shall either reside on the BACnet MS/TP or BACnet IP network
2. All ACUs shall be provided with LED type annunciation to continually display its operational mode, power and communications.
3. Each ACU shall have sufficient memory to support its operating system, database including the following:
   a. Data sharing.
   b. Device and network management.
   c. Alarm and event management.
   d. Scheduling.
   e. Energy Management.
4. Each ACU shall support firmware upgrades without the need to replace hardware and shall have a minimum of 15 percent spare capacity of

I/O functions. The type of spares shall be in the same proportion as the implemented functions on the controller, but in no case there shall be less than one point of each implemented I/O type.

5. Each ACU shall continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure shall assume the predetermined failure mode.
6. In the event of loss of normal power, there shall be orderly shutdown of the controllers to prevent the loss of database or software programming. When power is restored flash memory, battery backup or super capacitor will be automatically loaded into non-volatile flash memory and shall be incorporated for all programming data.

C. Unitary Control Units (UCUs) shall be microprocessor-based. They shall be capable of stand-alone operation, continuing to provide stable control functions if communication is lost with the rest of the system.

1. Unitary Control Units shall either reside on the BACnet MS/TP or BACnet IP network.
2. Each UCU shall have sufficient memory to support its own operating system, including data sharing.
3. All UCUs shall be provided with LED type annunciation to continually display its operational mode, power and communications.
4. In the event of loss of normal power, there shall be orderly shutdown of the controllers to prevent the loss of database or software programming. When power is restored flash memory, battery backup or super capacitor will be automatically loaded into non-volatile flash memory and shall be incorporated for all programming data.

D. Provide I/O module that connects sensors and actuators onto the field bus network for use by the direct digital controllers. I/O devices shall support the communication technology specified for each controller.

1. Analog input shall allow the monitoring of low voltage (0-10 VDC), current (4-20 ma), or resistance signals (thermistor, RTD). Analog input shall be compatible with, and field configurable to commonly available sensing devices. Analog output shall provide a modulating signal for these control devices.

2. Binary inputs shall allow the monitoring of on/off signals from remote devices. Binary inputs shall provide a wetting current of at least 12 milliamps to be compatible with commonly available control devices. Binary outputs shall provide on/off operation, or a pulsed low voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.
3. Binary outputs on remote and auxiliary controllers shall have 3-position (on/off/auto) override switches and status lights. Analog outputs on remote and auxiliary controllers shall have status lights and a 2-position (auto/manual) switch and manually adjustable potentiometer for manual override.
4. Each output point shall be provided with a light emitting diode (LED) to indicate status of outputs.

E. Communication Ports:
1. NACs controllers in the DDC systems shall be connected in a system local area network using protocol defined by ASHRAE Standard 135, BACnet protocol.
2. The control supplier shall provide connectors, repeaters, hubs, and routers necessary for inter-network communication.
3. Minimum baud rate between the peer-to-peer controllers in the system LAN shall be maintained at the rate of 10 Mbps. Minimum baud for the low level controllers between UCUs and ACUs, ACUs and NAC’s shall be maintained at the rate of 76 Kbps.
4. Provide RS-232 port with DB-9 or RJ-11 connector for communication with each controller that will allow direct connection of standard printers, operator terminals, modems, and portable laptop operator’s terminal. Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or terminals.
5. Database, such as points; status information, reports, system software, custom programs of any one controller shall be readable by any other controller on the network.

F. Electric Outlet: Provide a single phase, 120 VAC electrical receptacles inside or within 2 meters (6 feet) of the NAC and ACU enclosures for use with test equipment.

G. Spare Equipment:

1. Provide spare digital controller (CU) boards and spare I/O boards as required. It shall be possible for trained hospital personnel to replace CU boards and load software via the Laptop computer or the ECC.
2. Provide a minimum of one spare digital controller board of each type and associated parts including batteries to make at least one complete set of DDC control equipment spares.
3. If I/O boards are separate from the CU boards, provide two spare I/O boards for each spare CU board provided above.

2.3 DIRECT DIGITAL CONTROLLER SOFTWARE

A. The software programs specified in this section shall be commercially available, concurrent, multi-tasking operating system and support the use of software application that operates under DOS or Microsoft Windows.

B. All points shall be identified by up to 30-character point name and 16-character point descriptor. The same names shall be used at the operator workstation.

C. All control functions shall execute within the stand-alone control units via DDC algorithms. The VA shall be able to customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters natively from the Delta Controls OrcaWeb Front End.

D. All CU’s shall be capable of being programmed to utilize stored default values for assured fail-safe operation of critical processes. Default values shall be invoked upon sensor failure or, if the primary value is normally provided by the central or another CU, or by loss of bus communication. Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors. Loss of an input sensor shall result in output of a sensor-failed message at the ECC workstation. Each ACU and RCU shall have capability for local readouts of all functions. The UCUs shall be read remotely.

E. All DDC control loops shall be able to utilize any of the following control modes:
   1. Two position (on-off, slow-fast) control.
   2. Proportional control.
   3. Proportional plus integral (PI) control.

4. Proportional plus integral plus derivative (PID) control. All PID programs shall automatically invoke integral wind up prevention routines whenever the controlled unit is off, under manual control of an automation system or time initiated program.
5. Automatic tuning of control loops.

F. System Security: Operator access shall be secured using individual password and operator's name. Passwords shall restrict the operator to the level of object, applications, and system functions assigned to him. A minimum of six (6) levels of security for operator access shall be provided.

G. Application Software: The CUs shall provide the following programs as a minimum for the purpose of optimizing energy consumption while maintaining comfortable environment for occupants. All application software shall reside and run in the system digital controllers. Editing of the application shall occur at the operator workstation or via a portable workstation, when it is necessary, to access directly the programmable unit.

1. Power Demand Limiting (PDL): Power demand limiting program shall monitor the building power consumption and limit the consumption of electricity to prevent peak demand charges. PDL shall continuously track the electricity consumption from a pulse input generated at the kilowatt-hour/demand electric meter. PDL shall sample the meter data to continuously forecast the electric demand likely to be used during successive time intervals. If the forecast demand indicates that electricity usage will likely to exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads. Once the demand load has met, loads that have been shed shall be restored and returned to normal mode. Control system shall be capable of demand limiting by resetting the HVAC system set points to reduce load while maintaining indoor air quality.
2. Economizer: An economizer program shall be provided for VAV systems. This program shall control the position of air handler relief, return, and outdoors dampers. If the outdoor air dry bulb temperature and humidity fall below changeover set point the energy control center will modulate the dampers to provide 100 percent outdoor air. The operator shall be able to override the economizer cycle and return to minimum outdoor air operation at any time.

3. Night Setback/Morning Warm up Control: The system shall provide the ability to automatically adjust set points for this mode of operation.
4. Optimum Start/Stop (OSS): Optimum start/stop program shall automatically be coordinated with event scheduling. The OSS program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by the time of occupancy, and it shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period and still maintain desired comfort conditions. The OSS program shall consider both outside weather conditions and inside zone conditions. The program shall automatically assign longer lead times for weekend and holiday shutdowns. The program shall poll all zones served by the associated AHU and shall select the warmest and coolest zones. These shall be used in the start time calculation. It shall be possible to assign occupancy start times on a per air handler unit basis. The program shall meet the local code requirements for minimum outdoor air while the building is occupied. Modification of assigned occupancy start/stop times shall be possible via operator’s workstation.
5. Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or a group of points according to a stored time. This program shall provide the capability to individually command a point or group of points. When points are assigned to one common load group it shall be possible to assign variable time advances/delays between each successive start or stop within that group. Scheduling shall be calendar based and advance schedules may be defined up to one year in advance. Advance schedule shall override the day-to-day schedule. The operator shall be able to define the following information:
   a. Time, day.
   b. Commands such as on, off, auto.
   c. Time delays between successive commands.
   d. Manual overriding of each schedule.
   e. Allow operator intervention.
6. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the

appropriate workstations based on time and events. An alarm shall be able to start programs, login the event, print and display the messages. The system shall allow the operator to prioritize the alarms to minimize nuisance reporting and to speed operator's response to critical alarms. A minimum of six (6) priority levels of alarms shall be provided for each point.

7. Remote Communications: The system shall have the ability to dial out in the event of an alarm to workstations and alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications. Remote access shall allow the operator to function the same as local access.
8. Maintenance Management (PM): The program shall monitor equipment status and generate maintenance messages based upon the operators defined equipment run time, starts, and/or calendar date limits. A preventative maintenance alarm shall be printed indicating maintenance requirements based on pre-defined run time. Each preventive message shall include point description, limit criteria and preventative maintenance instruction assigned to that limit. A minimum of 480-character PM shall be provided for each component of units such as air handling units.

2.4 SENSORS (AIR, WATER AND STEAM)

A. Temperature and Humidity Sensors:

1. Electronic Sensors: Provide all remote sensors as required for the systems. All sensors shall be vibration and corrosion resistant for wall, immersion, and/or duct mounting.
   a. Temperature Sensors: Thermistor type for terminal units and Resistance Temperature Device (RTD) with an integral transmitter type for all other sensors.
      1) Duct sensors shall be rigid or averaging type as shown on drawings. Averaging sensor shall be a minimum of 1 linear ft of sensing element for each sq ft of cooling coil face area.
      2) Immersion sensors shall be provided with a separable well made of stainless steel, bronze or monel material. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.

3) Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings. Match room thermostats, locking cover.
4) Outdoor air temperature sensors shall have watertight inlet fittings and be shielded from direct sunlight.
5) Room security sensors shall have stainless steel cover plate with insulated back and security screws.
6) Wire: Twisted, shielded-pair cable.
7) Output Signal: 4-20 ma.

b. Humidity Sensors: Bulk polymer sensing element type.
1) Duct and room sensors shall have a sensing range of 20 to 80 percent with accuracy of ± 2 to ± 5 percent RH, including hysteresis, linearity, and repeatability.
2) Outdoor humidity sensors shall be furnished with element guard and mounting plate and have a sensing range of 0 to 100 percent RH.
3) 4-20 ma continuous output signal.

c. Static Pressure Sensors: Non-directional, temperature compensated.
1) 4-20 ma output signal.
2) 0 to 5 inches wg for duct static pressure range.
3) 0 to 0.25 inch wg for Building static pressure range.

B. Water flow sensors:
1. Type: Insertion vortex type with retractable probe assembly and 2 IN full port gate valve.
a. Pipe size: 3 to 24 IN.
b. Retractor: ASME threaded, non-rising stem type with hand wheel.
c. Mounting connection: 2 IN 150 PSI flange.
d Sensor assembly: Design for expected water flow and pipe size.
e. Seal: Teflon (PTFE).
2. Controller:
a. Integral to unit.
b. Locally display flow rate and total.
c. Output flow signal to BMCS: Digital pulse type.
3. Performance:
a. Accuracy: 1.0% of reading
b. Repeatability: 0.15% of reading

c. Turndown: 20:1

d. Response time: Adjustable from 1 to 100 seconds.

e. Power: 24 volt DC

4. Manufacturer: Emco V-Bar 910

5. Install flow meters according to manufacturer’s recommendations. Where recommended by manufacturer because of mounting conditions, provide flow rectifier.

C. Water Flow Sensors:

1. Sensor shall be insertion turbine type with turbine element, retractor and preamplifier/transmitter mounted on a two-inch full port isolation valve; assembly easily removed or installed as a single unit under line pressure through the isolation valve without interference with process flow; calibrated scale shall allow precise positioning of the flow element to the required insertion depth within plus or minute 1 mm (0.05 inch); wetted parts shall be constructed of stainless steel. Operating power shall be nominal 24 VDC. Local instantaneous flow indicator shall be LED type in NEMA 4 enclosure with 3-1/2 digit display, for wall or panel mounting.

2. Performance characteristics:

a. Ambient conditions: -40 to 60 degrees C (-40 to 140 degrees F), 5 to 100 percent humidity.

b. Operating conditions: 850 kPa (125 psig), 0 to 120 degrees C (30 to 250 degrees F), 0.15 to 12 m per second (0.5 to 40 feet per second) velocity.

c. Nominal range (turn down ratio): 10 to 1.

d. Overall accuracy plus or minus one percent of reading.

e. Repeatability: plus or minus 0.25 percent of reading.

f. Preamplifier mounted on meter shall provide 4-20 ma divided pulse output or switch closure signal for units of volume or mass per a time base. Signal transmission distance shall be a minimum of 1,800 meters (6,000 feet). Preamplifier for bi-directional flow measurement shall provide a directional contact closure from a relay mounted in the preamplifier.

g. Pressure Loss: Maximum 1 percent of the line pressure in line sizes above 100 mm (4 inches).

h. Ambient temperature effects, less than 0.005 percent calibrated span per degree C (degree F) temperature change.

i) RFI effect - flow meter shall not be affected by RFI.

j) Power supply effect less than 0.02 percent of span for a variation of plus or minus 10 percent power supply.

D. Steam Flow Sensor/Transmitter:

1. Sensor: Vortex shedder incorporating wing type sensor and amplification technology for high signal-to-noise ratio, carbon steel body with 316 stainless steel working parts, 24 VDC power, NEMA 4 enclosure.

a. Ambient conditions, -40 to 80 degrees C (-40 to 175 degrees F).

b. Process conditions, 900 kPa (125 psig) saturated steam.

c. Turn down ratio, 20 to 1.

d. Accuracy, plus or minus 1.0 percent of span.

e. Repeatability, plus or minus 0.1 percent.

f. Output signal, 4-20 ma DC.

g. Processor/Transmitter, NEMA 4 enclosure with keypad program selector and six digit LCD output display of instantaneous flow rate or totalized flow, solid state switch closure signal shall be provided to the nearest DDC panel for totalization.

1) Ambient conditions, -20 to 50 degrees C (0-120 degrees F), 0 95 percent non-condensing RH.

2) Power supply, 120 VAC, 60 hertz or 24 VDC.

3) Internal battery, provided for 24-month retention of RAM contents when all other power sources are removed.

h. Sensor on all steam lines shall be protected by pigtail siphons installed between the sensor and the line, and shall have an isolation valve installed between the sensor and pressure source.

E. Flow switches:

1. Shall be either paddle or differential pressure type.

a. Paddle-type switches (liquid service only) shall be UL Listed, SPDT snap-acting, adjustable sensitivity with NEMA 4 enclosure.

b. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap acting, NEMA 4 enclosure, with scale range and differential suitable for specified application.

F. Current Switches: Current operated switches shall be self powered, solid state with adjustable trip current as well as status, power, and relay command status LED indication. The switches shall be selected to

match the current of the application and output requirements of the DDC systems.

2.5 ENGINEERING CONTROL CENTER (ECC)—OPERATOR'S WORKSTATION

A. The Operator workstation is existing Delta Controls OrcaWeb system, and shall be reused.

2.6 CONTROL CABLES

As specified in Division 26.

2.7 THERMOSTATS AND HUMIDISTATS

A. Room thermostats controlling heating and cooling devices shall have three modes of operation (heating - null or dead band - cooling). Thermostats for patient bedrooms shall have capability of being adjusted to eliminate null or dead band. Wall mounted thermostats shall have finish to match existing installations, setpoint range and temperature display and external adjustment:
   1. Electronic Thermostats: Solid-state, microprocessor based, programmable to daily, weekend, and holiday schedules.
      a. Public Space Thermostat: Public space thermostat shall be a platinum sensor and shall not have a visible means of set point adjustment. Adjustment shall be via the digital controller to which it is connected.
      b. Patient Room Thermostats: Thermistor sensor with set point adjustment and an indicator.
      c. Psychiatric Patient Room Sensors: Electronic duct sensor as noted under Article 2.4.
      d. Battery replacement without program loss.

B. Strap-on thermostats shall be enclosed in a dirt-and-moisture proof housing with fixed temperature switching point and single pole, double throw switch.

C. Freezestats shall have a minimum of 300 mm (one linear foot) of sensing element for each 0.093 square meter (one square foot) of coil area. A freezing condition at any increment of 300 mm (one foot) anywhere along the sensing element shall be sufficient to operate the thermostatic element.

D. Room Humidistats: Provide fully proportioning humidistat with adjustable throttling range for accuracy of settings and conservation. The humidistat shall have set point scales shown in percent of relative

humidity located on the instrument. Systems showing moist/dry or high/low are not acceptable.

2.8 FINAL CONTROL ELEMENTS AND OPERATORS

A. Fail Safe Operation: Control valves and dampers shall provide "fail safe" operation in either the normally open or normally closed position as required for freeze, moisture, and smoke or fire protection.

B. Spring Ranges: Range as required for system sequencing and to provide tight shut-off.

C. Power Operated Control Dampers (other than VAV Boxes): Factory fabricated, balanced type dampers. All modulating dampers shall be opposed blade type and gasketed. Blades for two-position, duct-mounted dampers shall be parallel, airfoil (streamlined) type for minimum noise generation and pressure drop.

1. Leakage: Maximum leakage in closed position shall not exceed 7 L/S (15 CFMs) differential pressure for outside air and exhaust dampers and 200 L/S/ square meter (40 CFM/sq. ft.) at 50 mm (2 inches) differential pressure for other dampers.
2. Frame shall be galvanized steel channel with seals as required to meet leakage criteria.
3. Blades shall be galvanized steel or aluminum, 200 mm (8 inch) maximum width, with edges sealed as required.
4. Bearing shall be nylon, bronze sleeve or ball type.
5. Hardware shall be zinc-plated steel. Connected rods and linkage shall be non-slip. Working parts of joints shall be brass, bronze, nylon or stainless steel.

D. Operators shall be electric or electronic type operating at 140 kPa (20 psig) as required for proper operation.

1. See drawings for required control operation.
2. Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel.
3. Maximum air velocity and pressure drop through free area the dampers:
   a. Smoke damper in air handling unit; 210 meter per minute (700 fpm).
   b. Duct mounted damper; 600 meter per minute (2000 fpm).
   c. Maximum static pressure loss, 50 Pascal (0.20 inches water gage).

E. Smoke Dampers and Combination Fire/Smoke Dampers: Dampers and operators are specified in Section 23 31 00, HVAC DUCTS AND CASINGS. Control of these dampers is specified under this Section.

F. Control Valves:

1. Valves shall be rated for a minimum of 150 percent of system operating pressure at the valve location but not less than 900 kPa (125 psig).
2. Valves 50 mm (2 inches) and smaller shall be bronze body with threaded or flare connections.
3. Valves 60 mm (2 1/2 inches) and larger shall be bronze or iron body with flanged connections.
4. Brass or bronze seats except for valves controlling media above 100 degrees C (210 degrees F), which shall have stainless steel seats.
5. Flow characteristics:
   a. Three way valves shall have a linear relation or equal percentage relation of flow versus value position.
   b. Two-way valves position versus flow relation shall be linear for steam and equal percentage for water flow control.
6. Maximum pressure drop:
   a. Two position steam control: 20 percent of inlet gauge pressure.
   b. Modulating Steam Control: 80 percent of inlet gauge pressure (acoustic velocity limitation).
   c. Modulating water flow control, greater of 3 meters (10 feet) of water or the pressure drop through the apparatus.
   d. Two position water valves shall be line size.

G. Damper and Valve Operators and Relays:

1. Electric damper operator shall provide full modulating control of dampers. A linkage and pushrod shall be furnished for mounting the actuator on the damper frame internally in the duct or externally in the duct or externally on the duct wall, or shall be furnished with a direct-coupled design.
2. Electronic damper operators: VAV Box actuator shall be mounted on the damper axle or shall be of the air valve design, and shall provide complete modulating control of the damper. The motor shall have a closure torque of 35-inch pounds minimum with full torque applied at close off to attain minimum leakage.

2.9 AIR FLOW CONTROL

A. Airflow and static pressure shall be controlled via digital controller (CUs) with inputs from airflow control measuring stations and static pressure inputs as specified. Controller outputs shall be true analog output signals to pneumatic positioners or variable frequency drives. Pulse width modulation outputs are not acceptable. The CUs shall include the capability to control via simple proportional (P) control, proportional plus integral (PI), proportional plus integral plus derivative (PID), and on-off. The airflow control programs shall be factory-tested programs that are documented in the literature of the control manufacturer.

B. Air Flow Measuring Station -- Electronic Thermal Type:

1. Air Flow Sensor Probe:

a. Each air flow sensor shall contain two individual thermal sensing elements. One element shall determine the velocity of the air stream while the other element shall compensate for changes in temperature. Each thermal flow sensor and its associated control circuit and signal conditioning circuit shall be factory calibrated and be interchangeable to allow replacement of a sensor without recalibration of the entire flow station. The sensor in the array shall be located at the center of equal area segment of the duct and the number of sensors shall be adequate to accommodate the expected velocity profile and variation in flow and temperature. The airflow station shall be of the insertion type in which sensor support structures are inserted from the outside of the ducts to make up the complete electronic velocity array.

b. Thermal flow sensor shall be constructed of hermetically sealed thermistors or nickel chromium or reference grade platinum wire, wound over an epoxy, stainless steel or ceramic mandrel and coated with a material suitable for the conditions to be encountered. Each dual sensor shall be mounted in an extruded aluminum alloy strut.

2. Air Flow Sensor Grid Array:

a. Each sensor grid shall consist of a lattice network of temperature sensors and linear integral controllers (ICs) situated inside an aluminum casing suitable for mounting in a

duct. Each sensor shall be mounted within a strut facing downstream of the airflow and located so that it is protected on the upstream side. All wiring shall be encased (out of the air stream) to protect against mechanical damage.

b. The casing shall be made of welded aluminum of sufficient strength to prevent structural bending and bowing. Steel or iron composite shall not be acceptable in the casing material.

c. Pressure drop through the flow station shall not exceed 4 Pascal (0.015" W.G.) at 1,000 meter per minute (3,000 FPM).

3. Electronics Panel:

a. Electronics Panel shall consist of a surface mounted enclosure complete with solid-state microprocessor and software.

b. Electronics Panel shall be A/C powered 24 VAC and shall have the capability to transmit signals of 0-5 VDC, 0-10 VCD or 4-20 ma for use in control of the HVAC Systems. The electronic panel shall have the capability to accept user defined scaling parameters for all output signals.

c. Electronics Panel shall have the capability to digitally display airflow in CFM and temperature in degrees F . The displays shall be provided as an integral part of the electronics panel. The electronic panel shall have the capability to totalize the output flow in CFM for two or more systems, as required. A single output signal may be provided which will equal the sum of the systems totalized. Output signals shall be provided for temperature and airflow. Provide remote mounted air flow or temperature displays where indicated on the plans.

d. Electronics Panel shall have the following:

1) Minimum of 12-bit A/D conversion.

2) Field adjustable digital primary output offset and gain.

3) Airflow analog output scaling of 100 to 10,000 FPM.

4) Temperature analog output scaling from -45 to 70 degrees C (-50 to 160 degrees F).

5) Analog output resolution (full scale output) of 0.025%.

e. All readings shall be in S.I. units.

4. Thermal flow sensors and its electronics shall be installed as per manufacturer’s instructions. The probe sensor density shall be as follows:

Probe Sensor Density	
Area (sq.ft.)	**Qty. Sensors**
<=1	2
>1 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
>=16	16

a. Complete installation shall not exhibit more than ± 2.0% error in airflow measurement output for variations in the angle of flow of up to 10 percent in any direction from its calibrated orientation. Repeatability of readings shall be within ± 0.25%.

C. Static Pressure Measuring Station:

1. Static Pressure Control:

a. Systems shall consist of one or more static pressure sensors and transmitters along with relays or auxiliary devices as required for a complete functional system. The span of the transmitter shall not exceed two times the design static pressure at the point of measurement. The output of the transmitter shall be true representation of the input pressure with plus or minus 25 Pascal (0.1 inch) W.G. of the true input pressure.

1) Static pressure sensors shall have the same requirements as Airflow Measuring Devices except that total pressure sensors are optional, and only multiple static pressure sensors positioned on an equal area basis connected to a network of headers are required.

2) For systems with multiple major trunk supply ducts, furnish a static pressure transmitter for each trunk duct. The transmitter signal representing the lowest static pressure shall be selected and this shall be the input signal to the CU.

3) The CU shall receive the static pressure transmitter signal and CU shall provide a control output signal to the supply fan capacity control device. The control mode shall be

proportional plus integral (PI) (automatic reset) and where required shall also include derivative mode.

4) In systems with multiple static pressure transmitters, provide a switch located near the fan discharge to prevent excessive pressure during abnormal operating conditions.

D. Constant Volume Control:

1. Systems shall consist of an air flow measuring station along with such relays and auxiliary devices as required to produce a complete functional system. The transmitter shall receive its air flow signal and static pressure signal from the flow measuring station and shall have a span not exceeding three times the design flow rate. The CU shall receive the transmitter signal and shall provide an output to the fan volume control device to maintain a constant flow rate. The CU shall provide proportional plus integral (PI) (automatic reset) control mode and where required also inverse derivative mode. Overall system accuracy shall be plus or minus the equivalent of 2 Pascal (0.008 inch) velocity pressure as measured by the flow station.

E. Airflow Synchronization:

1. Systems shall consist of an air flow measuring station for each supply and return duct, the CU and such relays, as required to provide a complete functional system that will maintain a constant flow rate difference between supply and return air to an accuracy of ±10%. In systems where there is no suitable location for a flow measuring station that will sense total supply or return flow, provide multiple flow stations with a differential pressure transmitter for each station. Signals from the multiple transmitters shall be added through the CU such that the resultant signal is a true representation of total flow.
2. The total flow signals from supply and return air shall be the input signals to the CU. This CU shall track the return air fan capacity in proportion to the supply air flow under all conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Examine project plans for control devices and equipment locations; and report any discrepancies, conflicts, or omissions to Resident Engineer for resolution before proceeding for installation.
2. Work Coordination: See GENERAL CONDITIONS.
3. Install equipment, wiring /conduit parallel to or at right angles to building lines.
4. Install all equipment in readily accessible locations. Do not run conduit concealed under insulation or inside ducts.
5. Mount control devices, and conduit located on ducts and apparatus with external insulation on standoff support to avoid interference with insulation.
6. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
7. Run wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing.
8. Install equipment level and plum.

B. Electrical Wiring Installation:

1. Install conduits and wiring in accordance with Specification Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
2. Install signal and communication cables in accordance with Specification Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
3. Install conduit and wiring between operator workstation(s), digital controllers, electrical panels, indicating devices, instrumentation, miscellaneous alarm points, thermostats, and relays as shown on the drawings or as required under this section. All wiring shall be installed in conduits.
4. Install all electrical work required for a fully functional system and not shown on electrical plans or required by electrical specifications. Where low voltage power is required, provide suitable transformers.
5. Install all system components in accordance with local Building Code and National Electric Code.

a. Splices: Splices in shielded and coaxial cables shall consist of terminations and the use of shielded cable couplers. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties.
b. Equipment: Fit all equipment contained in cabinets or panels with service loops, each loop being at least 300 mm (12 inches) long. Equipment for fiber optics system shall be rack mounted, as applicable, in ventilated, self-supporting, code gauge steel enclosure. Cables shall be supported for minimum sag.
c. Cable Runs: Keep cable runs as short as possible. Allow extra length for connecting to the terminal board. Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.
d. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.

6. Conceal cables, except in mechanical rooms and areas where other conduits and piping are exposed.
7. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-coded cable with cable diagrams may be used to accomplish cable identification.
8. Grounding: ground electrical systems per manufacturer’s written requirements for proper and safe operation.

C. Install Sensors and Controls:

1. Temperature Sensors:
   a. Install all sensors and instrumentation according to manufacturer’s written instructions. Temperature sensor locations shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.
   b. Calibrate sensors to accuracy specified, if not factory calibrated.
   c. Use of sensors shall be limited to its duty, e.g., duct sensor shall not be used in lieu of room sensor.
   d. Install room sensors permanently supported on wall frame. They shall be mounted at 1.5 meter (5.0 feet) above the finished floor.

e. Mount sensors rigidly and adequately for the environment within which the sensor operates.
f. Sensors used in mixing plenum, and hot and cold decks shall be of the averaging of type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
g. All pipe mounted temperature sensors shall be installed in wells.
h. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor reading.
i. Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions. Line-protect all wiring that comes from external sources to the site from lightning and static electricity.

2. Pressure Sensors:
   a. Install duct static pressure sensor tips facing directly downstream of airflow.
   b. Install high-pressure side of the differential switch between the pump discharge and the check valve.
   c. Install snubbers and isolation valves on steam pressure sensing devices.
3. Actuators:
   a. Mount and link damper and valve actuators according to manufacturer’s written instructions.
   b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed position.
   c. Check operation of valve/actuator combination to confirm that actuator modulates valve smoothly in both open and closed position.
4. Flow Switches:
   a. Install flow switch according to manufacturer’s written instructions.
   b. Mount flow switch a minimum of 5 pipe diameters up stream and 5 pipe diameters downstream or 600 mm (2 feet) whichever is greater, from fittings and other obstructions.

c. Assure correct flow direction and alignment.

d. Mount in horizontal piping-flow switch on top of the pipe.

D. Installation of Network:

1. Ethernet:

a. The network shall employ Ethernet LAN architecture, as defined by IEEE 802.3. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3, Compliant Ethernet Networks.

b. The network shall directly support connectivity to a variety of cabling types. As a minimum provide the following connectivity: 10 Base 2 (ThinNet RG-58 A/U Coaxial cabling with BNC connectors), 10 Base T (Twisted-Pair RJ-45 terminated UTP cabling).

2. Third Party Interfaces: Contractor shall integrate real-time data from building systems by other trades and databases originating from other manufacturers as specified and required to make the system work as one system.

E. Installation of Digital Controllers and Programming:

1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, pumping unit etc. Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.

2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.

3. System point names shall be modular in design, permitting easy operator interface without the use of a written point index.

4. Provide software programming for the applications intended for the systems specified, and adhere to the strategy algorithms provided.

5. Provide graphics for each piece of equipment and floor plan in the building. This includes each air handling unit, fan, terminal unit, pumping unit etc. These graphics shall show all points dynamically as specified in the point list.

3.2 SYSTEM VALIDATION AND DEMONSTRATION

A. As part of final system acceptance, a System Demonstration is required (see below). Prior to start of this Demonstration, the contractor is

to perform a complete Validation of all aspects of the Controls and Instrumentation System.

B. Validation

1. Prepare and submit for approval a Validation Test Plan including Test Procedures for the performance verification tests. Test Plan shall address all specified functions of the Engineering Control Center and all specified sequences of operation. Explain in detail actions and expected results used to demonstrate compliance with the requirements of this specification. Explain the method for simulating the necessary conditions of operation used to demonstrate performance of the system. Test Plan shall include a Test Check List to be used by the Installer’s agent to check and initial that each test has been successfully completed. Deliver Test Plan documentation for the performance verification tests to the owner’s representative 30 days prior to start of performance verification tests. Provide draft copy of operation and maintenance manual with performance verification test.
2. After approval of the Validation Test Plan, Installer shall carry out all tests and procedures therein. Installer shall completely check out, calibrate, and test all connected hardware and software to insure that system performs in accordance with approved specifications and sequences of operation submitted. Installer shall complete and submit Test Check List.

C. Demonstration

1. System operation and calibration to be demonstrated by the Installer in the presence of the Architect or Owner's representative on random samples of equipment as dictated by the Owner’s representative. Should random sampling indicate improper commissioning, the owner reserves the right to subsequently witness complete calibration of the system at no addition cost to the owner.
2. Demonstrate to authorities that all required safeties and life safety functions are fully functional and complete.
3. Make accessible, personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
4. The following witnessed demonstrations of field control equipment shall be included:

a. Observe HVAC systems in shut down condition. Check dampers and valves for normal position.
b. Test application software for its ability to communicate with digital controllers, operator workstation, and uploading and downloading of control programs.
c. Demonstrate the software ability to edit the control program off-line.
d. Demonstrate reporting of alarm conditions for each alarm and ensure that these alarms are received at the assigned location, including operator workstations.
e. Demonstrate ability of software program to function for the intended applications-trend reports, change in status etc.
f. Demonstrate via graphed trends to show the sequence of operation is executed in correct manner, and that the HVAC systems operate properly through the complete sequence of operation, e.g., seasonal change, occupied/unoccupied mode, and warm-up condition.
g. Demonstrate hardware interlocks and safeties functions, and that the control systems perform the correct sequence of operation after power loss and resumption of power loss.
h. Prepare and deliver to the VA graphed trends of all control loops to demonstrate that each control loop is stable and the set points are maintained.
i. Demonstrate that each control loop responds to set point adjustment and stabilizes within one (1) minute. Control loop trend data shall be instantaneous and the time between data points shall not be greater than one (1) minute.

5. Witnessed validation demonstration of Operator’s Terminal functions shall consist of:
   a. Running each specified report.
   b. Display and demonstrate each data entry to show site specific customizing capability. Demonstrate parameter changes.
   c. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
   d. Execute digital and analog commands in graphic mode.
   e. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs (6 loops minimum).
   f. Demonstrate EMS performance via trend logs and command trace.

g. Demonstrate scan, update, and alarm responsiveness.

h. Demonstrate spreadsheet/curve plot software, and its integration with database.

i. Demonstrate on-line user guide, and help function and mail facility.

j. Demonstrate digital system configuration graphics with interactive upline and downline load, and demonstrate specified diagnostics.

k. Demonstrate multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.

l. Demonstrate class programming with point options of beep duration, beep rate, alarm archiving, and color banding.

----- END -----

SECTION 23 11 23
FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

Fuel gas systems, including piping, equipment and all necessary accessories as designated in this section. Fuel gas piping for central boiler plants is not included.

1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.

B. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.

C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

D. Section 22 05 23, GENERAL DUTY VALVES FOR PLUMBING PIPING

E. Section 23 07 11, PLUMBING INSULATION: Pipe Insulation.

G. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

H. Section 23 51 00 – BREECHINGS, CHIMEYS, and STACKS

I. Section 25 10 10 – ADVANCED UTILITY METERING SYSTEM

J. Section 01 91 00 – GENERAL COMMISSIONING REQUIREMENTS

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data:

1. Pipe & Fittings.
2. Valves.
3. Strainers.
4. All items listed in Part 2 - Products.

C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):

A-A-59617.....Unions, Brass or Bronze Threaded, Pipe Connections and Solder-Joint Tube Connections

C. American National Standards Institute (ANSI):

American Society of Mechanical Engineers (ASME): (Copyrighted Society)

A13.1-(2007) .....Scheme for Identification of Piping Systems

B16.3-(2006).....Malleable Iron Threaded Fittings: Classes 150 and 300 ANSI/ASME

B16.9-2007.....Factory-Made Wrought Steel Buttwelding Fittings ANSI/ASME

B16.11-2009.....Forged Steel Fittings, Socket-Welding and Threaded ANSI/ASME

B16.15-2006.....Cast Copper Alloy Threaded Fittings: Classes 125 and 250 ANSI/ASME

B31.8-2010 .....Gas Transmission and Distribution Piping Systems ANSI/ASME

D. American Society for Testing and Materials (ASTM):

A47-99(2009) .....Standard Specification for Ferritic Malleable Iron Castings

A53-10.....Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless

A183-09.....Standard Specification for Carbon Steel Track Bolts and Nuts

A536-09.....Standard Specification for Ductile Iron Castings

A733-03(2009)e1.....Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

B687-99(2005)e1.....Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

E. National Fire Protection Association (NFPA):

54-2009 .....National Fuel Gas Code

F. International Code Council

IPC 2009 .....International Plumbing Code

IFGC 2009.....International Fuel Gas Code

G. International Association of Plumbing and Mechanical Officials (IAPMO):

Uniform Plumbing Code – 2009

IS6-06.....Installation Standard

H. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-72-2010 .....Ball Valves with Flanged or Butt-Welding For General Service

SP-110-2010.....Ball Valve Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

1.5 SYSTEM PRESSURE

Natural gas systems // unless otherwise noted // are designed and materials and equipment selected to prevent failure under gas pressure of _____ kPa (__2__ psi) // entering government property // kPa ___ (.8__ psi) at downstream side of pressure regulator //.

PART 2 - PRODUCTS

2.1 FUEL GAS SERVICE CONNECTIONS TO BUILDING

A. From inside face of exterior wall to a distance of approximately 1500 mm (5 feet) outside of building, use coated piping.

B. Pipe: Black steel, ASTM A53, Schedule 40. Shop-applied pipe coating shall be one of the following types:

1. Coal Tar Enamel Coating: Exterior of pipe and fittings shall be cleaned, primed with Type B primer and coated with hot-applied coal tar enamel with bonded layer of felt wrap in accordance with AWWA C203. Asbestos felt shall not be used; felt material shall be fibrous glass mat as specified in Appendix Section A2.1 of AWWA C203.
2. Adhesive-thermoplastic Resin Coating: Fed. Spec. L-C-530, Type I
3. Thermosetting Epoxy Coating: Fed. Spec. L-C-530, Type II
4. Field-applied plastic tape material used on pipe joints and for repairing damaged areas of shop-applied coatings, Fed. Spec. L-T-1512, Type I, 10 mils nominal thickness for pipe joints, and Type II, 20 mils nominal thickness for coating repairs.

C. Holiday Inspections: Procedure for holiday inspection: Holiday Inspection shall be conducted on all coatings to determine the presence and number of discontinuities in those coatings referenced in 2.6/B - 1, 2, 3, and 4 using a Tinker & Rasor model AP/W Holiday Detector. Holiday inspection shall be performed in a manner spelled out in the Tinker & Rasor operating instructions and at a voltage level recommended by the coating manufacturer or applicable NACE International Standard such as RPO 274-93 or RPO 490-90 in the case

thermosetting epoxy coating. Holiday Detectors shall be calibrated and supplied with a certificate of calibration from the factory. A calibration of the Holiday Detector shall be performed once every 6 months to verify output voltages are true and correct.

D. Fittings:
   1. Butt weld fittings, wrought steel, ANSI B16.9.
   2. Socket weld and threaded fittings forged steel, ANSI B16.11.
   3. Grooved End: Ductile iron (ASTM A536, Grade 65-45-12), malleable iron (ASTM A47, Grade 32510), or steel (ASTM A53, Type F or Type E or S, Grade B).

E. Joints: Welded, ANSI B31.8.

2.2 FUEL GAS PIPING

A. Pipe: Black steel, ASTM A53, Schedule 40.

B. Nipples: Steel, ASTM A733, Schedule 40.

C. Fittings:
   1. Sizes 50 mm (2 inch) under ANSI B 16.3 threaded malleable iron.
   2. Over 50 mm (2 inch) and up to 100 mm (4 inch) ANSI B16.11 socket welded.
   3. Over 100 mm (4 inch) ANSI 16.9 butt welded.

D. Joints: Provide welded or threaded joints.

2.3 EXPOSED FUEL GAS PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed fuel gas piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
   1. Pipe: Fed. Spec. WW-P-351, standard weight
   2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
   3. Nipples: ASTM B 687, Chromium-plated.
   4. Unions: 50 mm (2 inches and smaller) Mss SP-72, SP-110, Brass or Bronze threaded with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
   5. Valves: Mss SP-72, SP-110, Brass or bronze with chrome finish.

B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING

2.4 VALVES

A. Ball Valve: Bronze body, rated for 1025 kPA at 185ºC (150 psi at 365ºF), 1725 kPa at 121ºC (250 psi at 250ºF), reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends, UL-listed for natural or LP gas shut off service when used on those services.

B. Gas Vent Cocks: Type 701: Bronze body, tee handle, rated for 205 kPa at 38ºC (30 psi at 100ºF), ground plug, rated for tight shut-off on fuel gas service.

2.5 WATERPROOFING

A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.

B. Floors: Provide cast iron stack sleeve with flashing device and a underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.

C. Walls: See detail shown on drawings.

2.6 STRAINERS

A. Provide on high pressure side of pressure reducing valves, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Gas Lines: "Y" type with removable mesh lined brass strainer sleeve.

C. Body: Smaller than 80 mm (3 inches), brass or bronze; 80 mm (3 inches) and larger, cast iron or semi-steel.

2.7 DIELECTRIC FITTINGS

Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

2.8 GAS EQUIPMENT CONNECTORS

Flexible connectors with teflon core, interlocked galvanized steel protective casing, AGA certified design.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International Fuel Gas Code and the following:

1. Install branch piping for fuel gas and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, shall be reamed to full size after cutting.

3. All pipe runs shall be laid out to avoid interference with other work.
4. Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible.
5. Install union and shut-off valve on pressure piping at connections to equipment.
6. Pipe Hangers, Supports and Accessories:
   a. All piping shall be supported per the International Fuel Gas Code, Chapter No. 4.
   b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with red lead or zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
   c. Floor, Wall and Ceiling Plates, Supports, Hangers:
      1) Solid or split unplated cast iron, chrome plated in finished areas.
      2) All plates shall be provided with set screws.
      3) Pipe Hangers: Height adjustable clevis type.
      4) Adjustable Floor Rests and Base Flanges: Steel.
      5) Concrete Inserts: "Universal" or continuous slotted type.
      6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
      7) Riser Clamps: Malleable iron or steel.
      8) Rollers: Cast iron.
      9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
      10) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories.
7. Install cast chrome plated escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
8. Penetrations:
   a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke

and gases as specified in Section 07 84 00, FIRESTOPPING. Completely fill and seal clearances between piping and openings with the fire stopping materials.

b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

B. Piping shall conform to the following:

1. Fuel Gas:

a. Entire fuel gas piping installation shall be in accordance with requirements of NFPA 54.

b. Provide fuel gas piping with plugged drip pockets at low points.

3.2 CLEANING OF SYSTEM AFTER INSTALLATION

Clean all piping systems to remove all dirt, coatings and debris. Remove all valves, controls etc., and reinstall after piping system has been cleaned.

3.3 TESTS

A. General: Test system either in its entirety or in sections after system is installed or cleaned.

B. Test shall be made in accordance with Section 406 of the International Fuel Gas Code. The system shall be tested at // a minimum of 1.5 times maximum working pressure, but not less than 3 psig (20 kPa) gage) /// 100 psig (690 kPa).

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

- - - E N D - - -

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Water piping to connect HVAC equipment, including the following:
   1. Chilled water, heating hot water and drain piping.
   2. Extension of domestic water make-up piping.
   3. Geothermal heat pump system piping.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.
B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 03 30 00, CAST-IN-PLACE CONCRETE.
D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
E. Section 23 21 23, HYDRONIC PUMPS: Pumps.
F. Section 23 07 11, HVAC INSULATION: Piping insulation.
G. Section 23 25 00, HVAC WATER TREATMENT: Water treatment for closed systems.
H. Section 23 82 00, CONVECTION HEATING AND COOLING UNITS: VAV and CV units, and radiant ceiling panels.
I. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Temperature and pressure sensors and valve operators.

1.3 QUALITY ASSURANCE

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.
B. Submit prior to welding of steel piping a certificate of Welder’s certification. The certificate shall be current and not more than one year old.
C. Manufacturers Training Service: The Contractor shall obtain the services of an independent trained representative of the preinsulated chilled water pipe system manufacturer to instruct contractor's work force in installation procedures for all preinsulated, prefabricated systems.

D. On Site Supervision of Underground Preinsulated Chilled Water Piping Installation:
   1. Provide services of a factory trained representative of the pipe manufacturer for a minimum of three days, to include pre installation, installation and testing periods.
   2. Representative's daily written reports to the Resident Engineer: Present the original of each report on the day it is prepared and forward a copy to the manufacturer's main office. The report shall be signed by the manufacturer's representative. The report shall state whether or not the condition and quality of the materials used and the installation of the system is in accordance with the plans, specifications, and published standards of the manufacturer, and is satisfactory in all respects. If anything connected with the installation is unsatisfactory, the report shall state that corrective action has been taken or shall contain the manufacturer's recommendations for corrective action. The report shall cover any condition that could result in an unsatisfactory installation. The representative shall take prompt action to return to the factory all damaged and defective material, and shall order prompt replacement of such material.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:
   1. Pipe and equipment supports.
   2. Pipe and tubing, with specification, class or type, and schedule.
   3. Pipe fittings, including miscellaneous adapters and special fittings.
   4. Flanges, gaskets and bolting.
   5. Valves of all types.
   6. Strainers.
   7. Flexible connectors for water service.
   8. Pipe alignment guides.
   9. Expansion compensators.
   10. All specified hydronic system components.
   11. Water flow measuring devices.
   12. Gages.

13. Thermometers and test wells.

C. Manufacturer's certified data report, Form No. U-1, for ASME pressure vessels:
   1. Convertors.
   2. Air separators.
   3. Expansion tanks.
   4. Buffer tanks.

D. Manufacturer's certificates for underground preinsulated chilled water piping:
   1. That the field representative for the factory insulated pipe installation is technically qualified and experienced in installation of the manufacturer's system and is qualified to provide the required site reports.
   2. Upon completion of the work and before final acceptance, the Contractor shall deliver a notarized statement, signed by a principal officer of both the manufacturing firm and the contracting firm, stating that the installation is satisfactory and in accordance with the plans, specifications, and manufacturer's standards.

E. Submit prior to welding of steel piping a certificate of Welder’s certification. The certificate shall be current and not more than one year old.

F. Calculations for thrust blocking for underground preinsulated piping.

G. Coordination Drawings: Refer to Article, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

H. As-Built Piping Diagrams: Provide drawing as follows for chilled water and heating hot water system and other piping systems and equipment.
   1. One wall-mounted stick file with complete set of prints. Mount stick file in the chiller plant or control room along with control diagram stick file.
   2. One complete set of reproducible drawings.
   3. One complete set of drawings in electronic format (Autocad, pdf, or other approved format).

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Mechanical Engineers (ASME):

B1.20.1-83.....Pipe Threads, General Purpose (Inch)

B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings

B16.3-98.....Malleable Iron Threaded Fittings

B16.4-98.....Gray Iron Threaded Fittings

B16.5-03.....Pipe Flanges and Flanged Fittings

B16.9-03.....Factory-Made Wrought Buttwelding Fittings

B16.11-05.....Forged Fittings, Socket-Welding and Threaded

B16.14-91.....Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads

B16.22-01.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.23-02.....Cast Copper Alloy Solder Joint Drainage Fittings

B16.24-01.....Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500

B16.39-98.....Malleable Iron Threaded Pipe Unions, Classes 150, 250, and 300

B16.42-98.....Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300

B31.1-01.....Power Piping

B31.9-04.....Building Services Piping

B40.100-05.....Pressure Gauges and Gauge Attachments

C. American National Standards Institute, Inc. (ANSI):

B16.1 00.....Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125 and 250

B16.3 00.....Malleable Iron Threaded Fittings Classes 150 and 300

B16.5 03.....Pipe Flanges and Flanged Fittings NPS ½ through NPS 24

B16.9 03.....Factory Made Wrought Butt Welding Fittings

B16.11 01.....Forged Fittings, Socket Welding and Threaded

B16.14 91.....Ferrous Pipe Plugs, Bushings and Locknuts with Pipe Threads

B16.18-01.....Cast Copper Alloy Solder joint Pressure fittings

B16.22 00.....Wrought Copper and Bronze Solder Joint Pressure Fittings

B16.24 01.....Cast Copper Alloy Pipe Fittings and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500

B31.1 01.....Power Piping

D. American Society for Testing and Materials (ASTM):

A47/A47M-99 (2004).....Ferritic Malleable Iron Castings

A53/A53M-06.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106/A106M-06.....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

A126-04.....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A181/A181M-01.....Standard Specification for Carbon Steel Forgings, for General-Purpose Piping

A183-03 ..... Standard Specification for Carbon Steel Track Bolts and Nuts

A216/A216M-04 ..... Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service

A234/A234M 04 ..... Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

A307-04 ..... Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

A536-84 (2004) ..... Standard Specification for Ductile Iron Castings

A 615/A 615M-04 ..... Deformed and Plain Carbon Steel Bars for Concrete Reinforcement

A653/A 653M-04 ..... Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) By the Hot-Dip Process

B32-04 ..... Standard Specification for Solder Metal

B61-02 ..... Standard Specification for Steam or Valve Bronze Castings

B62-02 ..... Standard Specification for Composition Bronze or Ounce Metal Castings

B88-03 ..... Standard Specification for Seamless Copper Water Tube

B209 04 ..... Aluminum and Aluminum Alloy Sheet and Plate

C177 97 ..... Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus

E. American Welding Society (AWS):

A5.8/A5.8M-04.....Specification for Filler Metals for Brazing and Braze Welding

B2.1-02.....Standard Welding Procedure Specification

F. Copper Development Association, Inc. (CDA):

CDA A4015-95.....Copper Tube Handbook

G. Expansion Joint Manufacturer’s Association, Inc. (EJMA):

EMJA-2003.....Expansion Joint Manufacturer’s Association Standards, Eighth Edition

H. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:

SP-67-02a.....Butterfly Valves

SP-70-06.....Gray Iron Gate Valves, Flanged and Threaded Ends

SP-71-05.....Gray Iron Swing Check Valves, Flanged and Threaded Ends

SP-72-99.....Ball Valves with Flanged or Butt-Welding Ends for General Service

SP-78-05.....Cast Iron Plug Valves, Flanged and Threaded Ends

SP-80-03.....Bronze Gate, Globe, Angle and Check Valves

SP-85-02.....Cast Iron Globe and Angle Valves, Flanged and Threaded Ends

I. Tubular Exchanger Manufacturers Association: TEMA 8th Edition, 2000

J. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

HVAC Duct Construction Standards, 2nd Edition 1997

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

2.2 PIPE AND TUBING

A. Chilled Water (above ground), Heating Hot Water, Interior Heat Pump System, and Vent Piping:
   1. Steel: ASTM A53 Grade B, seamless or ERW, Schedule 40.
   2. Copper water tube option: ASTM B88, Type K or L, hard drawn.
B. Extension of Domestic Water Make-up Piping: ASTM B88, Type K or L, hard drawn copper tubing.
C. Cooling Coil Condensate Drain Piping:
   1. From air handling units: Copper water tube, ASTM B88, Type M, or schedule 80 flame retardant polypropylene plastic.
D. Chemical Feed Piping for Condenser Water Treatment: Chlorinated polyvinyl chloride (CPVC), Schedule 80, ASTM F441.
E. Pipe supports, including insulation shields, for above ground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.3 FITTINGS FOR STEEL PIPE

A. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints. Mechanical couplings and fittings are optional for water piping only.
   1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
   2. Welding flanges and bolting: ASME B16.5:
      a. Water service: Weld neck or slip-on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).
         1) Contractor's option: Convoluted, cold formed 150 pound steel flanges, with teflon gaskets, may be used for water service.
      b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
B. 50 mm (2 inches) and Smaller: Screwed or welded. Mechanical couplings are optional for water piping only.
   1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
   2. Forged steel, socket welding or threaded: ASME B16.11.

3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
4. Unions: ASME B16.39.
5. Water hose connection adapter: Brass, pipe thread to 20 mm (3/4 inch) garden hose thread, with hose cap nut.

C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.

D. Mechanical Pipe Couplings and Fittings: May be used, with cut or roll grooved pipe, in water service up to 110 degrees C (230 degrees F) in lieu of welded, screwed or flanged connections.

1. Grooved mechanical couplings: Malleable iron, ASTM A47 or ductile iron, ASTM A536, fabricated in two or more parts, securely held together by two or more track-head, square, or oval-neck bolts, ASTM A183.
2. Gaskets: Rubber product recommended by the coupling manufacturer for the intended service.
3. Grooved end fittings: Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A53 or A106, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.

2.4 FITTINGS FOR COPPER TUBING

A. Solder Joint:

1. Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.

B. Bronze Flanges and Flanged Fittings: ASME B16.24.

2.5 DIELECTRIC FITTINGS

A. Provide where copper tubing and ferrous metal pipe are joined.

B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.

C. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.

D. Temperature Rating, 99 degrees C (210 degrees F).

2.6 SCREWED JOINTS

A. Pipe Thread: ANSI B1.20.

B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.7 VALVES

A. Asbestos packing is not acceptable.

B. All valves of the same type shall be products of a single manufacturer. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.

C. Provide chain operators for valves 100 mm (4 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.

D. Gate Valves:

1. 50 mm (2 inches) and smaller: MSS-SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.
2. 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke.
   a. MSS-SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.

E. Globe, Angle and Swing Check Valves:

1. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Globe and angle valves shall be union bonnet with metal plug type disc.
2. 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for globe valves and MSS-SP-71 for check valves.

F. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.

1. Body: Cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
2. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.

G. Butterfly Valves: May be used in lieu of gate valves in water service except for direct buried pipe. Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation.

1. MSS-SP 67, flange lug type (for end of line service) or grooved end rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F).
   a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.
   b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
   c. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
      1) Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
      2) Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.

H. Ball Valves: Brass or bronze body with chrome-plated ball with full port and Teflon seat at 4140 kPa (600 psig) working pressure rating. Screwed or solder connections. Provide stem extension to allow operation without interfering with pipe insulation.

I. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size and be one of the following types.

1. Butterfly valve as specified herein with memory stop.

2. Eccentric plug valve: Iron body, bronze or nickel-plated iron plug, bronze bearings, adjustable memory stop, operating lever, rated 861 kPa (125 psig) and 121 degrees C (250 degrees F).

J. Circuit Setter Valve: A dual purpose flow balancing valve and adjustable flow meter, with bronze or cast iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

2.8 WATER FLOW MEASURING DEVICES

A. Minimum overall accuracy plus or minus three percent over a range of 70 to 110 percent of design flow. Select devices for not less than 110 percent of design flow rate.

B. Flow Measurement/Balance Valves: A system comprised of two valves of bronze and stainless steel metallurgy designed for 1205 kPa (175 psig) pressure at 121 degrees C (250 degrees F), with thermal insulation sleeve.

1. Measurement and shut-off valve: An on/off ball valve with and dual quick connect valves with integral check valves and color coded safety caps for pressure/temperature readout.
2. A butterfly balancing valve as specified herein, with memory stop and quick connect valve for pressure/temperature readout.

C. Flow Measuring Device Identification:

1. Metal tag attached by chain to the device.
2. Include meter or equipment number, manufacturer's name, meter model, flow rate factor and design flow rate in l/m (gpm).

D. Portable Water Flow Indicating Meters:

1. Minimum 150 mm (6 inch) diameter dial, forged brass body, beryllium-copper bellows, designed for 1205 kPa (175 psig) working pressure at 121 degrees C (250 degrees F).
2. Bleed and equalizing valves.
3. Vent and drain hose and two 3000 mm (10 feet) lengths of hose with quick disconnect connections.
4. Factory fabricated carrying case with hose compartment and a bound set of capacity curves showing flow rate versus pressure differential.

5. Provide one portable meter for each range of differential pressure required for the installed flow devices.

2.9 STRAINERS

A. Y Type. Tee type is acceptable for water service.

B. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations.

1. 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.

C. Suction Diffusers: Specified in Section 23 21 23, HYDRONIC PUMPS.

2.10 FLEXIBLE CONNECTORS FOR WATER SERVICE

A. Flanged Spool Connector:

1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
2. Working pressures and temperatures shall be as follows:
   a. Connector sizes 50 mm to 100 mm (2 inches to 4 inches), 1137 kPa (165psig) at 121 degrees C (250 degrees F).
   b. Connector sizes 125 mm to 300 mm (5 inches to 12 inches), 965 kPa (140 psig) at 121 degrees C (250 degrees F).
3. Provide ductile iron retaining rings and control units.

B. Mechanical Pipe Couplings:

See other fittings specified under Part 2, PRODUCTS.

2.11 EXPANSION JOINTS

A. Expansion Compensators:

1. Corrugated bellows, externally pressurized, stainless steel or bronze.
2. Internal guides and anti-torque devices.
3. Threaded ends.
4. External shroud.
5. Conform to standards of EJMA.

B. Expansion Joint Identification: Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature,

date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.

C. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.

2.12 HYDRONIC SYSTEM COMPONENTS

A. Convertor: Shell and tube type, U-bend removable tube bundle, steam in shell, water in tubes, equipped with support cradles.
   1. Maximum tube velocity: 2.3 m/s (7.5 feet per second).
   2. Tube fouling factor: TEMA Standards, but not less than 0.001.
   3. Materials:
      a. Shell: Steel.
      b. Tube sheet and tube supports: Steel or brass.
      c. Tubes: 20 mm (3/4 inch) OD copper.
      d. Head or bonnet: Cast iron or steel.
   4. Construction: In accordance with ASME Pressure Vessel Code for 861 kPa (125 psig) working pressure for shell and tubes. Provide manufacturer's certified data report, Form No. U-1.

B. Optional Heat Transfer Package: In lieu of field erected individual components, the Contractor may provide a factory or shop assembled package of converters, pumps, and other components supported on a welded steel frame.

C. Air Purger: Cast iron or fabricated steel, 861 kPa (125 psig) water working pressure, for in-line installation.

D. Tangential Air Separator: ASME Pressure Vessel Code construction for 861 kPa (125 psig) working pressure, flanged tangential inlet and outlet connection, internal perforated stainless steel air collector tube designed to direct released air into expansion tank, bottom blowdown connection. Provide Form No. U-1. If scheduled on the drawings, provide a removable stainless steel strainer element having 5 mm (3/16 inch) perforations and free area of not less than five times the cross-sectional area of connecting piping.

E. Diaphragm Type Pre-Pressurized Expansion Tank: ASME Pressure Vessel Code construction for 861 kPa (125 psig) working pressure, welded steel shell, rust-proof coated, with a flexible elastomeric diaphragm

suitable for a maximum operating temperature of 116 degrees C (240 degrees F). Provide Form No. U-1. Tank shall be equipped with system connection, drain connection, standard air fill valve and be factory pre-charged to a minimum of 83 kPa (12 psig).

F. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 28 kPa (4 psig) above and below set point. Bronze, brass or iron body and bronze, brass or stainless steel trim, rated 861 kPa (125 psig) working pressure at 107 degrees C (225 degrees F).

G. Pressure Relief Valve: Bronze or iron body and bronze or stainless steel trim, with testing lever. Comply with ASME Code for Pressure Vessels, Section 8, and bear ASME stamp.

H. Automatic Air Vent Valves (where shown): Cast iron or semi-steel body, 1034 kPa (150 psig) working pressure, stainless steel float, valve, valve seat and mechanism, minimum 15 mm (1/2 inch) water connection and 6 mm (1/4 inch) air outlet. Pipe air outlet to drain.

2.13 POT CHEMICAL FEEDERS

See section 23 25 00, HVAC WATER TREATMENT, Article 2.2, CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS.

2.14 GAGES, PRESSURE AND COMPOUND

A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.

B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.

C. Range of Gages: Provide range equal to at least 130 percent of normal operating range.

2.15 PRESSURE/TEMPERATURE TEST PROVISIONS

A. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

B. Provide one each of the following test items to the Resident Engineer:
   1. 6 mm (1/4 inch) FPT by 3 mm (1/8 inch) diameter stainless steel pressure gage adapter probe for extra-long test plug. PETE'S 500 XL is an example.
   2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gage, , ––100 kPa (30 inches) Hg to 700 kPa (100 psig) range.
   3. 0 - 104 degrees C (220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (one inch) dial, 125 mm (5 inch) long stainless steel stem, plastic case.

2.16 THERMOMETERS

A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 150 mm (6 inch) brass stem, straight, fixed or adjustable angle as required for each in reading.

B. Case: Chrome plated brass or aluminum with enamel finish.

C. Scale: Not less than 225 mm (9 inches), range as described below, two degree graduations.

D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.

E. Scale ranges may be slightly greater than shown to meet manufacturer's standard. Required ranges in degrees C (F):

Chilled Water 0 to 38 degrees C (32-100 degrees F)	Hot Water -1 to 116 degrees C (30 to 240 degrees F).

2.17 FIRESTOPPING MATERIAL

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.18 BUFFER TANKS

A. General: Provide buffer tank assemblies to reduce heat pump short cycling. Tanks shall be of capacities and arrangements indicated on the drawings.

B. Description: Tank assembly shall be of Type 316L stainless steel construction with R-12 insulation and ABS plastic jacket. Tanks shall include internal baffles, inlet and outlet piping connections, valved drain connection and a 3/8 inch capped thermal well. Maximum working pressure shall be 125 psi.

2.19 UNDERGROUND GEOTHERMAL SYSTEM PIPE MATERIALS

A. Geothermal Heat Exchanger (Underground) Closed-Loop Piping: Acceptable pipe material for the underground buried portion of the geothermal heat exchanger loop is polyethylene, conforming to the following requirements:

1. General: All pipe and heat fused materials shall be manufactured from a virgin polyethylene extrusion compound material in accordance with ASTM D-2513, Sections 4.1 and 4.2. Pipe shall be manufactured to outside diameters, wall thickness, and respective tolerances as specified in ASTM D-3035. Piping, fittings, and accessories shall be the Driscopipe 5400 Climate Guard as manufactured by Phillips Driscopipe, or approved equal.
2. Material: The material shall maintain a 1600 psi Hydrostatic Design Basis at 73.4 degrees F per ASTM D-2837, and shall be listed in PPI TR4 as a PE3408 piping formulation. The material shall be a high density polyethylene extrusion compound having a cell classification of PE355434C with a UV stabilizer of C, D, or E as specified in ASTM D-3350 with the following exception: This material shall exhibit zero failures when tested for 192 or more hours under ASTM D-1693, condition C, as required in ASTM D-3350.
3. Dimensions:
   a. Pipe with a diameter less than 3" (nominal) shall be manufactured in accordance with ASTM D-3035 with a dimension ratio of 11 (for thermal and performance reasons).
   b. Pipe manufactured with a diameter of 3" and greater (nominal) shall be manufactured in accordance with ASTM D-3035 with a minimum dimension ratio of 13.5. If the pipe is used in a vertical bore application of over 200 ft. it shall be manufactured in accordance with ASTM D-3035 with a dimension ratio of 11 (for thermal and performance reasons).
4. Markings: Sufficient information shall be permanently marked on the length of the pipe as defined by the appropriate ASTM pipe standard.
5. Certification Materials: Manufacturer shall supply a notarized document confirming compliance with the above standards.
6. Warranty Materials: Manufacturer shall supply a written warranty of 25 years covering manufacturing defects in materials and providing material replacement and labor allowance.

B. Fusion Welded Connections (Polyethylene Pipe):
   1. The only acceptable method for joining buried pipe systems is by a heat fusion process.
   2. Polyethylene pipe shall be butt or socket fused in accordance with pipe manufacturer's procedures.
   3. Fused transition fittings with re-enforced threads shall be used to adapt to black steel, copper or brass valves. Barbed fittings are not permitted in polyethylene pipe.

PART 3 - EXECUTION

3.1 GENERAL

A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, coils, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.

C. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Install convertors at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.

D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves

with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.

G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.

H. Provide manual air vent at all piping system high points and drain valves at all low points.

I. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
   1. Water treatment pot feeders.
   2. Flow elements, control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

J. Thermometer Wells: In pipes 65 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.

K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC INSULATION.

L. Where copper piping is connected to steel piping, provide dielectric connections.

3.2 PIPE JOINTS

A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder’s qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.

C. Mechanical Joint: Pipe grooving shall be in accordance with joint manufacturer's specifications. Lubricate gasket exterior including lips, pipe ends and housing interiors to prevent pinching the gasket during installation. Lubricant shall be as recommended by coupling manufacturer.

D. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.

E. Solvent Welded Joints: As recommended by the manufacturer.

3.3 LEAK TESTING ABOVEGROUND PIPING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the Resident Engineer. Tests may be either of those below, or a combination, as approved by the Resident Engineer.

B. An operating test at design pressure, and for hot systems, design maximum temperature.

C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.4 FLUSHING AND CLEANING PIPING SYSTEMS

A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

1. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the Resident Engineer.

2. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/S (6 feet per second). Circulate each section for not less than four hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.
3. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.5 WATER TREATMENT

A. Install water treatment equipment and provide water treatment system piping.
B. Close and fill system as soon as possible after final flushing to minimize corrosion.
C. Charge systems with chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
D. Utilize this activity, by arrangement with the Resident Engineer, for instructing VA operating personnel.

3.6 OPERATING AND PERFORMANCE TEST AND INSTRUCTION

A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
B. Adjust red set hand on pressure gages to normal working pressure.

3.7 UNDERGROUND GEOTHERMAL SYSTEM PIPING INSTALLATION

A. All work involving the fabrication and installation the geothermal heat exchanger loop shall be provided by a Loop Subcontractor directly responsible to the Prime Contractor. The Loop Subcontractor (Drilling Contractor), must have a current IGSHPA certification, having completed an IGSHPA training course in the fundamentals of design, installation, and operation of ground source systems, and having passed the IGSHPA certification examination and pipe fusion tests.

B. Geothermal heat exchanger fabricators must have completed a heat fusion school in which each participant has performed heat fusion procedures under direct supervision of a IGSHPA Certified Heat Fusion Technician. The Fusion Technician must be thoroughly familiar with heat fusion procedures, and have had formal training and testing at a heat fusion school under direct supervision of an IGSHPA certified instructor.

C. Certified pipe fusion technicians shall attend a retaining school every three years. A single failure of a fusion joint will void the certification, and the technician must be retested to demonstrate satisfactory performance.

D. Local and State laws and ordinances as they pertain to buried pipe systems shall be strictly followed or a variance obtained.

E. Prior to any excavation, trenching, or drilling, all buried utilities, drainage, and irrigation systems shall be located and flagged by the appropriate utility and contractor representatives.

F. The Loop Subcontractor (Drilling Contractor), is responsible for all excavation, drilling, installation of outdoor horizontal and vertical geothermal piping, casing, grouting, and control of surface water runoff and erosion control. Immediately following the drilling of each bore hole, the loop contractor shall insert and pressure test loop, and grout bore hole. In no case shall a bore hole be left open, in order to prevent contamination and/or cross contamination of the aquifer

G. All exterior Geothermal Loop Heat Exchangers (GLHE's) shall be constructed of high density polyethylene pipe, SDR-11 (PE3408) as herein specified. Each GLHE shall be closed by means of single or double-elbow style U-bend at the bottom of the loop. The U-bend shall be constructed and attached to the GLHE using the heat fusion bonding method, prior to insertion into the bore hole. No other fusion joints are permitted on the vertical portion of the GLHE.

H. All fusion joints and loop lengths shall be checked to verify that no leaks have occurred due to the fusion joining or shipping damage.

I. All loops will be pressure tested before and after installation, and all horizontal components of the ground heat exchanger will be pressure tested prior to backfilling.

J. Heat exchangers will be tested hydrostatically at the smaller of 150% of the pipe design rating or 300% of the system operating pressure. No leaks shall occur within a 30 minute period. Flow rates and pressure

drops will be compared to calculated values to assure that there is no blockage or kinking of any pipe.

K. Before backfilling the trenches and bore holes, all systems shall be flushed and purged of air and flow tested to ensure all portions of the heat exchanger are properly flowing. A portable temporary purging unit shall be utilized and shall consist of the following: purge pump--high volume and high head; open reservoir; filter assembly with bypass; connecting piping, and connection hoses.

L. Using the purging unit described above flush and purge each Geothermal Loop Heat Exchanger system until free of air, dirt and debris. A velocity of 2 ft./sec. must be maintained for a minimum of 15 minutes in all pipe sections to remove the all air. This flushing and purging operation should be conducted with the water source heat pump (indoor metal) piping isolated with shut off valves. After the Geothermal Loop Heat Exchanger is completely flushed of air and debris, open the isolation valves and permit circulation through the heat pump portion of the system until the entire system is flushed and purged. The isolation valves at each of the heat pump units are to be closed during this activity, or the hoses to each pump unit joined together to form a loop. Do not flush and purge through the heat pump unit.

M. Do not allow the acid solution used to purge and flush the indoor metal pipe system to the heat pump units to become mixed with the solution in the GLHE.

N. Utilizing the purging unit, conduct a pressure flow test on the Geothermal Loop Heat Exchanger to ensure the system is free of Blockage. If the flow test indicated blockage, locate the blockage systematically clamping off loops with a pinch-off tool, remove the blockage, then repurge and conduct the pressure and flow test again until all portions of the system are flowing. The flow test must be observed and approved by the Architect.

O. The Geothermal Loop Heat Exchanger inspection report is to be filled out by the Contractor and is to be witnessed by the Contracting Officer. The Contractor shall provide the Using Agency with a copy of a dimensioned site layout showing the location of the buried GSHP piping relative to a permanent structure and buried conduits.

P. The Contractor shall make available on request, a certificate describing the specifications and the start-up performance test results of the system.

Q. Piping Tests: Fill piping 24 hours before testing and apply test pressure to stabilize piping. Use potable water only.

R. Hydrostatic Tests: Test at not less than 1-1/2 times the pipe working-pressure rating allowing for static pressure of borehole depth.

S. Increase pressure in 50-psig (345-kPa) increments and inspect each joint between increments. Hold at test pressure for 30 minutes. Slowly increase to next test pressure increment and hold for 30 minutes. After testing at maximum test pressure, reduce pressure to 30 psig (207 kPa). Hold for 90 minutes, and measure pressure at 30-minute intervals. Repair leaks and retest until no leaks exist.

T. Prepare reports of testing activity.

3.8 UNDERGROUND GEOTHERMAL SYSTEM EXCAVATION, DRILLING AND BACKFILLING

A. In addition to requirements of Division 31, provide the following work related to installation of ground source heat pump system piping. Site preparation for excavation and drilling under Division 23 will be provided under the work of Division 31. Coordinate all requirements with the Division 31 Site Contractor.

B. All work involving the fabrication and installation of the geothermal heat exchanger loop shall be provided by a Loop Subcontractor directly responsible to the Contractor. The Loop Subcontractor (Drilling Contractor), must have a current IGSHPA certification, having completed an IGSHPA training course in the fundamentals of design, installation, and operation of ground source systems, and having passed the IGSHPA certification examination and pipe fusion tests.

C. Geothermal heat exchanger fabricators must have completed a heat fusion school in which each participant has performed heat fusion procedures under direct supervision of an IGSHPA Certified Heat Fusion Technician. The Fusion Technician must be thoroughly familiar with heat fusion procedures, and have had formal training and testing at a heat fusion school under direct supervision of an IGSHPA certified instructor. Certified pipe fusion technicians must attend a retraining school every three years. A single failure of a fusion joint will void the certification, and the technician must be retested to demonstrate satisfactory performance.

D. Prior to any excavation, trenching, or drilling, all buried utilities, drainage, and irrigation systems shall be located and flagged by the appropriate utility and contractor representatives.

E. The Loop Subcontractor (Drilling Contractor) is responsible to perform the necessary excavating and drilling of widths and to depths for the installation of the geothermal heat exchanger loop piping system. Proposal shall include excavation, drilling, outdoor horizontal and vertical pipe installation, casing, grouting and surface water runoff/erosion control that may be necessary to complete the project, including any excavation and or drilling of any rock that may be encountered.

F. Contractor shall not permit any ground water resulting from the drilling work to leave the site and/or enter any nearby spring, stream, or other body of water.

G. Contractor shall conform to Act No. 187 - 1996 (Pennsylvania One Call System, Inc.) of the General Assembly of the Commonwealth of Pennsylvania, which was enacted to protect public health and safety.

H. Horizontal Trenching:

1. Excavation and drilling shall be kept safe. Shoring and sheathing shall be furnished and installed to safeguard the work. Shoring and sheathing shall be provided in strict accordance with applicable Federal, State, County and local ordinances and regulations. Excavation shall be kept free of water. Excavation below required depth shall be refilled with sand or gravel firmly compacted. Provide bell holes to insure uniform bearing of pipe. Depth of excavation for lines shall be sufficient to install lines at an even grade.

2. Excess excavated materials shall be disposed of at points on the site designated by the Architect, or off the site at an approved land fill area. Number of points at which this Contractor will be permitted to work and the length of continuous open trench that will be permitted will be governed by the Contracting Officer. When using local streets for disposal of excavated materials, the Contractor must obtain approval of his trucking route (between the building site and the disposal site) from local authorities and governing agencies having jurisdiction, prior to the disposal of excavated materials.

3. To protect persons from injury and to avoid property damage, adequate barricades, construction signs, red lanterns, audible and visual warning signals, guards, etc. shall be placed and maintained during the progress of construction work and until it is safe for traffic use. Rules and regulations of the local, federal, county and State authorities respecting safety provisions shall be observed.
4. Excavation shall be conducted in a manner to cause the least interruption to traffic. Where traffic must cross open trenches or open excavated areas, the Contractor shall provide suitable bridges.
5. Adequate protection shall be provided for existing or new structures, services or utilities encountered in the excavation. The protection shall include bracing, sheathing, supports and other materials to maintain grade and alignment and to provide proper mechanical strength. Any structures, services, or utilities damaged by the work of this Contractor shall be promptly repaired and placed in same condition as they originally were prior to such damage, by the Contractor at no additional cost to the Owner.
6. Trenches shall be of sufficient width to provide a free working space on each side of the pipe, according to the size of the pipe and the character of the ground, at the spacing requirements indicated on the contract drawings, but in every case, there shall be sufficient space between the pipe and the sides of the trench to thoroughly backfill around the pipe to secure tight joints. The trench shall be carried to a point 6 inches below the invert of the pipe. No horizontal pipe shall be bedded directly upon rock or earth, but shall be cushioned by a 6 inch layer of sand or finely ground bore hole drillings as indicated on the drawings. Minimum depth of trench excavation for piping shall be as indicated on the drawings.
7. Include any pumping, bailing or drainage of water that may accumulate or be found in trenches or other excavated areas. Trenches and excavated areas shall be kept free from water. No horizontal pipe or concrete shall be laid in water and new concrete shall be protected so that no flood or surface water may enter same. Protection shall be provided in a manner satisfactory to the Architect.

8. Backfilling of pipe trenches and excavated areas shall include prevention of any sharp edged rocks from coming in contact with the pipe. Backfilling shall be placed in horizontal layers not exceeding 6 inches in thickness with each layer thoroughly consolidated and compressed with pneumatic rammers. The backfill shall be compacted to a minimum density equal to 95 percent of the maximum dry density as determined by the Modified Proctor Test (ASTM D1557). The backfilling shall be thoroughly tamped and rammed underneath and around the conduit and fittings. No backfilling shall be done until undermined earth or pavement shall have been broken down and the sides of the excavation made vertical or inclined outward. Filling under, around and for a distance of at least 6 inches over lines shall be sand. Return bends in trenches must be partially backfilled by hand to properly support and prevent kinking. The remainder of the fill over lines and equipment to the surface of the adjoining ground shall be ordinary approved excavated materials placed in 6 inch layers and thoroughly compacted.
9. Any settling or washing out of earth after the initial installation shall be corrected by this Contractor.

I. Vertical Bore Holes:

1. he Loop Subcontractor (Drilling Contractor) shall be responsible to drill, leak test loop, install loop, and grout each bore hole immediately following completion of each borehole. In no case shall any bore hole be left open upon completion of drilling, in order to prevent contamination and/or cross contamination of the aquifers. "Wet" holes shall be cased so that the piping can be inserted.
2. No excavation shall be backfilled until lines and other equipment have been pressure tested, purged, inspected and approved by the Architect. Additional materials for backfilling in excess of that obtained by excavating shall be provided by the Contractor and shall be of materials approved by the Architect. Where necessary, backfill shall be hauled from off-site locations at no additional cost to the Owner.
3. All ground loop system piping shall be pressure grouted in place for the entire depth of the bore with a highly conductive, thermally enhanced (1.2 Btu/Hr-Ft-°F) Bentonite slurry in accordance with the recommendations of the International Ground Source Heat Pump

Association's (IGSHPA) standards specified in their publication "Proper Grouting Procedures for Ground-Source Heat Pump System," and the requirements of the PA Department of Environmental Protection, PA Department of Health, and the Federal Environmental Protection Agency. Since settling of the grouting material will occur after the initial grouting, Contractor shall monitor each bore hole and continue adding grout as required. The upper ends of each GLHE and all horizontal ground loop system piping shall be marked with geothermal piping metallic tracer tape, buried 6" to 18" below grade.

4. As the work progresses, record on the drawings changes and deviations from the Contract Drawings. Measurements shall include elevations and sufficient offset measurements from buildings to definitely locate lines and equipment installed or constructed under this Contract.
5. The Contractor shall provide a copy of a dimensioned site layout showing the location of the buried GSHP piping relative to a permanent structure and other buried utilities.

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SECTION 23 21 23
HYDRONIC PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Hydronic pumps for Heating, Ventilating and Air Conditioning.

B. Definitions:

1. Capacity: Liters per second (L/s) (Gallons per minute (GPM)) of the fluid pumped.
2. Head: Total dynamic head in kPa (feet) of the fluid pumped.
3. Flat head-capacity curve: Where the shutoff head is less than 1.16 times the head at the best efficiency point.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

D. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

E. Section 23 21 13, HYDRONIC PIPING.

F. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.

G. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Design Criteria:

1. Pumps design and manufacturer shall conform to Hydraulic Institute Standards.
2. Pump sizes, capacities, pressures, operating characteristics and efficiency shall be as scheduled.
3. Head-capacity curves shall slope up to maximum head at shut-off. Curves shall be relatively flat for closed systems. Select pumps near the midrange of the curve, so the design capacity falls to the left of the best efficiency point, to allow a cushion for the usual drift to the right in operation, without approaching the pump curve end point and possible cavitation and unstable operation. Select pumps for open systems so that required net positive suction head (NPSHR) does not exceed the net positive head available (NPSHA).
4. The head for pumps submitted for pumping through condensers and through chilled water coils and evaporators shall be increased, if necessary, to match the equipment approved for the project.

4. Pump Driver: Furnish with pump. Size shall be non-overloading at any point on the head-capacity curve including one pump operation in a parallel or series pumping installation.
5. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard and other accessories specified. Statically and dynamically balance all rotating parts.
6. Furnish each pump and motor with a nameplate giving the manufacturers name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current and motor efficiency.
7. Test all pumps before shipment. The manufacturer shall certify all pump ratings.
8. After completion of balancing, provide replacement of impellers or trim impellers to provide specified flow at actual pumping head, as installed.
9. Furnish one spare seal and casing gasket for each pump to the Resident Engineer.

C. Allowable Vibration Tolerance for Pump Units: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:
   1. Pumps and accessories.
   2. Motors and drives.

C. Manufacturer's installation, maintenance and operating instructions, in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

D. Characteristic Curves: Head-capacity, efficiency-capacity, brake horsepower-capacity, and NPSHR-capacity for each pump and for combined pumps in parallel or series service. Identify pump and show fluid pumped, specific gravity, pump speed and curves plotted from zero flow to maximum for the impeller being furnished and at least the maximum diameter impeller that can be used with the casing.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only:

B. American Iron and Steel Institute (AISI):
   AISI 1045.....Cold Drawn Carbon Steel Bar, Type 1045
   AISI 416.....Type 416 Stainless Steel

C. American National Standards Institute (ANSI):
ANSI B15.1-00.....Safety Standard for Mechanical Power Transmission Apparatus
ANSI B16.1-00.....Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800

D. American Society for Testing and Materials (ASTM):
A48-98.....Gray Iron Castings
B62-02.....Composition Bronze or Ounce Metal Castings

E. Maintenance and Operating Manuals in accordance with Section 01 00 00, General Requirements.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL PUMPS, BRONZE FITTED

In-Line or Base Mounted End Suction Type:

A. Casing and Bearing Housing: Close-grained cast iron, ASTM A48.

B. Casing Wear Rings: Bronze.

C. Suction or Discharge 65 mm (2-1/2 inches) and Larger: Plain face flange, 850 kPa (125 psig), ANSI B16.1.

D. Casing Vent: Manual brass cock at high point.

E. Casing Drain and Gage Taps: 15 mm (1/2-inch) plugged connections minimum size.

F. Bearings: Regreaseable ball or roller type. Provide lip seal and slinger outboard of each bearing.

G. Impeller: Bronze, ASTM B62, enclosed type, keyed to shaft.

H. Shaft: Steel, AISI Type 1045 or stainless steel.

I. Shaft Seal: Manufacturer's standard mechanical type to suit pressure and temperature and fluid pumped.

J. Shaft Sleeve: Bronze or stainless steel.

K. Motor: Furnish with pump. Refer to Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.

L. Base Mounted Pumps:

1. Designed for disassembling for service or repair without disturbing the piping or removing the motor.
2. Impeller Wear Rings: Bronze.
3. Shaft Coupling: Non-lubricated steel flexible type or spacer type with coupling guard, ANSI B15.1, bolted to the baseplate.
4. Base: Cast iron or fabricated steel for common mounting to a concrete base.
5. Suction Diffuser:
   a. Body: Cast iron with steel inlet vanes and combination diffuser-strainer-orifice cylinder with 5 mm (3/16-inch) diameter

openings for pump protection. Provide taps for strainer blowdown and gage connections.

b. Provide adjustable foot support for suction piping.

c. Strainer free area: Not less than five times the suction piping.

d. Provide disposable start-up strainer.

6. Suction Strainer, "Y" Type: Section 23 21 13, HYDRONIC PIPING.

a. May be furnished in lieu of a suction diffuser at the Contractor's option. Provide equivalent support of pump suction piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow manufacturer's written instructions for pump mounting and start-up. Access/ Service space around pumps shall not be less than minimum space recommended by pumps manufacturer.

B. Support piping adjacent to pump such that no weight is carried on pump casing. First 3 hangers for each pipe shall be spring and neoprene type.

C. Permanently support in-line pumps by the connecting piping only, not from the casing or the motor eye bolt.

D. Sequence of installation for base-mounted pumps:

1. Level and shim the unit base and grout to the concrete pad.
2. Shim the driver and realign the pump and driver. Correct axial, angular or parallel misalignment of the shafts.
3. Connect properly aligned and independently supported piping.
4. Recheck alignment.

E. Provide drains for bases and seals for base mounted pumps, piped to and discharging into floor drains.

F. Coordinate location of thermometer and pressure gauges as per Section 23 21 13, HYDRONIC PIPING.

3.2 START-UP

A. Verify that the piping system has been flushed, cleaned and filled.

B. Lubricate pumps before start-up.

C. Prime the pump, vent all air from the casing and verify that the rotation is correct. To avoid damage to mechanical seals, never start or run the pump in dry condition.

D. Verify that correct size heaters-motor over-load devices are installed for each pump controller unit.

E. Perform field mechanical balancing if necessary to meet specified vibration tolerance.

F. Ensure the disposable strainer is free of debris prior to testing and balancing of the hydronic system.

G. After several days of operation, replace the disposable start-up strainer with a regular strainer in the suction diffuser.

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SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field refrigerant piping for direct expansion HVAC systems.

B. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The schematic piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.

C. Definitions:

1. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
   a. Low side means the parts of a refrigerating system subjected to evaporator pressure.
   b. High side means the parts of a refrigerating system subjected to condenser pressure.
2. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 449 degrees C (840 degrees F) but less than the melting temperatures of the joined parts.

1.2 RELATED WORK

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.

B. Section 23 07 11, HVAC INSULATION: Requirements for piping insulation.

C. Section 23 81 00, DECENTRALIZED UNITARY HVAC EQUIPMENT: Piping requirements for split system air conditioners and condensing units.

1.3 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.

C. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.

D. Products shall comply with UL 207 "Refrigerant–Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrical Operated Valves."

1.4 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Shop Drawings:

1. Complete information for components noted, including valves and refrigerant piping accessories, clearly presented, shall be included to determine compliance with drawings and specifications for components noted below:
   a. Tubing and fittings
   b. Valves
   c. Strainers
   d. Moisture-liquid indicators
   e. Filter-driers
   f. Flexible metal hose
   g. Liquid-suction interchanges
   h. Gages
   i. Pipe and equipment supports
   j. Refrigerant and oil
   k. Pipe/conduit roof penetration cover
   l. Soldering and brazing materials
2. Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.

C. Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.

D. Design Manual: Furnish two copies of design manual of refrigerant valves and accessories.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Air Conditioning, Heating, and Refrigeration Institute (ARI/AHRI):

495-1999 (R2002).....Standard for Refrigerant Liquid Receivers
730-2005.....Flow Capacity Rating of Suction-Line Filters and Suction-Line Filter-Driers
750-2007.....Thermostatic Refrigerant Expansion Valves
760-2007.....Performance Rating of Solenoid Valves for Use with Volatile Refrigerants

C. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE):

ANSI/ASHRAE 15-2007.....Safety Standard for Refrigeration Systems (ANSI)

ANSI/ASHRAE 17-2008.....Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves (ANSI)

63.1-95 (RA 01).....Method of Testing Liquid Line Refrigerant Driers (ANSI)

D. American National Standards Institute (ANSI):

ASME (ANSI)A13.1-2007...Scheme for Identification of Piping Systems

Z535.1-2006.....Safety Color Code

E. American Society of Mechanical Engineers (ASME):

ANSI/ASME B16.22-2001 (R2005)

Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ANSI)

ANSI/ASME B16.24-2006 Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500 (ANSI)

ANSI/ASME B31.5-2006....Refrigeration Piping and Heat Transfer Components (ANSI)

ANSI/ASME B40.100-2005..Pressure Gauges and Gauge Attachments

ANSI/ASME B40.200-2008..Thermometers, Direct Reading and Remote Reading

F. American Society for Testing and Materials (ASTM)

A126-04.....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe FittingsB32-08 Standard Specification for Solder Metal

B88-03.....Standard Specification for Seamless Copper Water Tube

B88M-05.....Standard Specification for Seamless Copper Water Tube (Metric)

B280-08.....Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

G. American Welding Society, Inc. (AWS):

Brazing Handbook

A5.8/A5.8M-04.....Standard Specification for Filler Metals for Brazing and Braze Welding

H. Federal Specifications (Fed. Spec.)

Fed. Spec. GG

I. Underwriters Laboratories (U.L.):

U.L.207-2009.....Standard for Refrigerant-Containing Components and Accessories, Nonelectrical

U.L.429-99 (Rev.2006)...Standard for Electrically Operated Valves

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Refrigerant Piping: For piping up to 100 mm (4 inch) use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer.

B. Drain Piping: Copper water tube, ASTM B88M, Type B or C (ASTM B88, Type L). Optional drain piping material: Schedule 80 flame retardant Polypropylene plastic.

C. Fittings, Valves and Accessories:

1. Copper fittings: Wrought copper fittings, ASME B16.22.
   a. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
   b. Solder Joints, drain: 95-5 tin-antimony, ASTM B32 (95TA).
2. Refrigeration Valves:
   a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.
   b. Pressure Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; UL listed. Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.
   c. Solenoid Valves: Comply with ARI 760 and UL 429, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location and normally open holding coil.
   d. Thermostatic Expansion Valves: Comply with ARI 750. Brass body with stainless-steel or non-corrosive non ferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.
   e. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for

low pressure drop, and with solder-end connections. Direction of flow shall be legibly and permanently indicated on the valve body.

3. Strainers: Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines DN 25 (NPS 1) and smaller, 60 mesh in liquid lines larger than DN 25 (NPS 1), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.
4. Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
5. Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown on drawings. Conform to ARI Standard 730 and ASHRAE Standard 63.1. Heavy gage steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter driers with replaceable filters shall be furnished with one spare element of each type and size.
6. Flexible Metal Hose: Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends. Provide in suction and discharge piping of each compressor.

2.2 GAGES

A. Temperature Gages: Comply with ASME B40.200. Industrial-duty type and in required temperature range for service in which installed. Gages shall have Celsius scale in 1-degree (Fahrenheit scale in 2-degree) graduations and with black number on a white face. The pointer shall be adjustable. Rigid stem type temperature gages shall be provided in thermal wells located within 1525 mm (5 feet) of the finished floor. Universal adjustable angle type or remote element type temperature gages shall be provided in thermal wells located 1525 to 2135 mm (5 to 7 feet) above the finished floor. Remote element type temperature gages shall be provided in thermal wells located 2135 mm (7 feet) above the finished floor.

B. Vacuum and Pressure Gages: Comply with ASME B40.100 and provide with throttling type needle valve or a pulsation dampener and shut-off valve. Gage shall be a minimum of 90 mm (3-1/2 inches) in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system

working pressure. Each gage range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

1. Suction: 101 kPa (30 inches Hg) vacuum to 1723 kPa (gage) (250 psig).
2. Discharge: 0 to 3445 kPa (gage) (0 to 500 psig).

2.3 THERMOMETERS AND WELLS

A. Refer to specification Section 23 21 13, HYDRONIC PIPING.

2.4 PIPE SUPPORTS

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.5 REFRIGERANTS AND OIL

A. Provide EPA approved refrigerant and oil for proper system operation.

2.6 PIPE/CONDUIT ROOF PENETRATION COVER

A. Prefabricated Roof Curb: Galvanized steel or extruded aluminum 300 mm (12 inches) overall height, continuous welded corner seams, treated wood nailer, 38 mm (1-1/2 inch) thick, 48 kg/cu.m (3 lb/cu.ft.) density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs shall be constructed for pitched roof or ridge mounting as required to keep top of curb level.

B. Penetration Cover: Galvanized sheet metal with flanged removable top. Provide 38 mm (1-1/2 inch) thick mineral fiber board insulation.

C. Flashing Sleeves: Provide sheet metal sleeves for conduit and pipe penetrations of the penetration cover. Seal watertight penetrations.

2.7 PIPE INSULATION FOR DX HVAC SYSTEMS

Refer to specification Section 23 07 11, HVAC INSULATION.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5

1. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
2. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
3. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems

in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.

4. Use copper tubing in protective conduit when installed below ground.
5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.

B. Joint Construction:

1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
   a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
   b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
   c. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
   d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.

C. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.

D. Pipe relief valve discharge to outdoors for systems containing more than 45 kg (100 lbs) of refrigerant.

E. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.

3.2 PIPE AND TUBING INSULATION

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

3.3 SIGNS AND IDENTIFICATION

A. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.

3.4 FIELD QUALITY CONTROL

Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.

A. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of Resident Engineer. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.
   1. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.
   2. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 20 degrees C (68 degrees F) minimum.
B. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.5 SYSTEM TEST AND CHARGING

A. System Test and Charging: As recommended by the equipment manufacturer or as follows:
   1. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 70 kPa (10 psi) gage. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.

2. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.
3. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in mPa (microns). Pull the system down to 665 mPa (500 microns) 665 mPa (2245.6 inches of mercury at 60 degrees F) and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

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SECTION 23 25 00
HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies cleaning and treatment of circulating HVAC water systems, including the following.
   1. Cleaning compounds.
   2. Chemical treatment for closed loop heat transfer systems.
   4. Glycol-water heat transfer systems.

1.2 RELATED WORK

A. Test requirements and instructions on use of equipment/system: Section 01 00 00, GENERAL REQUIREMENTS.

B. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Piping and valves: Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.

1.3 QUALITY ASSURANCE

A. Refer to paragraph, QUALITY ASSURANCE in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Technical Services: Provide the services of an experienced water treatment chemical engineer or technical representative to direct flushing, cleaning, pre-treatment, training, debugging, and acceptance testing operations; direct and perform chemical limit control during construction period and monitor systems for a period of 12 months after acceptance, including not less than 4 service calls and written status reports. During this period perform monthly tests of the cooling tower for Legionella pneumophila and submit reports stating Legionella bacteria count per millimeter. These tests shall be conducted in a certified laboratory and not by a technician in the field. Minimum service during construction/start-up shall be 4 hours.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data including:
   1. Cleaning compounds and recommended procedures for their use.

2. Chemical treatment for closed systems, including installation and operating instructions.

C. Water analysis verification.

D. Materials Safety Data Sheet for all proposed chemical compounds, based on U.S. Department of Labor Form No. L5B-005-4.

E. Maintenance and operating instructions in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 CLEANING COMPOUNDS

A. Alkaline phosphate or non-phosphate detergent/surfactant/specific to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.

B. All chemicals to be acceptable for discharge to sanitary sewer.

C. Refer to Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING, PART 3, for flushing and cleaning procedures.

2.2 CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS

A. Inhibitor: Provide sodium nitrite/borate, molybdate-based inhibitor or other approved proprietary compound suitable for make-up quality and make-up rate and which will cause or enhance bacteria/corrosion problems or mechanical seal failure due to excessive total dissolved solids. Shot feed manually. Maintain inhibitor residual as determined by water treatment laboratory, taking into consideration residual and temperature effect on pump mechanical seals.

B. pH Control: Inhibitor formulation shall include adequate buffer to maintain pH range of 8.0 to 10.5.

C. Performance: Protect various wetted, coupled, materials of construction including ferrous, and red and yellow metals. Maintain system essentially free of scale, corrosion, and fouling. Corrosion rate of following metals shall not exceed specified mills per year penetration; ferrous, 0-2; brass, 0-1; copper, 0-1. Inhibitor shall be stable at equipment skin surface temperatures and bulk water temperatures of not less than 121 degrees C (250 degrees F) and 52 degrees C (125 degrees Fahrenheit) respectively. Heat exchanger fouling and capacity reduction shall not exceed that allowed by fouling factor 0.0005.

D. Pot Feeder: By-pass type, complete with necessary shut off valves, drain and air release valves, and system connections, for introducing chemicals into system, cast iron or steel tank with funnel or large opening on top for easy chemical addition. Feeders shall be 18.9 L (five gallon) minimum capacity at 860 kPa (125 psig) minimum working pressure.

2.3 GLYCOL-WATER SYSTEM

A. Propylene glycol shall be inhibited with 1.75 percent dipotassium phosphate. Do not use automotive anti-freeze because the inhibitors used are not needed and can cause sludge precipitate that interferes with heat transfer.

B. Provide required amount of glycol to obtain the percent by volume for glycol-water systems as follows and to provide one-half tank reserve supply: 15 percent glycol for geothermal system.

C. Glycol-Water Make-up System:

1. Glycol-Water storage tank: Self supporting polyethylene, minimum 90 mil thickness, with removable cover or black steel with 90 mil polyethylene insert. Capacity shall be 213 L (55 gallons), with approximate diameter of 584 mm (23 inches) and height of 914 mm (36 inches). Reinforced threaded pipe connections shall be provided for all connections. Provide identification for tank showing name of the contents.

2. Glycol-Water make-up pump: Bronze fitted, self-priming, high head type suitable for pumping a 33 percent to 50 percent glycol-water solution in intermittent service. The pump shall be provided with a mechanical shaft seal and be flange connected to a 1750 rpm NEMA type C motor. The pump capacity shall be 11 L/m (3 gpm) , 345 kPa (50 psig) discharge pressure with a suction lift capability of 127 mm (5 inches) of mercury, with a 2.5 kW (1/3 horsepower) drip-proof motor. The pump may be a "gear-within-a-gear" positive displacement type with built-in relief valve set for 296 kPa (43 psig), or the pump may be a regenerative turbine type providing self-priming with built-in or external relief valve set for design head of the pump.

3. Back pressure regulating valve: Spring loaded, diaphragm actuated type with bronze or steel body, stainless steel trim with capacity to relieve 100 percent of pump flow with an allowable rise in the

regulated pressure of 69 kPa (10 psig) above the set point. Set point shall be 103 kPa (15 psig) above system PRV setting.

4. Low water level control: Steel or plastic float housing, stainless steel or plastic float, positive snap-acting SPST switch mechanism, rated 10 amps-120 volt AC, in General Purpose (NEMA 1) enclosure. The control shall be rated for pressures to 1034 kPa (150 psig) and make alarm circuit on low water level. The alarm circuit shall be wired to an alarm light on the nearest local Temperature Control panel (LTCP

2.4 EQUIPMENT AND MATERIALS IDENTIFICATION

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Delivery and Storage: Deliver all chemicals in manufacturer's sealed shipping containers. Store in designated space and protect from deleterious exposure and hazardous spills.

B. Install equipment furnished by the chemical treatment supplier and charge systems according to the manufacturer's instructions and as directed by the Technical Representative.

1. Provide a by-pass line around water meters and bleed off piping assembly. Provide ball valves to allow for bypassing, isolation, and servicing of components.
2. Bleed off water piping with bleed off piping assembly shall be piped from pressure side of circulating water piping to a convenient drain. Bleed off connection to main circulating water piping shall be upstream of chemical injection nozzles.
3. Provide DN 25 (1 IN) Schedule 80 PVC piping for the flow assembly piping to the main control panel and accessories.
   a. The inlet piping shall connect to the discharge side of the circulating water pump.
   b. The outlet piping shall connect to the water piping serving the cooling tower downstream of the heat source.
   c. Provide inlet PVC wye strainer and PVC ball valves to isolate and service main control panel and accessories.
4. Provide installation supervision, start-up and operating instruction by manufacturer's technical representative.

C. Before adding cleaning chemical to the closed system, all air handling coils and fan coil units should be isolated by closing the inlet and outlet valves and opening the bypass valves. This is done to prevent dirt and solids from lodging the coils.

D. Do not valve in or operate system pumps until after system has been cleaned.

E. After chemical cleaning is satisfactorily completed, open the inlet and outlet valves to each coil and close the by-pass valves. Also, clean all strainers.

F. Perform tests and report results in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

G. After cleaning is complete, and water PH is acceptable to manufacturer of water treatment chemical, add manufacturer-recommended amount of chemicals to systems.

H. Instruct VA personnel in system maintenance and operation in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

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SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Ductwork and accessories for HVAC including the following:
   1. Supply air, return air, outside air, exhaust, and relief systems.
   2. Underground duct system.

B. Definitions:
   1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
   2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
   3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
   4. Exposed Duct: Exposed to view in a finished room.

1.2 RELATED WORK

A. Fire Stopping Material: Section 07 84 00, FIRESTOPPING.

B. Outdoor and Exhaust Louvers: Section 08 90 00, LOUVERS AND VENTS.

C. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

D. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

E. Duct Insulation: Section 23 07 11, HVAC INSULATION

F. Air Flow Control Valves and Terminal Units: Section 23 36 00, AIR TERMINAL UNITS.

G. Duct Mounted Coils: Section 23 82 16, AIR COILS.

H. Supply Air Fans: Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

I. Return Air and Exhaust Air Fans: Section 23 34 00, HVAC FANS.

J. Air Filters and Filters' Efficiencies: Section 23 40 00, HVAC AIR CLEANING DEVICES.

K. Duct Mounted Instrumentation: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

L. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

M. Smoke Detectors: Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 QUALITY ASSURANCE

A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Fire Safety Code: Comply with NFPA 90A.

C. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.

D. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.

E. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Rectangular ducts:
   a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
   b. Sealants and gaskets.
   c. Access doors.
2. Round and flat oval duct construction details:
   a. Manufacturer's details for duct fittings.
   b. Sealants and gaskets.
   c. Access sections.
   d. Installation instructions.
3. Volume dampers, back draft dampers.
4. Wall caps.
5. Upper hanger attachments.
6. Fire dampers, fire doors, and smoke dampers with installation instructions.
7. Sound attenuators, including pressure drop and acoustic performance.
8. Flexible ducts and clamps, with manufacturer's installation instructions.
9. Flexible connections.
10. Instrument test fittings.
11. Underground duct system components and installation procedures.
12. Details and design analysis of alternate or optional duct systems.

C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Air Moving and Conditioning Association (AMCA):
500D-98.....Laboratory Method of Testing Dampers for Rating
500L-99.....Laboratory Method of Testing Louvers for Rating

C. American Society of Civil Engineers (ASCE):
ASCE7-98.....Minimum Design Loads for Buildings and Other Structures

D. American Society for Testing and Materials (ASTM):
A167-99.....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
A653-01.....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process
A1011-02.....Standard Specification for Steel Sheet and Strip Hot rolled Carbon structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability
B209-01.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
C1071-00.....Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
E84-01.....Standard Test Method for Surface Burning Characteristics of Building Materials

E. National Fire Protection Association (NFPA):
90A-99.....Standard for the Installation of Air Conditioning and Ventilating Systems

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
2nd Edition – 1995.....HVAC Duct Construction Standards, Metal and Flexible
1st Edition, 1985.....HVAC Air Duct Leakage Test Manual

G. Underwriters Laboratories, Inc. (UL):

33-93.....UL Standard for Safety Heat Responsive Links for Fire Protection Service

181-96.....UL Standard for Safety Factory-Made Air Ducts and Connectors

555-02 .....Fire Dampers

555S-02 .....Smoke Dampers

PART 2 - PRODUCTS

2.1 DUCT MATERIALS AND SEALANTS

A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A527, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.

B. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, paragraph S1.9.

1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
3. Gaskets in Flanged Joints: Soft neoprene.

C. Approved factory made joints such as DUCTMATE SYSTEM may be used.

2.2 DUCT CONSTRUCTION AND INSTALLATION

A. Follow SMACNA HVAC Duct Construction Standards.

B. Duct Pressure Class: 500 Pa and 1000 Pa (2 inch and 4 inch) W.G.

C. Seal Class: As shown on the drawings and in accordance with SMACNA HVAC Air Duct Leakage Test Manual.

D. Duct for Negative Pressure Up to 750 Pa (3 inch W.G.): Provide for exhaust duct between HEPA filters and exhaust fan inlet including systems for Autopsy Suite exhaust.

1. Round Duct: Galvanized steel, spiral lock seam construction with standard slip joints.
2. Rectangular Duct: Galvanized steel, minimum 1.0 mm (20 gage), Pittsburgh lock seam, companion angle joints 32 mm by 3.2 mm (1-1/4 by 1/8 inch) minimum at not more than 2.4 m (8 feet) spacing.

DUCTMATE SYSTEM or equal manufactured joints are acceptable in lieu of companion angles.

E. Round and Flat Oval Ducts: Furnish duct and fittings made by the same manufacturer to insure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown on the drawings.
   1. Elbows: Diameters 80 through 200 mm (3 through 8 inches) shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
   2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards.
   3. Ribbed Duct Option: Lighter gage round/oval duct and fittings may be furnished provided certified tests indicating that the rigidity and performance is equivalent to SMACNA standard gage ducts are submitted.
      a. Ducts: Manufacturer's published standard gage, G90 coating, spiral lock seam construction with an intermediate standing rib.
      b. Fittings: May be manufacturer's standard as shown in published catalogs, fabricated by spot welding and bonding with neoprene base cement or machine formed seam in lieu of continuous welded seams.
   4. Provide flat side reinforcement of oval ducts as recommended by the manufacturer and SMACNA HVAC Duct Construction Standard S3.13. Because of high pressure loss, do not use internal tie-rod reinforcement unless approved by the Resident Engineer.

2.3 DUCT ACCESS DOORS, PANELS AND SECTIONS

A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
   1. Each duct mounted coil.
   2. Each fire damper (for link service), smoke damper and automatic control damper.
   3. Each duct mounted smoke detector.

B. Openings shall be as large as feasible in small ducts, 300 mm by 300 mm (12 inch by 12 inch) minimum where possible. Access sections in insulated ducts shall be double-wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.

1. For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2-12).
2. For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure 2-11).

2.4 FIRE DAMPERS

A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2 hour rating, 70 degrees C (160 degrees F) fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.

B. Fire dampers shall be of galvanized steel.
   1. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 1.9 mm (14 gage), required to provide installation equivalent to the damper manufacturer's UL test installation.
   2. Submit manufacturer's installation instructions conforming to UL rating test.
   3. Combination fire and smoke dampers: Multi-louver or curtain type units meeting all requirements of both dampers shall be used where shown and may be used at the Contractor's option where applicable.

2.5 SMOKE DAMPERS

A. Maximum air velocity, through free area of open damper, and pressure loss: Low pressure and medium pressure duct (supply, return, exhaust, outside air): 450 m/min (1500 fpm). Maximum static pressure loss: 32 Pa (0.13 inch W.G.).

B. Maximum air leakage, closed damper: 0.32 cubic meters /min/square meter (4.0 CFM per square foot) at 750 Pa (3 inch W.G.) differential pressure.

C. Minimum requirements for dampers:
   1. Shall comply with requirements of Table 6-1 of UL 555S, except for the Fire Endurance and Hose Stream Test.
   2. Frame: Galvanized steel channel with side, top and bottom stops or seals.
   3. Blades: Galvanized steel, parallel type preferably, 300 mm (12 inch) maximum width, edges sealed with neoprene, rubber or felt, if required to meet minimum leakage. Airfoil (streamlined) type for minimum noise generation and pressure drop are preferred for duct mounted dampers.
   4. Shafts: Galvanized steel.
   5. Bearings: Nylon, bronze sleeve or ball type.
   6. Hardware: Zinc plated.

7. Operation: Automatic open/close. No smoke damper that requires manual reset or link replacement after actuation is acceptable. See drawings for required control operation.

D. Motor operator (actuator): Provide electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

2.6 FIRE DOORS

Galvanized steel, interlocking blade type, UL listing and label, 71 degrees C (160 degrees F) fusible link, 3 hour rating and approved for openings in Class A fire walls with rating up to 4 hours, 100 percent free opening with no part of the blade stack or damper frame in the air stream.

2.7 FLEXIBLE AIR DUCT CONNECTORS

A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 m (5 feet). Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.

B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 200 mm (8 inches) in diameter shall be Class 1. Ducts 200 mm (8 inches) in diameter and smaller may be Class 1 or Class 2.

C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (foot) of straight duct, at 500 Hz, based on 150 mm (6 inch) duct, of 750 m/min (2500 fpm).

D. Application Criteria:

1. Temperature range: -18 to 93 degrees C (0 to 200 degrees F) internal.
2. Maximum working velocity: 1200 m/min (4000 feet per minute).
3. Minimum working pressure, inches of water gage: 2500 Pa (10 inches) positive, 500 Pa (2 inches) negative.

E. Duct Clamps: 100 percent nylon strap, 80 kg (175 pounds) minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

2.8 FLEXIBLE CONNECTIONS

Where duct connections are made to fans and air handling units, install a non-combustible flexible connection of 822 g (29 ounce) neoprene coated fiberglass fabric approximately 150 mm (6 inches) wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 50 mm (2 inches) on center. Fabric shall not be stressed other than by air pressure. Allow at least 25 mm (one inch) slack to insure that no vibration is transmitted.

2.9 FIRESTOPPING MATERIAL

Refer to Section 07 84 00, FIRESTOPPING.

2.10 THERMOMETER (AIR)

Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

2.11 INSTRUMENT TEST FITTINGS

A. Manufactured type with a minimum 50 mm (two inch) length for insulated duct, and a minimum 25 mm (one inch) length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.

B. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, cooling coil, and heat recovery unit.

2.12 UNDERGROUND DUCT SYSTEM

A. Provide elbows, pipe, diffusers, plenum, clamp & gasket, boots, saddle registers, caulk, water gauge test and adapters as required by drawings for underground installation. Provide 10-yr manufacturer’s parts warranty.

B. Ductwork shall be HDPE, food grade, closed cell plastic material that is recyclable, does not emit volatile organic compounds, and conforms to ASTMD2412. Ductwork shall be resistant to mildew, mold (UL 181B), and radon gas (BSS 7239-88). Ductwork shall not rust or crack under external stress or strain. Ductwork shall have R-10 thermal insulation value without the use of external insulation.

C. All joints shall be gasketed and sealed. Clamps and gaskets shall be used on ductwork without flanges. Clamps shall be polyethylene with 410 stainless steel plates and stainless steel screws. Gaskets shall comprise of ¼” thick butyl rubber sealant tape with Tedlar facing that

is water and UV resistant and shall not stain. Gaskets shall comply with ASTM-E84 for flame and smoke spread.

D. Flanged joints and duct branches shall use a co-polymer adhesive caulking sealant that is water and UV resistant. Flanges shall be connected with stainless steel bolts.

E. Assembled ductwork shall be able to maintain +/- 10” static pressure with no leakage.

F. Assembled ductwork shall be approved for installations 27” below flood plain elevation without water intrusion.

G. Installed duct system shall be air and water tight.

2.13 WALL CAPS

A. Provide wall caps at locations indicated o the drawings constructed of aluminum with integral backdraft damper, round duct connector and weather hood.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.

B. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:

1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.

2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.

3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.

4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.

C. Install duct hangers and supports in accordance with SMACNA Standards, Chapter 4.

D. Install fire dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test.

E. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.

F. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 1.5 m (5 feet) long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hour. Support ducts SMACNA Standards.

G. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.

H. Control Damper Installation:

1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
2. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.

I. Air Flow Measuring Devices (AFMD): Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.

J. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as

determined by Resident Engineer. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

K. Installation of Underground Duct System:
   1. Follow manufacturer’s installation instructions.
   2. Excavate a trench evenly. Provide a sand of light gravel bedding material. Backfill material may consist of pea gravel, sand or excavated material. Tamper backfill material to hold in place. Do not allow heavy loads to travel over backfilled duct, as crushing may occur.
   3. Cut piping material with hand, circular, reciprocating, jig or chain saw.
   4. Apply gaskets, clamps, sealant, screws or bolts to connect ductwork.

3.2 DUCT LEAKAGE TESTS AND REPAIR

A. Leak testing company shall be independent of the sheet metal company employed by General Contractor.

B. Ductwork leak test shall be performed for the entire air distribution supply, return, exhaust system Section by Section including fans, coils and filter Section designated as static pressure class 750 Pa (3 inch W.G.) and above. All supply ductwork less than 500 Pa (3 inch W.G) shall also be tested where there is no air terminal units employed in the system.

C. Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.

D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.

E. All tests shall be performed in the presence of the Resident Engineer and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the Resident Engineer and identify leakage source with excessive leakage.

F. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Resident Engineer.

G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.

H. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

3.3 TESTING, ADJUSTING AND BALANCING (TAB)

Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.4 OPERATING AND PERFORMANCE TESTS

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

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SECTION 23 34 00
HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Fans for heating, ventilating and air conditioning.

B. Product Definitions: AMCA Publication 99, Standard l-66.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

D. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.

E. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

F. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

G. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

H. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

I. Section 23 82 16, AIR COILS.

J. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 QUALITY ASSURANCE

A. Refer to paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Fans and power ventilators shall be listed in the current edition of AMCA 26l, and shall bear the AMCA performance seal.

C. Operating Limits for Centrifugal Fans: AMCA 99 (Class I, II, and III).

D. Fans and power ventilators shall comply with the following standards:

   l. Testing and Rating: AMCA 2l0.

   2. Sound Rating: AMCA 300.

E. Vibration Tolerance for Fans and Power Ventilators: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

F. Performance Criteria:

   l. The fan schedule shall show the design air volume and static pressure. Select the fan motor HP by increasing the fan BHP by 10 percent to account for the drive losses and field conditions.

   2. Select the fan operating point as follows:

      a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point

      b. Air Foil, Backward Inclined, or Tubular: At or near the peak static efficiency

G. Safety Criteria: Provide manufacturer's standard screen on fan inlet and discharge where exposed to operating and maintenance personnel.

H. Corrosion Protection:

1. All steel shall be mill-galvanized, or phosphatized and coated with minimum two coats, corrosion resistant enamel paint. Manufacturers paint and paint system shall meet the minimum specifications of: ASTM D1735 water fog; ASTM B117 salt spray; ASTM D3359 adhesion; and ASTM G152 and G153 for carbon arc light apparatus for exposure of non-metallic material.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturers Literature and Data:

l. Fan sections, motors and drives.

2. Centrifugal fans, motors, drives, accessories and coatings.

a. In-line centrifugal fans.

C. Certified Sound power levels for each fan.

D. Motor ratings types, electrical characteristics and accessories.

E. Belt guards.

F. Maintenance and Operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

G. Certified fan performance curves for each fan showing cubic feet per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Air Movement and Control Association International, Inc. (AMCA):

99-86.....Standards Handbook

2l0-06.....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

26l-09.....Directory of Products Licensed to bear the AMCA Certified Ratings Seal - Published Annually

300-08.....Reverberant Room Method for Sound Testing of Fans

C. American Society for Testing and Materials (ASTM):

B117-07a.....Standard Practice for Operating Salt Spray (Fog) Apparatus

D1735-08.....Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus

D3359-08.....Standard Test Methods for Measuring Adhesion by Tape Test

G152-06.....Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Non-Metallic Materials

G153-04.....Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Non-Metallic Materials

D. Underwriters Laboratories, Inc. (UL):

181-2005.....Factory Made Air Ducts and Air Connectors

1.6 EXTRA MATERIALS

A. Provide one additional set of belts for all belt-driven fans.

PART 2 - PRODUCTS

2.1 FAN SECTION (CABINET FAN)

Refer to specification Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

2.2 CENTRIFUGAL FANS

A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE. Record factory vibration test results on the fan or furnish to the Contractor.

B. Fan arrangement, unless noted or approved otherwise:

l. DWDl fans: Arrangement 3.

C. Construction: Wheel diameters and outlet areas shall be in accordance with AMCA standards.

l. Housing: Low carbon steel, arc welded throughout, braced and supported by structural channel or angle iron to prevent vibration or pulsation, flanged outlet, inlet fully streamlined. Provide lifting clips, and casing drain. Provide manufacturer's standard access door. Provide 12.5 mm (1/2 inches) wire mesh screens for fan inlets without duct connections.

2. Wheel: Steel plate with die formed blades welded or riveted in place, factory balanced statically and dynamically.

3. Shaft: Designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fans class.

4. Bearings: Heavy duty ball or roller type sized to produce a Bl0 life of not less than 50,000 hours, and an average fatigue life of 200,000

hours. Extend filled lubrication tubes for interior bearings or ducted units to outside of housing.

5. Belts: Oil resistant, non-sparking and non-static.
6. Belt Drives: Factory installed with final alignment belt adjustment made after installation.
7. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15HP, fixed pitch for use with motors larger than 15HP. Select pulleys so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
8. Motor, adjustable motor base, drive and guard: Furnish from factory with fan. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for specifications. Provide protective sheet metal enclosure for fans located outdoors.
9. Furnish variable speed fan motor controllers where shown on the drawings. Refer to Section, MOTOR STARTERS. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for controller/motor combination requirements.

D. In-line Centrifugal Fans: In addition to the requirements of paragraphs A and 2.2.C3 thru 2.2.C9, provide minimum 18 Gauge galvanized steel housing with inlet and outlet flanges, backward inclined aluminum centrifugal fan wheel, bolted access door and supports as required. Motors shall be factory pre-wired to an external junction box. Provide factory wired disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fan, motor and drive in accordance with manufacturer's instructions.
B. Align fan and motor sheaves to allow belts to run true and straight.
C. Bolt equipment to curbs with galvanized lag bolts.
D. Install vibration control devices as shown on drawings and specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

3.2 PRE-OPERATION MAINTENANCE

A. Lubricate bearings, pulleys, belts and other moving parts with manufacturer recommended lubricants.
B. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.
C. Clean fan interiors to remove foreign material and construction dirt and dust.

3.3 START-UP AND INSTRUCTIONS

A. Verify operation of motor, drive system and fan wheel according to the drawings and specifications.

B. Check vibration and correct as necessary for air balance work.

C. After air balancing is complete and permanent sheaves are in place perform necessary field mechanical balancing to meet vibration tolerance in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

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SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

Air terminal units.

1.2 RELATED WORK

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.

B. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise requirements.

C. Section 23 31 00, HVAC DUCTS AND CASINGS: Ducts and flexible connectors.

D. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Valve operators.

E. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Flow rates adjusting and balancing.

F. Section 23 82 16, AIR COILS: Heating and Cooling Coils pressure ratings.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data:

1. Air Terminal Units: Submit test data.

C. Certificates:

1. Compliance with paragraph, QUALITY ASSURANCE.
2. Compliance with specified standards.

D. Operation and Maintenance Manuals: Submit in accordance with paragraph, INSTRUCTIONS, in Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Air Conditioning and Refrigeration Institute (AHRI)/(ARI):
880-08.....Air Terminals Addendum to ARI 888-98 incorporated into standard posted 15th December 2002

C. National Fire Protection Association (NFPA):
90A-09.....Standard for the Installation of Air Conditioning and Ventilating Systems

D. Underwriters Laboratories, Inc. (UL):
181-08.....Standard for Factory-Made Air Ducts and Air Connectors

E. American Society for Testing and Materials (ASTM):
C 665-06.....Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

1.6 GUARANTY

In accordance with the GENERAL CONDITIONS

PART 2 - PRODUCTS

2.1 GENERAL

A. Coils:
1. Refer to Drawings and Section 23 82 16, AIR COILS for additional coil requirements.
2. Water Heating Coils:
a. ARI certified, continuous plate or spiral fin type, leak tested at 2070 kPa (300 PSI).
b. Capacity: As indicated, based on scheduled entering water temperature.
c. Headers: Copper or Brass.
d. Fins: Aluminum, maximum 315 fins per meter (8 fins per inch).
e. Tubes: Copper, arrange for counter-flow of heating water.
f. Water Flow Rate: Minimum 0.032 Liters/second (0.5 GPM).
g. Provide vent and drain connection at high and low point, respectively of each coil.
h. Coils shall be guaranteed to drain.

B. Labeling: Control box shall be clearly marked with an identification label that lists such information as nominal CFM, maximum and minimum factory-set airflow limits, coil type and coil connection orientation, where applicable.

C. Factory calibrate air terminal units to air flow rate indicated. All settings including maximum and minimum air flow shall be field adjustable.

D. Dampers with internal air volume control: See section 23 31 00 HVAC DUCTS and CASINGS.

2.2 AIR TERMINAL UNITS (BOXES)

A. General: Factory built, pressure independent units, factory set-field adjustable air flow rate, suitable for single duct applications. Use of dual-duct air terminal units is not permitted. Clearly show on each unit the unit number and factory set air volumes corresponding to the contract drawings. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC work assumes factory set air volumes. Coordinate flow controller sequence and damper operation details with the drawings and Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. All air terminal units shall be brand new products of the same manufacturer.

B. Capacity and Performance: The Maximum Capacity of a single terminal unit shall not exceed 566 Liters/second (1,200 CFM) with the exception of operating rooms and Cystoscopy rooms, which shall be served by a single air terminal unit at a maximum of 1,250 Liters/second (3,000 CFM).

C. Sound Power Levels:
Acoustic performance of the air terminal units shall be based on the design noise levels for the spaces stipulated in Section 23 05 41 (Noise and Vibration Control for HVAC Piping and Equipment). Equipment schedule (…) shall show the sound power levels in all octave bands. Terminal sound attenuators shall be provided, as required, to meet the intent of the design.

D. Casing: Unit casing shall be constructed of galvanized steel no lighter than 0.85 mm (22 Gauge). Air terminal units serving the operating rooms and Cystoscopy rooms shall be fabricated without lining. Provide hanger brackets for attachment of supports.

1. Lining material: Suitable to provide required acoustic performance, thermal insulation and prevent sweating. Meet the requirements of NFPA 90A and comply with UL 181 for erosion as well as ASTMC 665 antimicrobial requirements. Insulation shall consist of 13 mm (1/2 IN) thick non-porous foil faced rigid fiberglass insulation of 4-lb/cu.ft, secured by full length galvanized steel z-strips which

enclose and seal all edges. Tape and adhesives shall not be used. Materials shall be non-friable and with surfaces, including all edges, fully encapsulated and faced with perforated metal or coated so that the air stream will not detach material. No lining material is permitted in the boxes serving operating rooms and Cystoscopy rooms.

2. Access panels (or doors): Provide panels large enough for inspection, adjustment and maintenance without disconnecting ducts, and for cleaning heating coils attached to unit, even if there are no moving parts. Panels shall be insulated to same standards as the rest of the casing and shall be secured and gasketed airtight. It shall require no tool other than a screwdriver to remove.
3. Total leakage from casing: Not to exceed 2 percent of the nominal capacity of the unit when subjected to a static pressure of 750 Pa (3 inch WG), with all outlets sealed shut and inlets fully open.
4. Octopus connector: Factory installed, lined air distribution terminal. Provide where flexible duct connections are shown on the drawings connected directly to terminals. Provide butterfly-balancing damper, with locking means in connectors with more than one outlet. Octopus connectors and flexible connectors are not permitted in the Surgical Suite.

E. Construct dampers and other internal devices of corrosion resisting materials which do not require lubrication or other periodic maintenance.
   1. Damper Leakage: Not greater than 2 percent of maximum rated capacity, when closed against inlet static pressure of 1 kPa (4 inch WG).
F. Provide multi-point velocity pressure sensors with external pressure taps.
   1. Provide direct reading air flow rate table pasted to box.
G. Provide static pressure tubes.
H. Externally powered DDC variable air volume controller and damper actuator to be furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for factory mounting on air terminal units. The DDC controller shall be electrically actuated.

I. Fan powered terminal units:

1. General: The fan will be in a series configuration inside the unit casing.
2. Fan assembly: Forward curved centrifugal direct drive blower with adjustable speed controller.
   a. Motor: Integral thermal overload protection.
      1) 115 V single phase.
   b. Motor assembly: Completely isolated from cabinet with rubber vibration mounts.
3. Wiring: Factory mounted and wire controls. Mount electrical components NEMA-1 control box with removable cover. Incorporate single point electrical connection to power source. Provide terminal strip in control box for field wiring of power source. Provide factory wired non-fused disconnect switch on each terminal unit.
4. Provide 1-inch thick throwaway filter in the return air inlet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Work shall be installed as shown and according to the manufacturer’s diagrams and recommendations.

B. Handle and install units in accordance with manufacturer's written instructions.

C. Support units rigidly so they remain stationary at all times. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

D. Locate air terminal units to provide a straight section of inlet duct for proper functioning of volume controls. See VA Standard Detail.

3.2 OPERATIONAL TEST

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

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SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Air Outlets and Inlets: Diffusers, Registers, Grilles, Filter Grilles, and Displacement Diffusers.

1.2 RELATED WORK

A. Outdoor and Exhaust Louvers: Section 08 90 00, LOUVERS AND VENTS.

B. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

D. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

1.3 QUALITY ASSURANCE

A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Fire Safety Code: Comply with NFPA 90A.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data:

1. Diffusers, registers, grilles and accessories.

C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Air Diffusion Council Test Code:

1062 GRD-84.....Certification, Rating, and Test Manual 4th Edition

C. American Society of Civil Engineers (ASCE):

ASCE7-05.....Minimum Design Loads for Buildings and Other Structures

D. American Society for Testing and Materials (ASTM):

A167-99 (2004).....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

B209-07.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

E. National Fire Protection Association (NFPA):

90A-09.....Standard for the Installation of Air Conditioning and Ventilating Systems

F. Underwriters Laboratories, Inc. (UL):

181-08.....UL Standard for Safety Factory-Made Air Ducts and Connectors

PART 2 - PRODUCTS

2.1 EQUIPMENT SUPPORTS

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 AIR OUTLETS AND INLETS

A. Materials:

1. Aluminum only. Provide manufacturer's standard gasket.
2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless steel.
3. Contractor shall review all ceiling drawings and details and provide all ceiling mounted devices with appropriate dimensions and trim for the specific locations.

B. Performance Test Data: In accordance with Air Diffusion Council Code 1062GRD. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT for NC criteria.

C. Air Supply Outlets:

1. Ceiling Diffusers: Suitable for surface mounting, exposed T-bar or special tile ceilings, off-white finish, square or round neck connection as shown on the drawings. Provide plaster frame for units in plaster ceilings.
   a. Square, louver, fully adjustable pattern: Round neck, surface mounting unless shown otherwise on the drawings. Provide equalizing or control grid and volume control damper.
   b. Perforated face type: Manual adjustment for one-, two-, three-, or four-way horizontal air distribution pattern without change of air volume or pressure. Provide equalizing or control grid and opposed blade over overlapping blade damper. Perforated face diffusers for VAV systems shall have the pattern controller on the inner face, rather than in the neck and designed to discharge air horizontally at the ceiling maintaining a Coanda effect.

c. Slot diffuser/plenum:
   1) Diffuser: Frame and support bars shall be constructed of heavy gauge extruded aluminum. Form slots or use adjustable pattern controllers, to provide stable, horizontal air flow pattern over a wide range of operating conditions.
   2) Galvanized steel boot lined with 13 mm (1/2 inch) thick fiberglass conforming to NFPA 90A and complying with UL 181 for erosion. The internal lining shall be factory-fabricated, anti-microbial, and non-friable.
   3) Provide inlet connection diameter equal to duct diameter shown on drawings or provide transition coupling if necessary. Inlet duct and plenum size shall be as recommended by the manufacturer.
   4) Maximum pressure drop at design flow rate: 37 Pa (0.15 inch W.G.)

2. Linear Bar Grilles and Diffusers: Extruded aluminum, manufacturer's standard finish, and positive holding concealed fasteners.
   a. Margin Frame: Flat, 20 mm (3/4 inch) wide.
   b. Bars: Minimum 5 mm (3/16 inch) wide by 20 mm (3/4 inch) deep, zero deflection unless otherwise shown. Bar spacing shall be a minimum of 3 mm (1/8 inch) on center. Reinforce bars on 450 mm (18 inch) center for sidewall units and on 150 mm (6 inch) center for units installed in floor or sills.
   c. Provide opposed blade damper and equalizing or control grid where shown.
3. Supply Registers: Double deflection type with horizontal face bars and opposed blade damper with removable key operator.
   a. Margin: Flat, 30 mm (1-1/4 inches) wide.
   b. Bar spacing: 20 mm (3/4 inch) maximum.
   c. Finish: Off white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded with manufacturer's standard finish.
4. Supply Grilles: Same as registers but without the opposed blade damper.

D. Return and Exhaust Registers and Grilles: Provide opposed blade damper without removable key operator for registers.
   1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded aluminum with manufacturer's standard aluminum finish.

2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 30 mm (1-1/4 inch) margin.
3. Perforated Face Type: To match supply units.
4. Linear Type: To match supply units.

2.3 FILTER RETURN/EXHAUST GRILLE

A. Provide grille with in stream 1-inch deep MERV 4 filter and removable face.
   1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have manufacturer's standard aluminum finish.
   2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 30 mm (1-1/4 inch) margin.
   3. Aluminum.
   4. Standard face connected to a mounting frame with space for a throwaway filter. Hold face closed by a locking screw. Provide retaining clips to hold filter in place. Provide fiberglass throwaway filter.

2.4 RADIAL DISPLACEMENT DIFFUSERS

A. Supply and install 180 Degree Supply Radial Displacement diffuser of the sizes and capacities indicated on the drawings or diffuser schedule.
B. The 180 Degree Supply Radial Displacement diffuser shall be constructed with an equalization baffle behind the operative diffuser face for uniform, low velocity, distribution of supply air. Both the equalization baffle and face shall be securely retained in the diffuser frames. The diffuser frames shall be constructed of high strength aluminum extrusion for rigidity and protection of the operative face panel. There shall be no visible fasteners on the front panel. The operative face shall be constructed of painted high-gauge steel, side and end panels may be provided in painted steel. The frame and internal baffling elements shall be constructed of aluminum. The paint shall be powder coat polyester. Visible non-metallic components are unacceptable. The diffuser shall be supplied with concealed mounting brackets that do not require puncturing the diffuser to install.
C. The diffuser shall be available for duct connection into any non-operative panel. Air shall be delivered to the space at low noise levels and low velocities that are even across the diffuser face, in all ducting configurations.
D. Diffuser manufacturer shall provide sound and pressure drop data derived from tests in accordance with ASHRAE standard 70-1991. Performance data for adjacent zone shall be provided based on test in accordance with

Nordtest method, Air Terminal Devices: Aerodynamic Testing + Rating at Low Velocity NT VVS 083.

E. Base:
   1. Supply and install a base under each displacement diffuser. The base shall be manufactured by the displacement diffuser manufacturer. The base shall allow for removal from the space for access to the inlet of the diffuser if ducted from below.
   2. The base shall have an extruded aluminum frame and 22 gauge solid steel face. Base heights shall be as indicated on the drawings. Finish shall be white.

F. Duct Cover:
   1. Supply and install a duct cover over each displacement diffuser. The duct cover shall be manufactured by the displacement diffuser manufacturer. The duct cover shall allow for removal from the space for access to the inlet of the diffuser if ducted from below.

2.5 FLAT FACED DISPLACEMENT DIFFUSERS

A. Supply and install Flat Faced Wall Mounted Displacement diffuser of the sized and capacities indicated on the drawings or diffuser schedule.

B. The 1-Way Flat Faced Wall Mounted Displacement diffuser shall be constructed with an equalization baffle behind the operative diffuser face for uniform, low velocity, distribution of supply air. Both the equalization baffle and face shall be securely retained in the diffuser frame. The diffuser frame shall be constructed of rolled steel for rigidity and protection of the operative face. The operative face shall be constructed of painted high-gauge steel, the wall plenum may be satin coat steel. The internal baffling elements shall be constructed of aluminum. The paint shall be powder coat polyester. Epoxies and their derivatives are unacceptable. Visible non-metallic components are unacceptable.

C. Air shall be delivered to the space at low noise levels and low velocities that are even across the diffuser face, in all ducting configurations.

D. Diffuser manufacturer shall provide sound and pressure drop data derived from tests in accordance with ASHRAE standard 70-1991. Performance data for adjacent zone shall be provided based on test in accordance with Nordtest method, Air Terminal Devices: Aerodynamic Testing + Rating at Low Velocity NT VVS 083.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.

B. Protection and Cleaning: Protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by Resident Engineer. Protect equipment during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

3.2 TESTING, ADJUSTING AND BALANCING (TAB)

Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.3 OPERATING AND PERFORMANCE TESTS

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

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SECTION 23 40 00
HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Air filters for heating, ventilating and air conditioning.

B. Definitions: Refer to ASHRAE Standard 52.1 for definitions of face velocity, net effective filtering area, media velocity, resistance pressure drop), atmospheric dust spot efficiency and dust-holding capacity. ASHRAE Standard 52.1 measures arrestance, dust spot efficiency and dust holding capacity of filters.

C. Refer to ASHRAE Standard 52.2 for definitions of MERV (Minimum Efficiency Reporting Value), PSE (Particle Size Efficiency) and particle size ranges for each MERV number. ASHRAE Standard 52.2 measures particle size efficiency (PSE).

1.2 RELATED WORK

A. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Filter housing and racks: Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

1.3 QUALITY ASSURANCE

A. Air Filter Performance Report for Extended Surface Filters:

1. Submit a test report for each Grade of filter being offered. The report shall not be more than three (3) years old and prepared by using test equipment, method and duct section as specified by ASHRAE Standards 52.1 and 52.2 for type filter under test and acceptable to Resident Engineer, indicating that filters comply with the requirements of this specification. Test for 150 m/min (500 fpm) will be accepted for lower velocity rated filters provided the test report of an independent testing laboratory complies with all the requirements of this specification.

2. Government Option: The Government at its option may take one of the filters for each different type submitted and run an independent test to determine if the filter meets the requirements of this specification. When the filter meets the requirements, the Government will pay for the test. When the filter does not meet the specification requirements, the manufacturer will be required to pay for the test and replace the filters with filters that will perform as required by the specifications.

3. Guarantee Performance: The manufacturer shall supply ASHRAE 52.2 test reports on each filter type submitted. Any filter supplied will be required to maintain the minimum efficiency shown on the ASHRAE Standard 52.2 report throughout the time the filter is in service. Within the first 6-12 weeks of service a filter may be pulled out of service and sent to an independent laboratory for ASHRAE Standard 52.2 testing for initial efficiency only. If this filter fails to meet the minimum level of efficiency shown in the previously submitted reports, the filter manufacturer/distributor shall take back all filters and refund the owner all monies paid for the filters, cost of installation, cost of freight and cost of testing.

B. Filter Warranty for Extended Surface Filters: Guarantee the filters against leakage, blow-outs, and other deficiencies during their normal useful life, up to the time that the filter reaches the final pressure drop. Defective filters shall be replaced at no cost to the Government.

C. Comply with UL Standard 586 for flame test.

D. Nameplates: Each filter shall bear a label or name plate indicating manufacturer's name, filter size, rated efficiency, UL classification, and file number.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Extended surface filters.
2. Holding frames. Identify locations.
3. Side access housings. Identify locations, verify insulated doors.
4. HEPA filters.
5. Magnehelic gages.

C. Air Filter performance reports.

D. Suppliers warranty.

E. Field test results for HEPA filters as per paragraph 2.3.E.3.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE):

52.1-92R.....Gravimetric and Dust-Spot procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter

52.2-2007.....Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

C. American Society of Mechanical Engineers (ASME):

NQA-1-2008.....Quality Assurance Requirements for Nuclear Facilities Applications

D. Underwriters Laboratories, Inc. (UL):

586;Amendment 20 March 2000 High-Efficiency, Particulate, Air Filter Units

900;Revision 15 July 2009 Test Performance of Air Filter Units

PART 2 - PRODUCTS

2.1 REPLACEMENT FILTER ELEMENTS TO BE FURNISHED

A. To allow temporary use of HVAC systems for testing and in accordance with Paragraph, TEMPORARY USE OF MECHANICAL AND ELECTRICAL SYSTEMS in Section 01 00 00, GENERAL REQUIREMENTS, provide one complete set of spare filters to the Resident Engineer.

B. The Resident Engineer will direct whether these additional filters will either be installed as replacements for dirty units or turned over to VA for future use as replacements.

2.2 EXTENDED SURFACE AIR FILTERS

A. Use factory assembled air filters of the extended surface type with supported or non-supported cartridges for removal of particulate matter in air conditioning, heating and ventilating systems. Filter units shall be of the extended surface type fabricated for disposal when the dust-load limit is reached as indicated by maximum (final) pressure drop.

B. Filter Classification: UL approved Class 1 or Class 2 conforming to UL Standard 900.

C. Filter Grades, Percent, Average ASHRAE Efficiency and Controlled Containment:

Table 2.2C

Filter Grades				
MERV Value ASHRAE 52.2	Application	Dust-Spot Efficiency ASHRAE 52.1	Particle Size	Thickness /Type
8	Pre-Filter	30 to 35%	3 to 10 Microns	50 mm (2-inch) Throwaway
14	After-Filter	90 to 95%	0.3 to 1 Micron	300 mm (12-inch) Rigid Cartridge

D. Filter Media:
   1. MERV 14 Supported (Rigid Pleated) Type: Media shall be composed of high density glass fibers or other suitable fibers. Fastening methods used to maintain pleat shape, (metal backing or aluminum separators) shall be sealed in a proper enclosing frame to insure no air leakage for life of filter. Staples and stays are prohibited.
   2. MERV 8 (Pleated) Type: Media shall be composed of synthetic/natural fibers. Media shall maintain uniform pleat shape and stability for proper air flow and maximum dust loading. The media frame shall be constructed of aluminized steel. Bond the pleated media pack on all four edges to insure no air leakage for the life of the filter. Staples and stays are prohibited.

E. Filter Efficiency and Arrestance: Efficiency and arrestance of filters shall be determined in accordance with ASHRAE Standard 52.1, and MERV value in accordance with ASHRAE Standard 52.2.

F. Maximum initial resistance, recommended change over pressure drop, and maximum recommended final resistance, PA (inches of water), for each filter cartridge when operated at 150 m/min (500 feet per minute) face velocity shall be as specified in Table 2.2.F:

Table 2.2.F

Filter Initial and Final Resistance			
	Initial Resistance	Maximum Recommended Change Over Pressure Drop	Maximum Final Resistance
MERV 8 (2-inch deep)	95 (0.38)	190 (0.76)	250 (1.00)
MERV 14 (12-inch deep)	170 (0.68)	340 (1.36)	375 (1.50)

G. Side Servicing Housings:
   1. Minimum 1.6 mm (l6 Gauge) galvanized steel, or aluminum, completely factory assembled with upstream and downstream flanges for connection into the duct system. Furnish housing length sufficient to provide for fully extended operating filter elements.
   2. Access doors: Double wall insulated, located on one side of the housing; with continuous gasketing on the perimeter and positive locking devices. Provide access doors on both sides only when required as shown on drawings. Design doors to withstand a minimum positive/negative 1.0 kPa (4 inch WG) static pressure. Furnish access doors that are the full size of the housing.
   3. Filter slide channels: Channels shall incorporate a positive-sealing gasket material to seal the top and bottom of the filter cartridge frames to prevent bypass. Provide factory installed gasketing to prevent leakage between cartridges, and between cartridges and doors.

H. Holding Frame System:
   1. Minimum 1.6 mm (l6 Gauge) galvanized steel, 100 mm (4 inches) deep, factory-supplied hardware necessary for field assembly, suitable for either upstream or downstream filter servicing. All members shall be cut to size and prepunched for easy assembly into modules of the size and capacity noted in the schedules.
   2. The framing members shall be permanently gasketed to prevent the bypass of unfiltered air. If required, furnish suitable vertical support members to prevent deflection of horizontal members. The vertical support members shall not interfere with either the installation or operation of the filters.
   3. The framing system shall incorporate a factory installed positive sealing device for each row of filters. This device shall allow for

easy installation and removal of cartridges and shall insure the seal between the gasketed filter elements while the bank is in operation.

I. Equipment Identification: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.4 INSTRUMENTATION

A. Magnehelic Differential Pressure Filter Gages: Nominal 100 mm (four inch) diameter, zero to 500 Pa (zero to two inch water gage), three inch for HEPA) range. Gauges shall be flush-mounted in aluminum panel board, complete with static tips, copper or aluminum tubing, and accessory items to provide zero adjustment.

B. DDC static (differential) air pressure measuring station. Refer to Specification Section 23 09 23 DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

C. Provide one DDC sensor across each extended surface filter. Provide Petcocks for each gauge or sensor.

D. Provide one common filter gauge for two-stage filter banks with isolation valves to allow differential pressure measurement.

2.5 HVAC EQUIPMENT FACTORY FILTERS

A. Manufacturer standard filters within fabricated packaged equipment should be specified with the equipment and should adhere to industry standard.

B. Cleanable filters are not permitted.

2.6 FILTER RETURN GRILLES

A. Refer to Section 23 37 00 AIR OUTLETS AND INLETS.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install supports, filters and gages in accordance with manufacturer's instructions.

B. Label clearly with words "Contaminated Air" on exhaust ducts leading to the HEPA filter housing.

3.2 START-UP AND TEMPORARY USE

A. Clean and vacuum air handling units and plenums prior to starting air handling systems.

B. Install or deliver replacement filter units as directed by the Resident Engineer.

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SECTION 23 73 00
INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Air handling units including integral components specified herein.

B. Definitions: Air Handling Unit (AHU): A factory fabricated and tested assembly of modular sections consisting of fan, coils, filters, and other necessary equipment to perform one or more of the following functions of circulating, cleaning, heating, cooling, dehumidifying, and mixing of air. Design capacities of units shall be as scheduled on the drawings.

1.2 RELATED WORK

A. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Sound and vibration requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

C. Piping and duct insulation: Section 23 07 11, HVAC INSULATION.

D. Piping and valves: Section 23 21 13, HYDRONIC PIPING.

E. Heating and cooling coils and pressure requirements: Section 23 82 16, AIR COILS.

F. Return and exhaust fans: Section 23 34 00, HVAC FANS.

G. Requirements for flexible duct connectors and air leakage: Section 23 31 00, HVAC DUCTS and CASINGS.

H. Air filters and filters' efficiency: Section 23 40 00, HVAC AIR CLEANING DEVICES.

I. HVAC controls: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

J. Testing, adjusting and balancing of air and water flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

K. Types of motors: Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC.

L. Types of motor starters: Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 QUALITY ASSURANCE

A. Refer to Article, Quality Assurance, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Air Handling Units Certification: Certify air-handling units in accordance with ARI 430.

C. Heating, Cooling, and Air Handling Capacity and Performance Standards: ARI 430, ARI 410, ASHRAE 51, and AMCA 210.

D. Performance Criteria:
   1. The fan schedule indicates design CFM – Design Cubic Feet per Minute – followed by L/s – Liters per Second in brackets. The Fan motor BHP (KW) at the operating point on the fan curves shall be increased by 10% (safety factor) to cover the drive losses and field conditions. The fan motor shall be selected within the rated nameplate capacity, without relying upon NEMA Standard Service Factor.
   2. Select the fan operating point as follows:
      a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point.
      b. Air Foil, Backward Inclined: At or near the peak static efficiency.
   3. Operating Limits: AMCA 99.
E. Units shall be constructed by a manufacturer who has been manufacturing air handling units for at least five (5) years.

1.4. SUBMITTALS:

A. The contractor shall, in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish a complete submission for all air handling units covered in the project. The submission shall include all information listed below. Partial and incomplete submissions shall be rejected without reviews.
B. Manufacturer's Literature and Data:
   1. Submittals for AHUs shall include fans, drives, motors, coils, humidifiers, mixing box with outside/return air dampers, filter housings, and all other related accessories. The contractor shall provide custom drawings showing total air handling unit assembly including dimensions, operating weight, access sections, flexible connections, door swings, controls penetrations, electrical disconnect, lights, duplex receptacles, switches, wiring, utility connection points, unit support system, vibration isolators, drain pan, pressure drops through each component (filter, coil etc).
   2. Submittal drawings of section or component only will not be acceptable. Contractor shall also submit performance data including performance test results, charts, curves or certified computer selection data; data sheets; fabrication and insulation details. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements. This data shall be submitted in hard copies and in electronic version

compatible to AutoCAD version used by the VA at the time of submission.

3. Submit sound power levels in each octave band for fan and at entrance and discharge of AHUs at scheduled conditions. In absence of sound power ratings refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
4. Provide fan curves showing Liters/Second (cubic feet per minute), static pressure, efficiency, and horsepower for design point of operation and at maximum design Liters/Second (cubic feet per minute).
5. Submit total fan static pressure, external static pressure, for AHU including total, inlet and discharge pressures, and itemized specified internal losses and unspecified internal losses. Refer to air handling unit schedule on drawings.

C. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS. Include instructions for lubrication, filter replacement, motor and drive replacement, spare part lists, and wiring diagrams.

D. Submit written test procedures two weeks prior to factory testing. Submit written results of factory tests for approval prior to shipping.

E. Submit shipping information that clearly indicates how the units will be shipped in compliance with the descriptions below.

1. Units shall be shipped in one (1) piece where possible and in shrink wrapping to protect the unit from dirt, moisture and/or road salt.
2. If not shipped in one (1) piece, provide manufacturer approved shipping splits where required for installation or to meet shipping and/or job site rigging requirements in modular sections. Indicate clearly that the shipping splits shown in the submittals have been verified to accommodate the construction constraints for rigging as required to complete installation and removal of any section for replacement through available access without adversely affecting other sections.
3. If shipping splits are provided, each component shall be individually shrink wrapped to protect the unit and all necessary hardware (e.g. bolts, gaskets etc.) will be included to assemble unit on site (see section 2.1.A4).
4. Lifting lugs will be provided to facilitate rigging on shipping splits and joining of segments. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each

unit will have to be broken into to meet shipping and job site rigging requirements.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI)/(ARI):
410-01.....Standard for Forced-Circulation Air-Heating and Air-Cooling Coils
430-09.....Central Station Air Handling Units

C. Air Movement and Control Association International, Inc. (AMCA):
210-07.....Laboratory Methods of Testing Fans for Rating

D. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE):
170-2008.....Ventilation of Health Care Facilities

E. American Society for Testing and Materials (ASTM):
ASTM B117-07a.....Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D1654-08.....Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D1735-08.....Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
ASTM D3359-08.....Standard Test Methods for Measuring Adhesion by Tape Test

F. Military Specifications (Mil. Spec.):
MIL-P-21035B-2003.....Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

G. National Fire Protection Association (NFPA):
NFPA 90A.....Standard for Installation of Air Conditioning and Ventilating Systems, 2009

H. Energy Policy Act of 2005 (P.L.109-58)

PART 2 - PRODUCTS

2.1 AIR HANDLING UNITS

A. General:

1. AHUs shall be entirely of double wall galvanized steel construction without any perforations except as specified in section 2.1.C.2. Casing is specified in paragraph 2.1.C. Foil face lining is not an acceptable substitute for double wall construction. Galvanizing shall

be hot dipped conforming to ASTM A525 and shall provide a minimum of 0.275 kg of zinc per square meter (0.90 oz. of zinc per square foot) (G90). Aluminum constructed units may be provided subject to VA approval and documentation that structural rigidity is equal or greater than the galvanized steel specified.

2. The contractor and the AHU manufacturer shall be responsible for insuring that the unit will not exceed the allocated space shown on the drawings, including required clearances for service and future overhaul or removal of unit components. All structural, piping, wiring, and ductwork alterations of units, which are dimensionally different than those specified, shall be the responsibility of the contractor at no additional cost to the government.
3. AHUs shall be fully assembled by the manufacturer in the factory in accordance with the arrangement shown on the drawings. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. All units shall be fully assembled, tested and then split to accommodate shipment and job site rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include air flow direction to facilitate assembly at the job site. Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit.
4. The AHU manufacturer shall provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. The manufacturer shall provide a local representative at the job site to supervise the assembly and to assure the units are assembled to meet manufacturer's recommendations and requirements noted on the drawings. Provide documentation that this representative has provided this service on similar jobs to the Contracting Officer. If a local representative cannot be provided, the manufacturer shall provide a factory representative.
5. Gaskets: All door and casing and panel gaskets and gaskets between air handling unit components, if joined in the field, shall be high quality which seal air tight and retain their structural integrity and sealing capability after repeated assembly and disassembly of bolted panels and opening and closing of hinged components. Bolted sections may use a more permanent gasketing method provided they are not disassembled.

6. Structural Rigidity: Provide structural reinforcement when required by span or loading so that the deflection of the assembled structure shall not exceed 1/200 of the span based on a differential static pressure of 1991 PA (8 inch WG) or higher.

B. Base:

1. Provide a heavy duty steel base for supporting all major AHU components. Bases shall be constructed of wide-flange steel I-beams, channels, or minimum 125 mm (5 inch) high 3.5 mm (10 Gauge) steel base rails. Welded or bolted cross members shall be provided as required for lateral stability. Contractor shall provide supplemental steel supports as required to obtain proper operation heights for cooling coil condensate drain as shown on drawings.
2. AHUs shall be completely self supporting for installation on concrete housekeeping pad.
3. The AHU bases not constructed of galvanized steel shall be cleaned, primed with a rust inhibiting primer, and finished with rust inhibiting exterior enamel.

C. Casing (including wall, floor and roof):

1. General: AHU casing shall be constructed as solid double wall, galvanized steel insulated panels without any perforations, integral of or attached to a structural frame. The thickness of insulation, mode of application and thermal breaks shall be such that there is no visible condensation on the exterior panels of the AHU located in the non-conditioned spaces.
2. Casing Construction:

Table 2.1.C.2

Outer Panel	0.8 mm (22 Gage) Minimum
Inner Panel	0.8 mm (22 Gage) Minimum
Insulation Thickness Density	Foam 50 mm (2 inch) Minimum 48 kg/m^3 (3.0 lb/ft^3) Minimum
Total R Value	2.3 m^2.K/W (13.0 ft^2.^{o}F.hr/Btu) Minimum

3. Casing Construction (Contractor’s Option):

Table 2.1.C.3

Outer Panel	1.3 mm (18 Gage) Minimum
Inner Panel	1.0 mm (20 Gage) Minimum
Insulation Thickness	Fiberglass 50 mm (2 inch) Minimum

Density	24 kg/m^3 (1.5 lb/ft^3) Minimum
Total R Value	1.4 m^2.K/W (8.0 ft^2.^{0}F.hr/Btu) Minimum

4. Blank-Off: Provide blank-offs as required to prevent air bypass between the AHU sections, around coils, and filters.
5. Casing panels shall be secured to the support structure with stainless steel or zinc-chromate plated screws and gaskets installed around the panel perimeter. Panels shall be completely removable to allow removal of fan, coils, and other internal components for future maintenance, repair, or modifications. Welded exterior panels are not acceptable.
6. Access Doors: Provide in each access section and where shown on drawings. Doors shall be a minimum of 50 mm (2 inch) thick with same double wall construction as the unit casing. Doors shall be a minimum of 600 mm (24 inches) wide, unless shown of different size on drawings, and shall be the full casing height up to a maximum of 1850 mm (6 feet). Doors shall be gasketed, hinged, and latched to provide an airtight seal. The access doors for fan section, mixing box, coil section shall include a minimum 150 mm x 150 mm (6 inch x 6 inch) double thickness, with air space between the glass panes tightly sealed, reinforced glass or Plexiglas window in a gasketed frame.
   a. Hinges: Manufacturers standard, designed for door size, weight and pressure classifications. Hinges shall hold door completely rigid with minimum 45 kg (100 lb) weight hung on latch side of door.
   b. Latches: Non-corrosive alloy construction, with operating levers for positive cam action, operable from either inside or outside. Doors that do not open against unit operating pressure shall allow the door to ajar and then require approximately 0.785 radian (45 degrees) further movement of the handle for complete opening. Latch shall be capable of restraining explosive opening of door with a force not less than 1991 Pa (8 inch WG).
   c. Gaskets: Neoprene, continuous around door, positioned for direct compression with no sliding action between the door and gasket. Secure with high quality mastic to eliminate possibility of gasket slipping or coming loose.
7. Provide sealed sleeves, metal or plastic escutcheons or grommets for penetrations through casing for power and temperature control wiring and pneumatic tubing. Coordinate with electrical and temperature

control subcontractors for number and location of penetrations. Coordinate lights, switches, and duplex receptacles and disconnect switch location and mounting. All penetrations and equipment mounting may be provided in the factory or in the field. All field penetrations shall be performed neatly by drilling or saw cutting. No cutting by torches will be allowed. Neatly seal all openings airtight.

D. Floor:

1. Unit floor shall be level without offset space or gap and designed to support a minimum of 488 kg/square meter (100 lbs per square foot) distributed load without permanent deformation or crushing of internal insulation. Provide adequate structural base members beneath floor in service access sections to support typical service foot traffic and to prevent damage to unit floor or internal insulation. Unit floors in casing sections, which may contain water or condensate, shall be watertight with drain pan.
2. Where indicated, furnish and install floor drains, flush with the floor, with nonferrous grate cover and stub through floor for external connection.

E. Condensate Drain Pan: Drain pan shall be designed to extend entire length of cooling coils including headers and return bends. Depth of drain pan shall be at least 43 mm (1.7 inches) and shall handle all condensate without overflowing. Drain pan shall be double-wall, double sloping type, and fabricated from stainless (304) with at least 50 mm (2 inch) thick insulation sandwiched between the inner and outer surfaces. Drain pan shall be continuous metal or welded watertight. No mastic sealing of joints exposed to water will be permitted. Drain pan shall be placed on top of casing floor or integrated into casing floor assembly. Drain pan shall be pitched in all directions to drain line.

1. An intermediate, stainless-steel (304) condensate drip pan with copper downspouts shall be provided on stacked cooling coils. Use of intermediate condensate drain channel on upper casing of lower coil is permissible provided it is readily cleanable. Design of intermediate condensate drain shall prevent upper coil condensate from flowing across face of lower coil.
2. Drain pan shall be piped to the exterior of the unit. Drain pan shall be readily cleanable.
3. Installation, including frame, shall be designed and sealed to prevent blow-by.

F. Fans Sections:

1. Fans shall be minimum Class II construction, double width, double inlet centrifugal, air foil or backward inclined or forward curved type as indicated on drawings, factory balanced and rated in accordance with AMCA 210 or ASHRAE 51. Provide self-aligning, pillow block, regreasable ball-type bearings selected for a B (10) life of not less than 50,000 hours and an L (50) average fatigue life of 200,000 hours per AFBMA Standard 9. Extend bearing grease lines to motor and drive side of fan section. Fan shall be located in airstream to assure proper air flow.
2. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT and Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC. For plenum fan applications, the fan wheel shall meet or exceed guidelines in AMCA 801-92 for dynamic balancing requirements. Following fan assembly, the complete fan assembly balance shall be tested using an electronic balance analyzer with a tunable filter and stroboscope. Vibration measurements shall be taken on each motor bearing housing in the vertical, horizontal, and axial planes (5 total measurements, 2 each motor bearing and 1 axial).

G. Fan Motor, Drive and Mounting Assembly:

1. Provide internally vibration isolated fan, motor and drive, mounted on a common integral bolted or welded structural steel base with adjustable motor slide rail with locking device. Provide vibration isolators and flexible duct connections at fan discharge to completely isolate fan assembly. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, for additional requirements.
2. Fan Motor and Drive: Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005, with efficiencies as shown in the Specifications Section 23 05 12 (General Motor Requirements For HVAC and Steam Equipment), on drawings and suitable for use in variable frequency drive applications on AHUs where this type of drive is indicated. Refer to Section 23 05 11, COMMON WORK

RESULTS FOR HVAC, for additional motor and drive specifications. Refer to Specification Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

3. Fan drive and belts shall be factory mounted with final alignment and belt adjustment to be made by the Contractor after installation. Drive and belts shall be as specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Provide additional drive(s) if required during balancing, to achieve desired airflow.

H. Mixing Boxes: Mixing box shall consist of casing and outdoor air and return air dampers in opposed blade arrangement with damper linkage for automatic operation. Coordinate damper operator with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Dampers shall be of ultra-low leak design with metal compressible bronze jamb seals and extruded vinyl edge seals on all blades. Blades shall rotate on stainless steel sleeve bearings or bronze bushings. Leakage rate shall not exceed 1.6 cubic meters/min/square meter (5 CFM per square foot) at 250 Pa (1 inch WG) and 2.8 cubic meters/min/square meter (9 CFM per square foot) at 995 Pa (4 inch WG) Electronic operators shall be furnished and mounted in an accessible and easily serviceable location by the air handling unit manufacturer at the factory. Damper operators shall be of same manufacturer as controls furnished under Section 23 09 23, DIRECT-

I. Filter Section: Refer to Section 23 40 00, HVAC AIR CLEANING DEVICES, for filter requirements.

1. Filters including one complete set for temporary use at site shall be provided independent of the AHU. The AHU manufacturer shall install filter housings and racks in filter section compatible with filters furnished. The AHU manufacturer shall be responsible for furnishing temporary filters (pre-filters and after-filters, as shown on drawings) required for AHU testing.
2. Factory-fabricated filter section shall be of the same construction and finish as the AHU casing including filter racks and hinged double wall access doors. Filter housings shall be constructed in accordance with side service or holding frame housing requirements in Section 23 40 00, HVAC AIR CLEANING DEVICES.
3. Air-Handling Units serving surgical suites, shall have after filters located on the downstream side of the supply air fans and cooling coils. Provide a diffuser section between the fan and the after-filters to ensure uniform air distribution. The final filters shall be HEPA filters located prior to the air outlets.

J. Coils: Coils shall be mounted on hot dipped galvanized steel supports to assure proper anchoring of coil and future maintenance. Coils shall be

face or side removable for future replacement thru the access doors or removable panels. Each coil shall be removable without disturbing adjacent coil. Cooling coils shall be designed and installed to insure no condensate carry over. Provide factory installed extended supply, return, drain, and vent piping connections. Refer to Drawings and Section 23 82 16, AIR COILS for additional coil requirements.

1. Water Coils.

K. Electrical and Lighting: Wiring and equipment specifications shall conform to Division 26, ELECTRICAL.

1. Vapor-proof lights using cast aluminum base style with glass globe and cast aluminum guard shall be installed in access sections for fan, mixing box, and any section over 300 mm (12 inch) wide. A switch shall control the lights in each compartment with pilot light mounted outside the respective compartment access door. Wiring between switches and lights shall be factory installed. All wiring shall run in neatly installed electrical conduits and terminate in a junction box for field connection to the building system. Provide single point 115 volt - one phase connection at junction box.
2. Install compatible 100 watt bulb in each light fixture.
3. Provide a convenience duplex receptacle next to the light switch.
4. Disconnect switch and power wiring: Provide factory or field mounted disconnect switch. Coordinate with Division 26, ELECTRICAL.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install air handling unit in conformance with ARI 435.

B. Assemble air handling unit components following manufacturer's instructions for handling, testing and operation. Repair damaged galvanized areas with paint in accordance with Military Spec. DOD-P-21035. Repair painted units by touch up of all scratches with finish paint material. Vacuum the interior of air handling units clean prior to operation.

C. Leakage and test requirements for air handling units shall be the same as specified for ductwork in Specification Section 23 31 00, HVAC DUCTS AND CASINGS except leakage shall not exceed Leakage Class (C_L) 12 listed in SMACNA HVAC Air Duct Leakage Test Manual when tested at 1.5 times the design static pressure. Repair casing air leaks that can be heard or felt during normal operation and to meet test requirements.

D. Perform field mechanical (vibration) balancing in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

E. Seal and/or fill all openings between the casing and AHU components and utility connections to prevent air leakage or bypass.

3.2 STARTUP SERVICES

A. The air handling unit shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated and fan has been test run under observation.

B. After the air handling unit is installed and tested, provide startup and operating instructions to VA personnel.

C. An authorized factory representative should start up, test and certify the final installation and application specific calibration of control components. Items to be verified include fan performance over entire operating range, noise and vibration testing, verification of proper alignment, overall inspection of the installation, Owner/Operator training, etc.

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SECTION 23 81 00
DECENTRALIZED UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies split-system air conditioners.

B. Definitions:

1. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions (Btu hour/Watt).
2. Seasonal Energy Efficiency Ratio (EER): The ratio of the total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period (Btu hour/Watt).
3. Unitary: A Unitary Air Conditioner consists of one or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well.
4. Where such equipment is provided in more than one assembly the separated assemblies are to be designed to be used together and the requirements of rating are based upon use of matched assemblies.

1.2 RELATED WORK

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.

B. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT: Requirements for different types of vibration isolators and noise ratings in the occupied areas.

C. Section 23 07 11, HVAC INSULATION: Requirements for piping insulation.

D. Section 23 23 00, REFRIGERANT PIPING: Requirements for refrigerant pipes and fittings.

1.3 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Safety Standards: ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.

1.4 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES

B. Manufacturer's literature and data:
   1. Sufficient information, including capacities, pressure drops and piping connections clearly presented, shall be included to determine compliance with drawings and specifications for units noted below:
      a. Unitary air conditioners:
         1) Split systems
   2. Unit Dimensions required clearances, operating weights accessories and start-up instructions.
   3. Electrical requirements, wiring diagrams, interlocking and control wiring showing factory installed and portions to be field installed.
   4. Mounting and flashing of the roof curb to the roofing structure with coordinating requirements for the roof membrane system.
C. Certification: Submit proof of specified ARI Certification.
D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible-to-heat-ratio, energy efficiency ratio (EER), and coefficient of performance (COP).
E. Operating and Maintenance Manual: Submit three copies of Operating and Maintenance manual to Resident Engineer three weeks prior to final inspection.
F. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
B. Federal Specifications (Fed. Spec.):
   A-A-50502-90..... Air conditioner (Unitary Heat Pump) Air to Air (3000-300,000 Btu)
C. Military Specifications (Mil. Specs.):
   MIL-PRF-26915D-06.....Primer Coating, for Steel Surfaces
D. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
   210/240-08.....Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
   270-08.....Sound Rating of Outdoor Unitary Equipment
   310/380-04.....Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-04)
   340/360-07.....Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment

520-04.....Performance Rating of Positive Displacement Condensing Units

E. Air Movement and Control Association (AMCA):

210-07.....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI)

410-96.....Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans

F. American National Standards Institute (ANSI):

S12.51-02(R2007).....Acoustics - Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Method for Reverberation Rooms (same as ISO 3741:1999)

G. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

2008 Handbook.....HVAC Systems and Equipment

15-10.....Safety Standard for Refrigeration Systems (ANSI)

H. American Society of Testing and Materials (ASTM):

B117-09.....Standard Practice for Operating Salt Spray (Fog) Apparatus

I. American Society of Civil Engineers (ASCE)

ASCE 7-10.....Minimum Design Loads for Buildings and Other Structures

J. National Electrical Manufacturer's Association (NEMA):

MG 1-09 (R2010).....Motors and Generators (ANSI)

ICS 1-00 (R2005, R2008).Industrial Controls and Systems: General Requirements

K. National Fire Protection Association (NFPA) Publications:

90A-09.....Standard for the Installation of Air-Conditioning and Ventilating Systems

PART 2 - PRODUCTS

2.1 UNITARY AIR CONDITIONERS - GENERAL

A. Applicable ARI Standards:

1. Cooling Capacity Less Than 39.6 kW (135,000 Btu/h): AHRI 210/240. Units shall be listed in the ARI Directory of Certified Unitary Air-Conditioners.

B. Performance Rating: Cooling capacity of units shall meet the sensible heat and total heat requirements shown in the contract documents. In selecting unit size, make true allowance for "sensible to total heat ratio" to satisfy required sensible cooling capacity.

C. Machinery Guards: Provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory fabricated casings.

D. Corrosion Prevention: Unless specified otherwise, equipment fabricated from ferrous metals that do not have a zinc coating or a duplex coating of zinc and paint shall be treated for prevention of rust with a factory coating or paint system that will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall be tested for 500 hours. The salt-spray fog test shall be in accordance with ASTM B117 using a 20 percent sodium chloride solution. Immediately after completion of the test, the coating shall show no signs of blistering, wrinkling or cracking, no loss of adhesion, and the specimen shall show no signs of rust beyond 3 mm (1/8-inch) on both sides from the scratch mark.

2.3 SPLIT-SYSTEM AIR CONDITIONERS

A. Description: Factory assembled and tested, wall-mounted units, with an air-cooled remote condensing unit, and field-installed refrigeration piping.

B. Wall-Mounting, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
3. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2007. Provide factory installed and wired condensate pump and level controls.
4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
6. Fan: Direct drive, centrifugal fan.
7. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
8. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.

F. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Service valves,

fittings, and gage ports shall be brass and located outside of the casing.

2. Compressor: Hermetically sealed reciprocating or scroll type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
3. Compressor motor with manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
4. Refrigerant: R-407C or R-410A unless otherwise indicated.
5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
6. Fan: Aluminum, propeller type, directly connected to motor.
7. Motor: Permanently lubricated, with integral thermal-overload protection.
8. Low Ambient Kit: Permit operation down to minus 18 deg C (0 deg F).
10. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."

PART 3 EXECUTION

3.1 INSTALLATION

A. Install units level and plumb maintaining manufacturer’s recommended clearances and tolerances.
B. Install ground-mounting, compressor-condenser components on 100 mm (4-inch) thick, reinforced concrete base; 100 mm (4 inches) larger on each side than unit. Concrete, reinforcement, and formwork are specified in Section 03 30 00, CAST-IN-PLACE CONCRETE. Coordinate anchor installation with concrete base.
C. Install and connect refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
D. Install wall sleeves in finished wall assembly and weatherproof.

3.2 CONNECTIONS

A. Verify condensate drainage requirements.
B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
C. Install piping adjacent to units to allow service and maintenance.
D. Ground equipment and install power wiring, switches, and controls for self contained and split systems.

E. Connect refrigerant piping to coils with shutoff valves on the suction and liquid lines at the coil and a union or flange at each connection at the coil and condenser.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections: After installing units and after electrical circuitry has been energized, test units for compliance with requirements. Inspect for and remove shipping bolts, blocks, and tie-down straps. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.

3.4 INSTRUCTIONS

Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of units.

3.5 STARTUP AND TESTING

The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

3.6 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.7 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS.

---END---

SECTION 23 81 46
WATER-SOURCE HEAT PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies electrically operated “Water-Source Water-to-Water Heat Pumps"

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS: For pre-test requirements.
B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
C. Section 23 21 13, HYDRONIC PIPING.
D. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Requirements for controls and instrumentation.
E. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: Requirements for testing, adjusting and balancing of HVAC system.
F. Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.
G. Section 01 91 00 – GENERAL COMMISSIONING REQUIREMENTS

1.3 QUALITY ASSURANCE:

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.
C. Comply with ASHRAE 90.1-2010.

1.4 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
B. Manufacturer’s Literature and Data.
   1. Water Source Water-to-Water Heat Pumps:
C. Certification: Submit, simultaneously with shop drawings, a proof of certification that this product has been certified by AHRI.
D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required cooling and heating capacities EER and COP values as applicable.
E. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

1.5 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Federal Specification (Fed. Spec.):
A-A-50502-90.....Air-conditioner (UNITARY HEAT PUMP), AIR TO AIR (3000 TO 300,000 BTUH)

C. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standards:
AHRI-DCPP.....Directory of Certified Product Performance - Applied Directory of Certified Products
325-98.....Ground Water-Source Heat Pumps

D. American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc (ASHRAE):
15-10.....Safety Standard for Refrigeration Systems (ANSI)
90.1-10.....Energy Standard for Buildings except Low-Rise Residential Buildings
2008 Handbook HVAC Systems and Equipment

E. National Electrical Manufacturer’s Association (NEMA):
MG 1-09 (R2010).....Motors and Generators (ANSI)
ICS 1-00 (R2005).....Industrial Controls and Systems: General Requirements

F. Underwriters Laboratory (UL):
1995-05.....Heating and Cooling Equipment

PART 2- PRODUCTS

2.1 OPERATING CONDITIONS

A. Provide water-to-water heat pump with the capacity as scheduled on drawings.

B. Heat Pump shall be designed to operate using R-410a Refrigerant.

C. Heat Pump shall be designed for parallel heat exchanger water flow.

D. Heat pump shall be designed for simultaneous variable capacity heating and cooling operation in conjunction with a single source/sink.

E. The liquid to be heated and cooled will be water containing corrosion inhibitors.

F. Heat Pump shall be designed to operate using 460 volt, 3 phase, 60Hz electrical power supply.

2.2 WATER-TO-WATER PACKAGED HEAT PUMP

A. System Description: Heat Pump shall incorporate Scroll-type compressors and consist of multiple refrigerant circuits. Each refrigerant circuit shall consist of an individual compressor, condenser, evaporator

circuit, thermal expansion valve, reversing valve, and control system. Each circuit shall be constructed to be independent of other circuits from a refrigeration and electrical stand-point. The multi-circuit heat pump must be able to produce chilled or heated water even in the event of a failure of one or more refrigerant circuits.

C. Virtual Moveable Endcap: The heat pump shall be designed for simultaneous variable capacity operation through Virtual Moveable Endcap (VME) technology. There shall be a VME module at every module-to-module interface. The VME module shall contain fast-acting motorized butterfly valves that close on a command from the central control system and isolate heating modules from cooling modules. By closing VME valves, capacity can be shifted between heating and cooling based on the required loads in each system.

D. General:
   1. All Modules shall be ETL listed in accordance with UL Standard 465, CSA certified per Standard C22.2#119.
   2. Modules shall ship wired and charged with refrigerant. All modules shall be factory run tested prior to shipment.
   3. Compressors, heat exchangers, piping and controls shall be mounted on a heavy gauge steel frame. Electrical controls, contactors, and relays for each module shall be mounted within that module.

E. Water Mains: Each module shall include supply and return mains for both load and source-sink water. Grooved end connections are provided for interconnection to six inch standard (6.625″ outside diameter) piping with Victaulic type couplings. Water Mains shall be installed such that they are beneath any power or control wiring so as to insure for safe operation in the event of condensation or minor piping leaks. Water piping must be under all electrical devices.

F. Heat Exchangers: Each load and source-sink heat exchanger shall be brazed plate heat exchangers constructed of 316 stainless steel; designed, tested, and stamped in accordance with UL 1995 code for 650 psig working pressure on the load side and 650 psig working pressure on the source-sink. Both the load side and source-sink side heat exchangers shall be mounted below the compressor, to eliminate the effect of migration of refrigerant to the cold heat exchanger with consequent liquid slugging on start-up.

G. Compressor: Each module shall contain two hermetic scroll compressors independently circuited and with internal spring isolation mounted to the module with rubber-in-shear isolators. Each system also includes

high discharge pressure and low suction pressure manual reset safety cut-outs.

H. VME Module: Each VME module shall include motorized fast-acting butterfly valves, water mains with Victaulic grooved connections, and provisions for connection to the high voltage buss bar. Each module shall be electrically isolatable from the high voltage buss through a disconnecting means without disconnecting power from other modules.

I. Head Pressure Control Valves: Heat exchangers on the source/sink side of the Heat Pump Modules shall be equipped with motorized modulating butterfly type valves driven by a signal from the master controller and used to maintain head pressure whenever necessary.

J. Single Point Power: Chiller shall be equipped with a pre-engineered genuine buss bar electrical system for single point power. Where the equipment size exceeds the amp rating of the buss bar, multiple power connections may be applied. Pre-engineered system shall also incorporate individual module isolation circuit breakers for full redundancy and ability of a module to be taken off-line for repair while the rest of the modules continue to operate. Isolating circuit breaker/service lock-out switch must be included on each module

K. Central Control System.

1. Sequencing and operation of the of the various compressors, VME isolating valves, and head pressure control valves shall be performed by a microprocessor based control system (Master Controller).
   a. Master control must be powered off of the chiller. Individual control power source is not permissible.
   b. Each heat pump module must have an individual switch ”manual-off-auto”, so if the master controller fails it can still operate on its own slave controller
2. The Master Controller shall monitor and report the following on each refrigeration system:
   a. Discharge Pressure Fault
   b. Suction Pressure Fault
   c. Compressor Winding Temperature
   d. Suction Temperature
   e. Load Leaving Water Temperature
   f. Source-Sink Leaving Water Temperature
3. The Master Controller shall be powered by the chillers single point power connection and shall monitor and report the following system parameters:
   a. Cooling Load Water Entering and Leaving Temperature

b. Heating Load Water Entering and Leaving Temperature
c. Source-Sink Water Entering and Leaving Temperature
d. Load Water (both heating and cooling) and Source-Sink Water Flow

4. An out of tolerance indication from these controls or sensors shall cause a “fault” indication at the Master Controller and shutdown of that compressor with the transfer of load requirements to the next available compressor. In the case of a System Fault the entire heat pump will be shut down. When a fault occurs, the Master Controller shall record conditions at the time of the fault and store the data for recall. This information shall be capable of being recalled through the keypad of the Master Controller and displayed on the Master Controller’s 2 line by 40 character back-lit LCD. A history of faults shall be maintained including date and time of day of each fault (up to the last 20 occurrences).
5. Individual monitoring of leaving water temperatures from each refrigeration system shall be programmed to protect against heat exchanger freeze-up.
6. The control system shall evaluate the water temperatures of the heating and cooling systems to assess the required capacity of each and cycle compressors of the Heat Pump Modules and valves in the VME Modules to configure the equipment as needed. The control system shall monitor entering and leaving load water temperatures to determine system load and select the number of compressor circuits required to satisfy heating and cooling setpoints simultaneously. Response times and set points shall be adjustable. The system shall provide for variable time between compressor sequencing and temperature sensing, so as to fine tune the heat pump to different existing building conditions.
7. Interoperability: The Heat pump shall be capable of interfacing with the Building Automation System via an Interoperability Web Portal.

L. Heat pump shall have a single point power connection and external inputs and outputs to be compatible with the building management system. Inputs/Outputs include:
1. Remote Start/Stop
2. General Alarm
3. Cooling Load Limit
4. Heating Load Limit
5. Cooling Load Reset
6. Heating Load Reset

M. Each inlet water header shall incorporate a built in 30-mesh (minimum) in-line strainer system to prevent heat exchanger fouling.

N. Heat pump to be provided with on board condenser debris management system

2.3 SAFETIES, CONTROLS AND OPERATION

A. Heat pump safety controls system shall be provided with the unit (minimum) as follows:
   1. Low refrigerant pressure
   2. Loss of flow through the source/sink heat exchanger
   3. Loss of flow through the load (cooling and/or heating) heat exchanger
   4. High refrigerant pressure
   5. High compressor motor temperature
   6. Low suction gas temperature
   7. Low leaving water temperature

B. Failure of heat pump to start or heat pump shutdown due to any of the above safety cutouts shall be enunciated by display of the appropriate diagnostic description at the unit control panel. This annunciation will be in plain English.

C. The heat pump shall be furnished with a Master Controller as an integral portion of the heat pump control circuitry to provide the following functions:
   1. Provide automatic heat pump shutdown during periods when the load level decreases below the normal operating requirements of the heat pump. Upon an increase in load, the heat pump shall automatically restart.
   2. Provisions for connection to automatically enable the heat pump from a remote energy management system.
   3. The control panel shall provide alphanumeric display showing all system parameters in plain English language with numeric data in English units.

D. Normal Heat pump Operation
   1. When heat pump is enabled, the factory supplied Master Controller modulates the heat pump capacity from minimum to maximum as required by building load.
   2. The heat pump control system shall respond to Entering Water Temperature and will have an integral reset based on entering water temperature to provide for efficient operation at part-load conditions.

E. Power Phase Monitor
   1. Provide a Power Phase Monitor on the incoming power supply to the heat pump. This device shall prevent the heat pump from operating during periods when the incoming power is unsuitable for proper operation.
   2. The Power Phase Monitor shall provide protection against the following conditions:
      a. Low Voltage (Brown-Out)
      b. Phase Rotation
      c. Loss of Phase
      d. Phase Imbalance

PART 3- EXECUTION

3.1 PIPING SYSTEM FLUSHING PROCEDURE

A. Prior to connecting the heat pump to the condenser and chilled water loop, the piping loops shall be flushed with a detergent and hot water (110-130° F) mixture to remove previously accumulated dirt and other organics. In old piping systems with heavy encrustation of inorganic materials consult a water treatment specialist for proper passivation and/or removal of these contaminants.

B. During the flushing, a 30 mesh (max.) Y-strainers shall be in place in the system piping and examined periodically as necessary to remove collected residue. The flushing process shall take no less than 6 hours or until the strainers when examined after each flushing are clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturer's instructions. After flushing with the detergent and/or dilute acid concentrations the system loop shall be purged with clean water for at least one hour to ensure that all residual cleaning chemicals have been flushed out.

C. Prior to supplying water to the heat pump the Water Treatment Specification shall be consulted for requirements regarding the water quality during heat pump operation. The appropriate heat pump manufacturer’s service literature shall be available to the operator and/or service contractor and consulted for guidelines concerning preventative maintenance and off-season shutdown procedures.

3.2 WATER TREATMENT REQUIREMENTS

A. Supply water for both the hydronic and geothermal heat pump water circuits shall be analyzed and treated by a professional water treatment specialist who is familiar with the operating conditions and materials of construction specified for the heat pump’s heat exchangers, headers

and associated piping. Cycles of concentration shall be controlled such that recirculated water quality for modular heat pumps using 316 stainless steel brazed plate heat exchangers and carbon steel headers is maintained within the following parameters:

1. pH: Greater than 7 and less than 9
2. Total Dissolved Solids (TDS): Less than 1000 ppm
3. Hardness as $CaCO_3$: 30 to 500 ppm
4. Alkalinity as $CaCO_3$: 30 to 500 ppm
5. Chlorides: Less than 200 ppm
6. Sulfates: Less than 200 ppm

3.3 INSTALLATION

A. Floor-Mounted Units: Support on neoprene pads with minimum 3.17-mm (0.125-inch) static deflection. Secure units to anchor bolts installed in concrete bases.

B. Suspended Units: Suspend from structure with threaded steel rods and minimum 6.35-mm (0.25-inch) static deflection rubber-in-shear vibration isolators.

3.4 CONNECTIONS

A. Connect supply and return hydronic piping to heat pump with unions and shutoff valves and hose kits.

B. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

C. Install piping adjacent to machine to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Test the heat pump units for the performance compliance after the installation is complete and electrical circuitry is energized.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.6 INSTRUCTIONS

A. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of heat pumps.

3.7 STARTUP AND TESTING

A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

3.8 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.9 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS.

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SECTION 23 82 00
CONVECTION HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

Fan-coil units, radiant ceiling panels, unit heaters, finned-tube radiation and air curtains.

1.2 RELATED WORK

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.

B. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise requirements.

C. Section 23 21 13, HYDRONIC PIPING: Heating hot water and chilled water piping.

D. Section 23 31 00, HVAC DUCTS AND CASINGS: Ducts and flexible connectors.

E. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Valve operators.

F. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Flow rates adjusting and balancing.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Fan-Coil units.
2. Unit heaters.
3. Cabinet unit heaters.
4. Finned-tube radiation.
5. Radiant ceiling panels.
6. Air curtains.

C. Certificates:

1. Compliance with paragraph, QUALITY ASSURANCE.
2. Compliance with specified standards.

D. Operation and Maintenance Manuals: Submit in accordance with paragraph, INSTRUCTIONS, in Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Air Conditioning and Refrigeration Institute (ARI):
440-05.....Room Fan Coils

C. National Fire Protection Association (NFPA):
90A-02.....Standard for the Installation of Air Conditioning and Ventilating Systems
70-05.....National Electrical Code

D. Underwriters Laboratories, Inc. (UL):
181-05.....Standard for Factory-Made Air Ducts and Air Connectors
1995-05.....Heating and Cooling Equipment

1.6 GUARANTY

In accordance with FAR clause 52.246-21.

PART 2 - PRODUCTS

2.1 ROOM FAN-COIL UNITS

A. Capacity Certification: ARI 440.

B. Safety Compliance: NEC compliant and UL listed.

C. Noise Levels: Operating at full cooling capacity, sound power level shall not exceed by more than 5 dB the numerical value of sound pressure levels associated with noise criteria specified in Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT. Select units at intermediate speed, for compliance with the noise criteria.

D. Chassis: Galvanized steel, acoustically and thermally insulated to attenuate noise and prevent condensation.

E. Cabinet Type: Not lighter than 1.3 mm (l8 gage) steel, reinforced and braced. Arrange components and provide adequate space for installation of piping package and control valves. Finish shall be factory-baked enamel in manufacturer's standard color.

1. Horizontal Unit: Hinged bottom access panel with cam-lock fasteners. Provide stamped integral discharged grilles in front of cabinet.
2. Concealed Units: Enclosed type with inlet and outlet duct collars.

F. Fans: Centrifugal, direct drive, galvanized steel or polyester resin.

l. Motors: 3-speed ECM type with integral thermal overload protection, for operation at not more than l200 RPM.

2. Provide a fan speed selector switch, with off, low, medium, and high positions. Switch shall have a set of auxiliary contacts which are open when the switch is in the "off" position and closed when the switch in any of the other positions. On vertical units, mount switch in a junction box in the cabinet of each unit. On horizontal units, switch shall be wall mounted.

G. Cooling and Heating Coils:

1. Hydronic (two separate coils for cooling and heating): Copper tubes, 10 mm (three-eighths inch) minimum inside diameter, not less than 4.3 mm (0.0l7 inch) thick with copper or aluminum fins. Coils shall be pressure tested for bursting and strength in accordance with Underwriters Laboratories, Inc., requirements for pressure tested coils, and shall be designed to provide adequate heat transfer capacity. Provide manual air vent at high point of each coil and drain at each low point.

2. Electrical heating coils: Spiral sheath or finned-tube construction with Cal-rod resistance elements in aluminum tubes. Units shall be UL listed and factory wired with unit mounted heat switch, magnetic contactors, high temperature cutout safety control, and fan override thermostat.

H. Piping Package: Furnished with unit by the manufacturer to fit control valves provided by the controls supplier. Submit manufacturer's detailed drawings of the piping in the end compartments for approval prior to fabrication of the piping packages. Provide ball stop valves on the supply and return pipes and balancing fittings on the return pipes.

I. Drain pans: Furnish galvanized steel with solderless drain connections and molded polystyrene foam insulating liner.

1. Provide condensate pump and float controls for field installation and wiring.

2. Auxiliary drain pan: Located under control valve and piping to prevent dripping.

J. Air Filter: Manufacturer's standard throwaway type, not less than one inch thick, supported to be concealed from sight and be tight fitting

to prevent air by-pass. Filters shall have slide out frames and be easily replaced without removing enclosure or any part thereof.

K. Control valves and unit mounted return air thermostats are to be field installed.

2.2 UNIT HEATERS

A. General: Horizontal discharge type for hot water heating medium, as indicated.

B. Casing: Steel sheet, phosphatized to resist rust and finished in baked enamel. Provide hanger supports.

C. Fan: Propeller type, direct driven by manufacturer's standard electric motor. Provide resilient mounting. Provide fan guard for horizontal discharge units.

D. Discharge Air Control:

1. Horizontal discharge: Horizontal, adjustable louvers.
2. Vertical discharge: Radial louver diffuser.

E. Hot Water Coil: Aluminum fins bonded to seamless copper tubing by mechanical expansion of the tubing, designed for 517 kPa (75 psig) steam working pressure.

2.3 CABINET UNIT HEATERS

A. General: Vertical or horizontal type for hot water heating medium, as indicated.

B. Cabinet: Not less than 1.3 mm (l8 gage) steel with front panel for vertical units and hinged front panel for horizontal units. Finish on exposed cabinet shall be factory-baked enamel in manufacturer's standard color as selected by the Architect. Provide 76 mm (3-inch) high sub-base for vertical floor mounted units.

C. Fan: Centrifugal blower, direct driven by a single phase, two-speed, electric motor with inherent overload protection. Provide resilient motor/fan mount.

D. Filter: Manufacturer's standard, one inch thick, throwaway type.

E. Hot Water Coil: Aluminum fins bonded to seamless copper tubing by mechanical expansion of the tubing, designed for 517 kPa (75 psi) steam working pressure.

F. Factory Mounted Controls: Manual fan starter and three-position (low, high and off) fan speed switch.

2.4 FINNED-TUBE RADIATION

A. Ratings: Certified under the I=B=R program of the Gas Appliance Manufacturer’s Association.

B. Enclosures: 1.6 mm (l6 gage) steel, sloping top, designed for wall mounting. Provide baked enamel finish in standard manufacturer's colors as selected by the Architect. End plates and corner pieces shall be die-formed with round edges and fit flush with enclosure surface. Where continuous wall-to-wall installations are shown on the drawings provide all fillers, corner fittings, sleeves, end caps and other accessories, which shall have the same profile as the basic unit. Provide access panels or extensions where required for access to valves, or traps shown on the drawings.

C. Hydronic Heating Elements: Steel pipe or nonferrous tubing with fins mechanically bonded by mechanical expansion of the tube. Elements shall be positively positioned front-to-back with provisions for silent horizontal expansion and contraction.

2.5 RADIANT CEILING PANELS:

A. Provide complete extruded linear and modular radiant panel ceiling systems in all areas as scheduled and detailed on the drawings and as specified.

B. Provide wall channels and support angles required to frame the ceiling openings. The ceiling openings shall provide for necessary expansion and contraction of ceiling panels. Install panels in finished openings and provide support steel and panel support channels. Cross channels shall be located on not more than thirty (30) inch centers.

C. The linear radiant ceiling panels shall consist of extruded V-grooved aluminum faceplate, 0.500" I.D. copper tubes and 1 inch thick fiberglass insulating blanket. The panels shall consist of interlocking extruded sections with galvanized steel channel cross braces attached by plated steel assembly clips. The copper tubing shall be mechanically bonded into an extruded aluminum saddle so that the tube is an intimate engagement with the saddles and provides efficient heat transfer. Furnish blank filler pieces at corners and other locations shown or required to form a continuous line. Panels shall be field cut, mitered and installed to conform to architectural features of ceilings and panel layout shown on drawings.

D. Each preassembled panel shall be factory painted white. The assembled panel consisting of individual sections shall be delivered to the job site and tagged for each location. Assembled panels shall be arranged for wall-to-wall installation or ceiling opening sizes and arrangement as noted on the drawings. Dimensions on drawings are for active length only and do not represent the full radiant panel length required for opening or wall-to-wall dimensions.

E. The non-radiant matching linear panels shall be fastened to the active radiant panels and shall provide a continuous surface. Cutting, mitering, suspending and fitting of the radiant panels shall be performed in accordance with the requirements of the panel manufacturer. These matching inactive panels shall be same color, texture and finish as the active linear radiant heating panels.

F. The modular ceiling panels shall be 2 feet by 4 feet in size designed to be installed in a lay-in acoustical tile ceiling. Panels fabricated of .040 inch thick nonperforated aluminum face plate with .500 inch O.D. serpentined copper tubing metallurigically bonded to the face plate. Also included shall be 1 inch thick, 3/4 PCF density glass fiber acoustical pad. Panel face plates shall be factory painted white. Where scheduled, custom painted of colors selected by the Architect and factory silk-screening to match adjacent acoustical ceiling tile pattern shall be provided. Coordinate requirements with the General Contractor. Submit samples of silk-screened patterns to the Architect for approval.

G. Hangers shall be installed as recommended by the manufacturer.

H. Interconnecting of radiant panels shall consist of .500" I.D. Type L soft copper tubing.

2.6 AIR CURTAINS

A. Housing Materials: Heavy-gage, aluminum construction.

1. Anodized Finish: Match finish and color of adjacent architectural metals. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

3. Mounting Brackets: Steel, for wall or ceiling mounting.

B. Intake Louvers: Integral part of the housing, mechanically field adjustable.

C. Discharge Nozzle: Integral part of the housing, containing adjustable air-directional vanes.

D. Fans: Galvanized steel, centrifugal, forward curved, double width, double inlet; statically and dynamically balanced.

1. Fan Drives: Direct.
2. Motor Type: Multispeed, resiliently mounted, continuous duty, totally enclosed, air over, with integral thermal-overload protection.
3. Bearings: Permanently sealed, lifetime, prelubricated, ball bearings.
4. Disconnect: Internal power cord with plug and receptacle.

E. Water Coils:

1. Description: Continuous-circuit coil.
2. Piping Connections: Threaded on same end.
3. Tubes: Copper, complying with ASTM B 75.
   a. Tube Diameter: 0.625 inch.
4. Fins: Aluminum with fin spacing 0.167 inch.
   a. Fin and Tube Joint: Mechanical bond.
5. Headers: Seamless copper tube with brazed joints.
6. Frames: Galvanized-steel channel frame, 0.052 inch.
7. Ratings: According to ASHRAE 33.
   a. Working-Pressure Ratings: 200 psig, 325 deg F.
8. Source Quality Control: Test to 300 psig and to 200 psig underwater.

F. Disposable Panel Filters: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with glass-fiber media sprayed with nonflammable adhesive in cardboard frame.

1. Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

G. Accessories:

1. Built-in Thermostat: Line voltage, factory installed and wired to the junction box on air curtain.

2. Automatic Door Switch: Plunger type installed in door area to activate air curtain when door opens and to deactivate air curtain when door closes.
3. Start-Stop, Push-Button Switch: Manually activates and deactivates air curtain.
4. Time-Delay Relay: Factory installed and adjustable to allow air curtain to operate from 0.5 seconds to 10 hours.
5. Motor-Control Panel: Complete with motor starter, 115-V ac transformer with primary and secondary fuses, terminal strip, and NEMA 250, Type 1 enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Work shall be installed as shown and according to the manufacturer’s diagrams and recommendations.

B. Handle and install units in accordance with manufacturer's written instructions.

C. Support units rigidly so they remain stationary at all times. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

D. Install 3-inch thick fiberglass blanket insulation above hydronic radiant panels.

3.2 OPERATIONAL TEST

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

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SECTION 23 82 16
AIR COILS

PART 1 - GENERAL

1.1 DESCRIPTION

Heating and cooling coils for air handling unit and duct applications.

1.2 RELATED WORK

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

C. Reheat coils for VAV/CV terminals: Section 23 82 00, CONVECTION HEATING AND COOLING UNITS.

1.3 QUALITY ASSURANCE

A. Refer to paragraph, QUALITY ASSURANCE, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Unless specifically exempted by these specifications, heating and cooling coils shall be tested, rated, and certified in accordance with ARI Standard 4l0 and shall bear the ARI certification label.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data for Heating and Cooling Coils: Submit type, size, arrangements and performance details. Present application ratings in the form of tables, charts or curves.

C. Provide installation, operating and maintenance instructions.

D. Certification Compliance: Evidence of listing in current ARI Directory of Certified Applied Air Conditioning Products.

E. Coils may be submitted with Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Air Conditioning and Refrigeration Institute (ARI):
Directory of Certified Applied Air Conditioning Products
ARI 4l0-02.....Forced-Circulation Air-Cooling Air-Heating Coils.

C. American Society for Testing and Materials (ASTM):
B75/75M-02.....Seamless Copper Tube (Metric)

PART 2 - PRODUCTS

2.1 HEATING AND COOLING COILS

A. Conform to ASTM B75 and ARI 410.

B. Tubes: Minimum 16 mm (0.625 inch) tube diameter; Seamless copper tubing.

C. Fins: 0.1397 mm (0.0055 inch) aluminum or 0.1143 mm (0.0045 inch) copper mechanically bonded or soldered or helically wound around tubing. Provide copper fins for sprayed coil applications and reheat coils for Operating Rooms.

D. Headers: Copper, welded steel or cast iron. Provide seamless copper tubing or resistance welded steel tube for volatile refrigerant coils.

E. "U" Bends, Where Used: Machine die-formed, silver brazed to tube ends.

F. Coil Casing: 1.6 mm (l6 gage) galvanized steel with tube supports at 1200 mm (48 inch) maximum spacing. Construct casing to eliminate air bypass and moisture carry-over. Provide duct connection flanges.

G. Pressures kPa (PSIG):

Pressure	Water Coil		
Test	2070 (300)		
Working	1380 (200)		

H. Protection: Unless protected by the coil casing, provide cardboard, plywood, or plastic material at the factory to protect tube and finned surfaces during shipping and construction activities.

I. Vents and Drain: Coils that are not vented or drainable by the piping system shall have capped vent/drain connections extended through coil casing.

J. Cooling Coil Condensate Drain Pan: Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

2.2 REHEAT COILS, DUCT MOUNTED

Continuous circuit booster type for hot water as shown on drawings. Material of coils same as noted in Article 2.1.

2.3 WATER COILS

A. Drainable Type (Self-Draining, Self-Venting); manufacturer standard:

l. Cooling, all types.

2. Heating or preheat.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow coil manufacturer's instructions for handling, cleaning, installation and piping connections.

B. Comb fins, if damaged. Eliminate air bypass or leakage at coil sections.

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SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section applies to all sections of Division 26.

B. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, panelboards, and other items and arrangements for the specified items are shown on drawings.

C. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

A. References to the International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) are minimum installation requirement standards.

B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. COTR: Contracting Officer's Technical Representative.
2. Listed; Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or

services, that maintains periodic inspection of production or listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3. Labeled; Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
4. Certified; equipment or product which:
   a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
   b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
   c. Bears a label, tag, or other record of certification.
5. Nationally recognized testing laboratory; laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:
   1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
   2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

Applicable publications listed in all Sections of Division are the latest issue, unless otherwise noted.

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class or type of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COTR a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the COTR prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.7 EQUIPMENT REQUIREMENTS

Where variations from the contract requirements are requested in accordance with Section 00 72 00, GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 EQUIPMENT PROTECTION

A. Equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
   1. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited to panelboards, controllers, circuit protective devices, cables, wire, light fixtures, electronic equipment, and accessories.
   2. During installation, equipment shall be protected against entry of foreign matter; and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
   3. Damaged equipment shall be, as determined by the COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
   4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
   5. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.

B. Job site safety and worker safety is the responsibility of the contractor.

C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
   1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
   2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
   3. Before initiating any work, a job specific work plan must be developed by the contractor with a peer review conducted and

documented by the COR and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.

4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COR.

D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working spaces shall not be less than specified in the NEC for all voltages specified.

C. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.

2. "Conveniently accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.11 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards, panelboards, cabinets, motor controllers (starters), fused and un-fused safety switches, separately enclosed circuit breakers and other significant equipment.

B. Nameplates for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Nameplates for Normal/Emergency Electrical System equipment shall be laminated red

phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 1/2 inch high. Nameplates shall indicate equipment designation, rated bus amperage, voltage, number of phases, and number of wires. Secure nameplates with screws.

C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm^2), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

1.12 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.

4. Parts list which shall include those replacement parts recommended by the equipment manufacturer.

F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
   a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
   b. A control sequence describing start-up, operation, and shutdown.
   c. Description of the function of each principal item of equipment.
   d. Installation instructions.
   e. Safety precautions for operation and maintenance.
   f. Diagrams and illustrations.
   g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
   h. Performance data.
   i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
   j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of manuals together with shop drawings.

H. After approval and prior to installation, furnish the COTR with one sample of each of the following:

1. A 12 inch length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
2. Each type of conduit coupling, bushing and termination fitting.
3. Conduit hangers, clamps and supports.
4. Duct sealing compound.
5. Each type of receptacle, toggle switch, occupancy sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 ACCEPTANCE CHECKS AND TESTS

The contractor shall furnish the instruments, materials and labor for field tests.

1.15 TRAINING

A. Training shall be provided in accordance with Article 1.25, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

B. Training shall be provided for the particular equipment or system as required in each associated specification.

C. A training schedule shall be developed and submitted by the contractor and approved by the COR at least 30 days prior to the planned training.

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SECTION 26 05 13
MEDIUM VOLTAGE CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of medium voltage cables, splices, and terminations.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirement and items that are common to more than one section of Division 26.

B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for medium voltage cables.

D. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Manholes and ducts for medium voltage cables.

E. Section 31 20 00, EARTH MOVING: Bedding of conduits.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

Medium voltage cables shall be thoroughly tested at the factory per NEMA WC 74 to ensure that there are no electrical defects. Factory tests shall be certified.

1.5 SUBMITTALS

A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. Shop Drawings:

1. Clearly present sufficient information to determine compliance with drawings and specifications.
2. Include product and installation information for cables, splices, terminations, and fireproofing tape.

C. Samples: After approval and prior to installation, furnish the Resident Engineer with a minimum 12 in length of each type and size of cable, along with the tag from the reel from which the sample was taken. The

sample shall contain the manufacturer's markings, showing all cable jacket information.

D. Certifications:

1. Factory Test Reports: Prior to installation of the cables, deliver four copies of the manufacturers certified NEMA WC 71 or WC 74 standard factory test reports to the Resident Engineer. Certified copies of test data shall show conformance with the referenced standards and shall be approved prior to delivery of cable.
2. Compatibility: Provide certification from the cable manufacturer that the terminations are approved for use with the cable.
3. Field Test Reports: Test reports shall comply with the paragraph entitled "Acceptance Checks and Tests." After testing, submit four certified copies to the Resident Engineer of each of the graphs specified under field testing.
4. After terminations have been installed and tested, deliver four copies of a certificate by the contractor to the Resident Engineer which includes the following:
   a. A statement that the materials, detail drawings, and printed instructions used are those contained in the kits approved for this contract.
   b. A statement that each termination was completely installed in a single continuous work period by a single qualified worker without any overnight interruption.
   c. A statement that field-made terminations conform to the following requirements:
      1) Pencil the cable insulation precisely.
      2) Connector installations:
         a) Use tools that are designed for the connectors being installed.
         b) Round and smooth the installed connectors to minimize localized voltage stressing of the insulating materials.
      3) Remove contaminants from all surfaces within the splices and terminations before installing the insulating materials.
      4) Solder block throughout stranded grounding wires that might penetrate the splicing and terminating materials.
      5) Use mirrors to observe the installation of materials on the backsides of the splices and terminations.

6) Eliminate air voids throughout the splices and terminations.

7) Stretch each layer of tape properly during installation.

d. List all the materials purchased and installed for the splices and terminations for this contract, including the material descriptions, manufacturers' names, catalog numbers, and total quantities.

E. Installer Approval:

1. Employees who install splices and terminations and test the cables shall have not fewer than five years of experience splicing and terminating cables equivalent to those being spliced and terminated, including experience with the materials in the kits.
2. Furnish satisfactory proof of such experience for each employee who splices or terminates the cables.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only:

American Society for Testing and Materials (ASTM):

B3-01 (R2007).....Standard Specification for Soft or Annealed Copper Wire

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

386-95 (R2001).....Separable Insulated Connector Systems for Power Distribution Systems above 600 V

400-01.....Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems

400.2-05.....Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)

400.3-06.....Guide for Partial Discharge Testing of Shielded Power Cable Systems in a Field Environment

404-00.....Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500-500,000 Volts

C. National Electrical Manufacturers Association (NEMA):
WC 74-06.....5-46 KV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy (ICEA S-93-969)

D. National Fire Protection Association (NFPA):
70-08.....National Electrical Code (NEC)

E. Underwriters Laboratories (UL):
1072-06 ..... Medium-Voltage Power Cables

1.7 SHIPMENT AND STORAGE

A. Cable shall be shipped on reels such that it is protected from mechanical injury. Each end of each length of cable shall be hermetically sealed with manufacturer’s end caps and securely attached to the reel.

B. Cable stored and/or cut on site shall have the ends turned down, and sealed with cable manufacturer’s standard cable end seals, or field-installed heat-shrink cable end seals.

PART 2 - PRODUCTS

2.1 MEDIUM VOLTAGE CABLE

A. Medium voltage cable shall be in accordance with the NEC and NEMA WC 71, WC 74, and UL 1072.

B. Single conductor stranded copper conforming to ASTM B3.

C. Voltage Rating:
1. 15,000 V cable shall be used on all distribution systems with voltages ranging from 5,000 V to 15,000 V.

D. Insulation:
1. Insulation level shall be 133%.
2. Types of insulation:
a. Cable type abbreviation, XLPE: cross-linked polyethylene insulated shielded shall be thermosetting, light and heat stabilized and chemically cross-linked.

E. Conductors and insulation shall be wrapped separately with semi-conducting tape.

F. Insulation shall be wrapped with non-magnetic, metallic shielding tape, helically-applied over semi-conducting insulation shield.

G. Heavy duty, overall protective jacket of chlorosulphonated polyethylene or polyvinyl chloride shall enclose every cable. The manufacturer's

name, cable type and size, and other pertinent information shall be marked or molded clearly on the overall protective jacket.

H. Cable temperature ratings for continuous operation, emergency overload operation, and short circuit operation shall be not less than the NEC, NEMA WC 71, or NEMA WC 74 standard for the respective cable.

2.2 TERMINATIONS

A. The materials shall be compatible with the cables.

B. Where the Government determines that unsatisfactory terminations have been installed, the contractor shall replace the unsatisfactory terminations with approved material at no additional cost to the Government.

C. Terminations:

1. Materials shall be designed for the cables being terminated, and shall be suitable for the prevailing environmental conditions.
2. Terminations:
   a. Shall comply with IEEE 48. Include shield ground strap for shielded cable terminations.
   b. Class 3 terminations for outdoor use: Kit with stress cone and compression-type connector.
   c. Load-break terminations for indoor and outdoor use: Elbow-type unit with test point and 200-A load make/break and continuous-current rating.

2.3 FIREPROOFING TAPE

Fireproofing tape shall be flexible, non-corrosive, self-extinguishing, arcproof, and fireproof intumescent elastomer. Securing tape shall be glass cloth electrical tape not less than 7 mils thick, and 0.75 in wide.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation shall be in accordance with the NEC, as shown on the drawings, and per cable manufacturer’s instructions.

B. Cable shall be installed in conduit above grade and duct bank below grade. All cables of a feeder shall be pulled simultaneously.

C. Splice the cables only in manholes and accessible pullboxes.

D. Ground shields in accordance with Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

E. Cable maximum pull length, maximum pulling tension, and minimum bend radius shall conform with the recommendations of the cable manufacturer.

F. Use suitable lubricating compounds on the cables to prevent pulling damage. Provide compounds that are not injurious to the cable jacket and do not harden or become adhesive.

G. Seal the cable ends prior to pulling, to prevent the entry of moisture or lubricant.

3.2 PULLING CABLES IN DUCTS AND MANHOLES/HANDHOLES

A. Cables shall be pulled into ducts with equipment designed for this purpose, including power-driven winches, cable-feeding flexible tube guides, cable grips, pulling eyes, and lubricants. A sufficient number of trained personnel and equipment shall be employed to ensure the careful and proper installation of the cable.

B. Cable reels shall be set up at the side of the manhole/handhole opening and above the duct or hatch level, allowing cables to enter through the opening without reverse bending. Flexible tube guides shall be installed through the opening in a manner that will prevent cables from rubbing on the edges of any structural member.

C. Cable shall be unreeled from the top of the reel. Pay-out shall be carefully controlled. Cables to be pulled shall be attached through a swivel to the main pulling wire by means of a suitable cable grip and pulling eye.

D. Woven-wire cable grips shall be used to grip the cable end when pulling small cables and short straight lengths of heavier cables.

E. Pulling eyes shall be attached to the cable conductors to prevent damage to the cable structure.

F. Cables shall be liberally coated with a suitable lubricant as they enter the tube guide or duct. Rollers, sheaves, or tube guides around which the cable is pulled shall conform to the minimum bending radius of the cable.

G. Cables shall be pulled into ducts at a reasonable speed. Cable pulling using a vehicle shall not be permitted. Pulling operations shall be stopped immediately at any indication of binding or obstruction, and shall not be resumed until the potential for damage to the cable is corrected. Sufficient slack shall be provided for free movement of cable due to expansion or contraction.

H. Cables cut in the field shall have the cut ends immediately sealed to prevent entrance of moisture.

3.3 TERMINATIONS

A. Install the materials as recommended by the manufacturer, including precautions pertaining to air temperature and humidity during installation.

B. Installation shall be accomplished by qualified personnel trained to accomplish medium voltage equipment installations. All manufacturer’s instructions shall be followed precisely.

3.4 FIREPROOFING

A. Cover all cable segments exposed in manholes and pull-boxes with fireproofing tape.

B. Apply the tape in a single layer, wrapped in a half-lap manner, or as recommended by the manufacturer. Extend the tape not less than 1 in into each duct.

C. At each end of a taped cable section, secure the fireproof tape in place with glass cloth tape.

3.5 CIRCUIT IDENTIFICATION OF FEEDERS

In each manhole/handhole and pullbox, install permanent tags on each circuit's cables to clearly designate the circuit identification and voltage. The tags shall be the embossed brass type, 1.5 in in diameter and 40 mils thick. Attach tags with plastic ties. Position the tags so they will be easy to read after the fireproofing tape is installed.

3.6 ACCEPTANCE CHECKS AND TESTS

A. Perform tests in accordance with the manufacturer's recommendations. Include the following visual and electrical inspections.

B. Test equipment and labor and technical personnel shall be provided as necessary to perform the acceptance tests. Arrangements shall be made to have tests witnessed by the Resident Engineer.

C. Visual Inspection:

1. Inspect exposed sections of cables for physical damage.
2. Inspect shield grounding, cable supports, splices, and terminations.
3. Verify that visible cable bends meet manufacturer’s minimum published bending radius.
4. Verify installation of fireproofing tape and identification tags.

D. Electrical Tests:
   1. Acceptance tests shall be performed on new and service-aged cables as specified herein.
   2. Test new cable after installation, splices, and terminations have been made, but before connection to equipment and existing cable.
E. Service-Aged Cable Tests:
   1. Maintenance tests shall be performed on service-aged cable interconnected to new cable.
   2. After new cable test and connection to an existing cable, test the interconnected cable. Disconnect cable from all equipment that could be damaged by the test.
F. Insulation-Resistance Test: Test all new and service-aged cables with respect to ground and adjacent conductors.
   1. Test data shall include megohm readings and leakage current readings. Cable shall not be energized until insulation-resistance test results have been approved by the Resident Engineer. Test voltages and minimum acceptable resistance values shall be:

Voltage Class	Test Voltage	Min. Insulation Resistance
15kV	2,500 VDC	5,000 megohms

   2. Provide a comprehensive report that describes the identification and location of cables tested, the test equipment used, and the date tests were performed; identifies the persons who performed the tests; and identifies the insulation resistance and leakage current results for each cable section tested. The report shall provide conclusions and recommendations for corrective action.
G. Online Partial Discharge Test: Comply with IEEE 400 and 400.3. Test all new and service-aged cables. Perform tests after cables have passed the insulation-resistance test, and after successful energization.
   1. Testing shall use a time or frequency domain detection process, incorporating radio frequency current transformer sensors with a partial discharge detection range of 10 kHz to 300 MHz.
   2. Provide a comprehensive report that describes the identification and location of cables tested, the test equipment used, and the date tests were performed; identifies the persons who performed the tests; and numerically and graphically identifies the magnitude of

partial discharge detected for each cable section tested. The report shall provide conclusions and recommendations for corrective action.

H. Final Acceptance: Final acceptance shall depend upon the satisfactory performance of the cables under test. No cable shall be energized until recorded test data have been approved by the Resident Engineer. Final test reports shall be provided to the Resident Engineer.

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SECTION 26 05 21
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-rated construction.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

Low voltage cables shall be thoroughly tested at the factory per NEMA WC-70 to ensure that there are no electrical defects. Factory tests shall be certified.

1.5 SUBMITTALS

A. In addition to the requirements of Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certifications: Two weeks prior to the final inspection, submit four copies of the following certifications to the COR:
   a. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
   b. Certification by the contractor that the materials have been properly installed, connected, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.

B. American Society of Testing Material (ASTM):
D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

C. National Fire Protection Association (NFPA):
70-08.....National Electrical Code (NEC)

D. National Electrical Manufacturers Association (NEMA):
WC 70-09.....Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

E. Underwriters Laboratories, Inc. (UL):
44-05.....Thermoset-Insulated Wires and Cables
83-08.....Thermoplastic-Insulated Wires and Cables
467-071.....Electrical Grounding and Bonding Equipment
486A-486B-03.....Wire Connectors
486C-04.....Splicing Wire Connectors
486D-05.....Sealed Wire Connector Systems
486E-94.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-07.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
514B-04.....Conduit, Tubing, and Cable Fittings
1479-03.....Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Conductors and cables shall be in accordance with NEMA WC-70 and as specified herein.

B. Single Conductor:
1. Shall be annealed copper.
2. Shall be stranded.
3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.

C. Insulation:
1. XHHW-2 or THHN-THWN shall be in accordance with NEMA WC-70, UL 44, and UL 83.

D. Color Code:
1. Secondary service feeder and branch circuit conductors shall be color-coded as follows:

208/120 volt	Phase	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

a. Lighting circuit “switch legs” and 3-way switch “traveling wires” shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the COR.

2. Use solid color insulation or solid color coating for No. 12 AWG and No. 10 AWG branch circuit phase, neutral, and ground conductors.
3. Conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
   a. Solid color insulation or solid color coating.
   b. Stripes, bands, or hash marks of color specified above.
   c. Color as specified using 0.75 in wide tape. Apply tape in half-overlapping turns for a minimum of 3 in for terminal points, and in junction boxes, pull-boxes, and troughs. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

2.2 SPLICES AND JOINTS

A. In accordance with UL 486A, C, D, E, and NEC.
B. Circuits (No. 10 AWG and smaller):
   1. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220˚ F, with integral insulation, approved for copper and aluminum conductors.
   2. The integral insulator shall have a skirt to completely cover the stripped wires.
   3. The number, size, and combination of conductors, as listed on the manufacturer's packaging, shall be strictly followed.

C. Circuits (No. 8 AWG and larger):
   1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
   2. Field-installed compression connectors for cable sizes 250 kcmil and larger shall have not fewer than two clamping elements or compression indents per wire.
   3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
   4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 WIRE LUBRICATING COMPOUND

A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.

PART 3 - EXECUTION

3.1 GENERAL

A. Install in accordance with the NEC, and as specified.
B. Install all wiring in raceway systems.
C. Splice cables and wires only in outlet boxes, junction boxes, or pull-boxes.
D. Wires of different systems (e.g., 120 V, 277 V) shall not be installed in the same conduit or junction box system.
E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
F. For panel boards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
G. Wire Pulling:
   1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables. Use lubricants approved for the cable.
   2. Use nonmetallic ropes for pulling feeders.
   3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COTR.
   4. All cables in a single conduit shall be pulled simultaneously.

5. Do not exceed manufacturer’s recommended maximum pulling tensions and sidewall pressure values.

H. No more than three, single-phase branch circuits shall be installed in any one conduit.

3.2 WIRE AND INSULATION APPLICATIONS

A. Feeders: Type THHN/THWN, in raceway.

B. Branch Circuits: Type THHN/THWN, in raceway.

C. Wet Location Branch Circuits: Type XHHW, in raceway.

D. Concealed Branch Circuits: Type THHN/THWN, in raceway.

E. Exposed Branch Circuits: Type THHN/THWN, in raceway.

F. Fire Alarm Circuits: Type THHN/THWN, in raceway.

G. Class 1 Control Circuits: Type THHN/THWN, in raceway.

H. Class 2 Control Circuits: Type THHN/THWN, in raceway.

3.3 SPLICE INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure.

B. Tighten electrical connectors and terminals according to manufacturer's published torque values.

C. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

3.4 FEEDER IDENTIFICATION

A. In each interior pull-box and junction box, install metal tags on all circuit cables and wires to clearly designate their circuit identification and voltage. The tags shall be the embossed brass type, 1.5 in in diameter and 40 mils thick. Attach tags with plastic ties.

3.5 ACCEPTANCE CHECKS AND TESTS

A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices, such as fixtures, motors, or appliances. Test each conductor with respect to adjacent conductors and to ground. Existing conductors to be reused shall also be tested.

B. Applied voltage shall be 500VDC for 300-volt rated cable, and 1000VDC for 600-volt rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300-volt rated cable and 100 megohms for 600-volt rated cable.

C. Perform phase rotation test on all three-phase circuits.

D. The contractor shall furnish the instruments, materials, and labor for all tests.

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the general grounding and bonding requirements for electrical equipment and operations to provide a low impedance path for possible ground fault currents.

B. “Grounding electrode system” refers to all electrodes required by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.

C. The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

C. Section 26 24 16, PANELBOARDS: Low voltage panelboards.

D. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for lightning protection.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. In addition to the requirements of Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

1. Shop Drawings:
   a. Clearly present enough information to determine compliance with drawings and specifications.
   b. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
2. Test Reports: Provide certified test reports of ground resistance.
3. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR:

a. Certification that the materials and installation are in accordance with the drawings and specifications.

b. Certification by the contractor that the complete installation has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

A. American Society for Testing and Materials (ASTM):

B1-07.....Standard Specification for Hard-Drawn Copper Wire

B3-07.....Standard Specification for Soft or Annealed Copper Wire

B8-04.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-1983.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C2-07.....National Electrical Safety Code

C. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

99-2005.....Health Care Facilities

D. Underwriters Laboratories, Inc. (UL):

44-05 .....Thermoset-Insulated Wires and Cables

83-08 .....Thermoplastic-Insulated Wires and Cables

467-07 .....Grounding and Bonding Equipment

486A-486B-03 .....Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 44 or UL 83 insulated stranded copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper.

C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

2.2 GROUND RODS

A. Steel or copper clad steel, 0.75 in diameter by 10 ft long, conforming to UL 467.

B. Quantity of rods shall be as required to obtain the specified ground resistance, as shown on the drawings.

2.3 CONCRETE ENCASED ELECTRODE

Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

2.4 GROUND CONNECTIONS

A. Below Grade: Exothermic-welded type connectors.

B. Above Grade:

1. Bonding Jumpers: Compression-type connectors, using zinc-plated fasteners and external tooth lockwashers.
2. Connection to Building Steel: Exothermic-welded type connectors.
3. Ground Busbars: Two-hole compression type lugs, using tin-plated copper or copper alloy bolts and nuts.
4. Rack and Cabinet Ground Bars: One-hole compression-type lugs, using zinc-plated or copper alloy fasteners.

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 0.375 in thick x 0.75 in wide.

2.6 GROUND TERMINAL BLOCKS

At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.7 GROUNDING BUS

Pre-drilled rectangular copper bar with stand-off insulators, minimum 0.25 in thick x 4 in high in cross-section, length as shown on drawings, with 0.281 in holes spaced 1.125 in apart.

PART 3 - EXECUTION

3.1 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as specified herein.

B. System Grounding:
   1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
   2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
C. Equipment Grounding: Metallic structures, including ductwork and building steel, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

Make grounding connections, which are normally buried or otherwise inaccessible (except connections for which access for periodic testing is required), by exothermic weld.

3.3 MEDIUM VOLTAGE EQUIPMENT AND CIRCUITS

A. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium voltage conductors, sized per NEC except that minimum size shall be 2 AWG. Bond the equipment grounding conductors to the switchgear ground bus, to all manhole hardware and ground rods, to the cable shielding grounding provisions of medium-voltage cable splices and terminations, and to equipment enclosures.
B. Pad-Mounted Transformers:
   1. At a minimum, provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad.
   2. Ground the secondary neutral.

3.4 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
   1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building steel, and supplemental or made electrodes. Provide jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
   2. Provide a supplemental ground electrode and bond to the grounding electrode system.

C. Panelboards:
   1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
   2. For service entrance equipment, connect the grounding electrode conductor to the ground bus.
   3. Provide ground bars, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
   4. Connect metallic conduits that terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.

3.5 RACEWAY

A. Conduit Systems:
   1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
   2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
   3. Conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
   4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a bare grounding conductor to the equipment ground bus.

B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, power, and lighting branch circuits.

C. Boxes, Cabinets, Enclosures, and Panelboards:
   1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
   2. Provide lugs in each box and enclosure for equipment grounding conductor termination.

D. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to

the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

E. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

F. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

3.6 CORROSION INHIBITORS

Apply a corrosion inhibitor to all contact surfaces when making ground and ground bonding connections. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.7 LIGHTNING PROTECTION SYSTEM

Bond the lightning protection system to the electrical grounding electrode system.

3.8 ELECTRICAL ROOM GROUNDING

Building Earth Ground Busbars: Provide ground busbar and mounting hardware at each electrical room and connect to pigtail extensions of the building grounding ring.

3.9 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.

B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

C. Below-grade connections shall be visually inspected by the COTR prior to backfilling. The contractor shall notify the COTR 24 hours before the connections are ready for inspection.

3.10 GROUND ROD INSTALLATION

A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 24 in below final grade.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.

C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

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SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

A. Section 06 10 00, ROUGH CARPENTRY: Mounting board for telephone closets.

B. Section 07 60 00, FLASHING AND SHEET METAL: Fabrications for the deflection of water away from the building envelope at penetrations.

C. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.

D. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.

E. Section 09 91 00, PAINTING: Identification and painting of conduit and other devices.

F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

G. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

H. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground conduits.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. In addition to the requirements of Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

1. Manufacturer's Literature and Data: Showing each cable type and rating. The specific item proposed and its area of application shall be identified on the catalog cuts.

2. Shop Drawings:
   a. Size and location of main feeders.
   b. Size and location of panels and pull-boxes.
   c. Layout of required conduit penetrations through structural elements.
3. Certifications:
   a. Two weeks prior to the final inspection, submit four copies of the following certifications to the COR:
      1. Certification by the manufacturer that the material conforms to the requirements of the drawings and specifications.
      2. Certification by the contractor that the material has been properly installed.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American National Standards Institute (ANSI):
C80.1-05.....Electrical Rigid Steel Conduit
C80.3-05.....Steel Electrical Metal Tubing
C80.6-05.....Electrical Intermediate Metal Conduit

C. National Fire Protection Association (NFPA):
70-08.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):
1-05.....Flexible Metal Conduit
5-04.....Surface Metal Raceway and Fittings
6-07.....Electrical Rigid Metal Conduit - Steel
50-95.....Enclosures for Electrical Equipment
360-093.....Liquid-Tight Flexible Steel Conduit
467-07.....Grounding and Bonding Equipment
514A-04.....Metallic Outlet Boxes
514B-04.....Conduit, Tubing, and Cable Fittings
514C-96.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
797-07.....Electrical Metallic Tubing
1242-06.....Electrical Intermediate Metal Conduit - Steel

E. National Electrical Manufacturers Association (NEMA):
FB1-07.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

PART 2 - PRODUCTS

2.1 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 0.75 in unless otherwise shown. Where permitted by the NEC, 0.5 in flexible conduit may be used for tap connections to recessed lighting fixtures.

B. Conduit:
   1. Rigid steel: Shall conform to UL 6 and ANSI C80.1.
   2. Rigid intermediate steel conduit (IMC): Shall conform to UL 1242 and ANSI C80.6.
   3. Electrical metallic tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 4 in and shall be permitted only with cable rated 600 V or less.
   4. Flexible galvanized steel conduit: Shall conform to UL 1.
   5. Liquid-tight flexible metal conduit: Shall conform to UL 360.

C. Conduit Fittings:
   1. Rigid steel and IMC conduit fittings:
      a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
      b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
      c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
      d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
      e. Sealing fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
   3. Electrical metallic tubing fittings:
      a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
      b. Only steel or malleable iron materials are acceptable.
      c. Compression couplings and connectors: Concrete-tight and rain-tight, with connectors having insulated throats
      d. Indent-type connectors or couplings are prohibited.
      e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.

4. Flexible steel conduit fittings:
   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp-type, with insulated throat.
5. Liquid-tight flexible metal conduit fittings:
   a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

D. Conduit Supports:
1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple conduit (trapeze) hangers: Not less than 1.5 x 1.5 in, 12-gauge steel, cold-formed, lipped channels; with not less than 0.375 in diameter steel hanger rods.
4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
4. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:
1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the COTR prior to drilling through structural elements.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except where permitted by the COR as required by limited working space.

B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight, as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

A. In accordance with UL, NEC, as shown, and as specified herein.

B. Normal/Emergency raceway systems shall be entirely independent of other raceway systems, except where shown on drawings.

C. Install conduit as follows:

1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut square, ream, remove burrs, and draw up tight.
6. Independently support conduit at 8 ft on centers. Do not use other supports, i.e., suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts.
7. Support within 12 in of changes of direction, and within 12 in of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.

12. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

D. Conduit Bends:
1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown on drawings.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COR.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:
1. Conduit: Rigid steel.
2. Align and run conduit in direct lines.
3. Otherwise prohibited, install conduit through concrete beams only:
   a. Where shown on the structural drawings.
   b. As approved by the COTR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 3 in thick is prohibited.
   a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
   b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.
   c. Install conduits approximately in the center of the slab so that there will be a minimum of 0.75 in of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.

B. Above Furred or Suspended Ceilings and in Walls:
1. Conduit for conductors 600 V and below: Rigid steel, IMC, or EMT. Mixing different types of conduits indiscriminately in the same system is prohibited.

2. Align and run conduit parallel or perpendicular to the building lines.
3. Connect recessed lighting fixtures to conduit runs with maximum 6 ft of flexible metal conduit extending from a junction box to the fixture.
4. Tightening setscrews with pliers is prohibited.

3.4 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
B. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits indiscriminately in the system is prohibited.
C. Align and run conduit parallel or perpendicular to the building lines.
D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
E. Support horizontal or vertical runs at not over 8 ft intervals.
F. Surface metal raceways: Use only where shown.
G. Painting:
   1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.

3.5 WET OR DAMP LOCATIONS

A. Unless otherwise shown, use conduits of rigid steel or IMC.
B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.
C. Unless otherwise shown, use rigid steel or IMC conduit within 5 ft of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.

3.6 MOTORS AND VIBRATING EQUIPMENT

A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.

Provide a green equipment grounding conductor with flexible metal conduit.

3.7 CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 lbs. Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:

1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
2. Existing Construction:
   a. Steel expansion anchors not less than 0.25 in bolt size and not less than 1.125 in embedment.
   b. Power set fasteners not less than 0.25 in diameter with depth of penetration not less than 3 in.
   c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.8 BOX INSTALLATION

A. Boxes for Concealed Conduits:
   1. Flush-mounted.
   2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations.

C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

D. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 24 in center-to-center lateral spacing shall be maintained between boxes.

E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 4 in square x 2.125 in deep, with device covers for the wall material and thickness involved.

F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."

G. On all branch circuit junction box covers, identify the circuits with printed label.

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SECTION 26 05 36
CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes steel cable trays and accessories.

1.2 SUBMITTALS

A. Along with the submittal requirements found in section 26 05 11 "Requirements for Electrical Installations", submit the following:

1. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.
2. Shop Drawings: For each type of cable tray.
   a. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
   b. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
      1) Design Calculations: Calculate requirements for selecting seismic restraints.
      2) Detail fabrication, including anchorages and attachments to structure and to supported cable trays.
3. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:
   a. Vertical and horizontal offsets and transitions.
   b. Clearances for access above and to side of cable trays.
   c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
4. Field quality-control reports.
5. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store indoors to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. GS Metals Corp.; GLOBETRAY Products.
3. MONO-SYSTEMS, Inc.
4. MPHusky.
5. PW Industries.

2.2 MATERIALS AND FINISHES

A. Cable Trays, Fittings, and Accessories: Steel, complying with NEMA VE 1.

1. Electrogalvanized before fabrication, complying with ASTM B 633; with hardware galvanized according to ASTM B 633.

B. Sizes and Configurations: Refer to the Drawings for specific requirements for sizes and configurations.

2.3 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 WARNING SIGNS

A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

PART 3 - EXECUTION

3.1 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA VE 1.

3.2 CABLE TRAY INSTALLATION

A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

B. Remove burrs and sharp edges from cable trays.

C. Fasten cable tray supports to building structure.

1. Design each fastener and support to carry load indicated by seismic requirements.
2. Place supports so that spans do not exceed maximum spans on schedules.
3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
4. Support bus assembly to prevent twisting from eccentric loading.
5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
6. Locate and install supports according to NEMA VE 1.

D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.

E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.

F. Make changes in direction and elevation using standard fittings.

G. Make cable tray connections using standard fittings.

H. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

I. Workspace: Install cable trays with enough space to permit access for installing cables.

J. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

K. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.3 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Install covers after installation of cable is completed.

3.4 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.5 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:

1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.

6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

B. Report results in writing.

3.6 PROTECTION

A. Protect installed cable trays.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.
3. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

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SECTION 26 05 41
UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of precast manholes and pullboxes with ducts to form a complete underground raceway system.

B. “Duct” and “conduit,” and “rigid metal conduit” and “rigid steel conduit” are used interchangeably in this specification.

1.2 RELATED WORK

A. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings and boxes for raceway systems.

E. Section 31 20 00, EARTH MOVING: Trenching, backfill and compaction.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Coordinate layout and installation of ducts, manholes, pullboxes, and pull-boxes with final arrangement of other utilities, site grading, and surface features, as determined in the field.

1.4 SUBMITTALS

A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Shop Drawings:

1. Clearly present sufficient information to determine compliance with drawings and specifications.
2. Include manholes, pullboxes, duct materials, and hardware. Submit plan and elevation drawings, showing openings, pulling irons, cable supports, cover, ladder, sump, and other accessories and details.
3. Proposed deviations from details on the drawings shall be clearly marked on the submittals. If it is necessary to locate manholes or

pullboxes at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit four copies to the Resident Engineer for approval prior to construction.

C. Certifications: Two weeks prior to the final inspection, submit four copies of the following certifications to the Resident Engineer:
   1. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
   2. Certification by the contractor that the materials have been properly installed, connected, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Concrete Institute (ACI):
   Building Code Requirements for Structural Concrete
   318/318M-05.....Building Code Requirements for Structural Concrete & Commentary
   SP-66-04.....ACI Detailing Manual

C. American National Standards Institute (ANSI):
   77-07.....Underground Enclosure Integrity

D. American Society for Testing and Materials (ASTM):
   C478-09.....Standard Specification for Precast Reinforced Concrete Manhole Sections
   C858-09.....Underground Precast Concrete Utility Structures
   C990-09.....Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.

E. Institute of Electrical and Electronic Engineers (IEEE):
   C2-07 .....National Electrical Safety Code

F. National Electrical Manufacturers Association (NEMA):
   TC 2-03.....Electrical Polyvinyl Chloride (PVC) Tubing And Conduit
   TC 3-2004.....PVC Fittings for Use With Rigid PVC Conduit And Tubing

TC 6 & 8 2003.....PVC Plastic Utilities Duct For Underground Installations

TC 9-2004.....Fittings For PVC Plastic Utilities Duct For Underground Installation

G. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

H. Underwriters Laboratories, Inc. (UL):

6-07.....Electrical Rigid Metal Conduit-Steel

467-07.....Grounding and Bonding Equipment

651-05.....Schedule 40 and 80 Rigid PVC Conduit and Fittings

651A-00.....Type EB and A Rigid PVC Conduit and HDPE Conduit

651B-07.....Continuous Length HDPE Conduit

I. U.S. General Services Administration (GSA):

A-A-60005-1998.....Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

1.6 STORAGE

Lift and support pre-cast concrete structures only at designated lifting or supporting points.

PART 2 - PRODUCTS

2.1 PULLBOXES

A. General: Size as indicated on drawings. Provide pullboxes with weatherproof, non-skid covers with recessed hook eyes, secured with corrosion- and tamper-resistant hardware. Cover material shall be identical to pullbox material. Covers shall have molded lettering, ELECTRIC or SIGNAL as applicable. Pullboxes shall comply with the requirements of ANSI/SCTE 77 Tier 8 loading. Provide pulling irons, 0.875 in [22 mm] diameter galvanized steel bar with exposed triangular-shaped opening.

B. Concrete Pullboxes: Shall be monolithically-poured reinforced concrete.

2.2. DUCTS

A. Number and sizes shall be as shown on drawings.

B. Ducts (concrete-encased):

1. Plastic Duct:

a. NEMA TC6 & 8 and TC9 plastic utilities duct.

b. Duct shall be suitable for use with 194° F [90° C] rated conductors.

2. Conduit Spacers: Prefabricated plastic.

2.3 GROUNDING

A. Rods: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

B. Ground Wire: Stranded bare copper 6 AWG minimum or as indicated on drawings.

2.4 WARNING TAPE

Standard 4-mil polyethylene 3 in [76 mm] wide detectable tape, red with black letters, imprinted with “CAUTION - BURIED ELECTRIC CABLE BELOW” or similar.

2.5 PULL ROPE FOR SPARE DUCTS

Plastic with 200 lb [890 N] minimum tensile strength.

PART 3 - EXECUTION

3.1 PULLBOX INSTALLATION

A. Assembly and installation shall follow the printed instructions and recommendations of the manufacturer. Install manholes and pullboxes level and plumb.

1. Units shall be installed on a 12 in level bed of 90% compacted granular fill, well-graded from the 1 in sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.

2. Seal duct terminations so they are watertight.

B. Access: Ensure the top of frames and covers are flush with finished grade.

3.2 TRENCHING

A. Refer to Section 31 20 00, EARTH MOVING for trenching, backfilling, and compaction.

B. Before performing trenching work at existing facilities, the Ground Penetrating Radar Survey shall be carefully performed by certified technician to reveal all existing underground ducts, conduits, cables, and other utility systems.

C. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.

D. Cut the trenches neatly and uniformly.

E. For Concrete-Encased Ducts:

1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 4 ft intervals to establish the grade and route of the duct bank.
2. Pitch the trenches uniformly toward manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts toward buildings wherever possible.
3. The walls of the trench may be used to form the side walls of the duct bank, provided that the soil is self-supporting and that concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.
4. After the concrete-encased duct has sufficiently cured, the trench shall be backfilled to grade with earth, and appropriate warning tape installed.

F. Conduits to be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place. Conduits shall be heavy wall rigid steel.

3.3 DUCT INSTALLATION

A. General Requirements:

1. Ducts shall be in accordance with the NEC and IEEE C2, as shown on the drawings, and as specified.
2. Slope ducts to drain towards manholes and pullboxes, and away from building and equipment entrances. Pitch not less than 4 in in 100 ft.
3. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be taped galvanized rigid steel, and shall extend a minimum of 5 ft outside the building foundation. Tops of conduits below building slab shall be minimum 24 in below bottom of slab.
4. Stub-ups, sweeps, and risers to equipment mounted on outdoor concrete slabs shall be taped galvanized rigid steel, and shall extend a minimum of 5 ft away from the edge of slab.
5. Install insulated grounding bushings on the terminations.
6. Radius for turns of direction shall be sufficient to accomplish pulls without damage. Minimum radius shall be six times conduit diameter. Use manufactured long sweep bends.
7. Additional burial depth shall be required in order to accomplish NEC-required minimum bend radius of ducts.

8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 3 in above the bottom of the trench during the concrete pour. Spacer spacing shall not exceed 5 ft. Secure spacers to ducts and earth to prevent floating during concrete pour. Provide nonferrous tie wires to prevent displacement of the ducts during pouring of concrete. Tie wires shall not act as substitute for spacers.
9. Duct lines shall be installed no less than 12 in from other utility systems, such as water, sewer, and chilled water.
10. Clearances between individual ducts:
    a. For like services, not less than 3 in.
    b. For power and signal services, not less than 6 in.
11. Duct lines shall terminate at window openings in e walls as shown on the drawings. All ducts shall be fitted with end bells.
12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.
14. Seal conduits, including spare conduits, at building entrances and at outdoor equipment terminations with a suitable compound to prevent entrance of moisture and gases.

B. Concrete-Encased Ducts and Conduits:
1. Install concrete-encased ducts for medium-voltage systems.
2. Duct lines shall consist of single or multiple duct assemblies encased in concrete. Ducts shall be uniform in size and material throughout the installation.
3. Tops of concrete-encased ducts shall be:
    a. Not less than 24 in and not less than shown on the drawings, below finished grade.
    b. Not less than 30 in and not less than shown on the drawings, below roads and other paved surfaces.
    c. Conduits crossing under grade slab construction joints shall be installed a minimum of 4 ft below slab.
4. Extend the concrete envelope encasing the ducts not less than 3 in beyond the outside walls of the outer ducts and conduits.

5. Within 10 ft of building pullbox wall penetrations, install reinforcing steel bars at the top and bottom of each concrete envelope to provide protection against vertical shearing.
6. Install reinforcing steel bars at the top and bottom of each concrete envelope of all ducts underneath roadways and parking areas.
7. Where new ducts, conduits, and concrete envelopes are to be joined to existing manholes, pullboxes, ducts, conduits, and concrete envelopes, make the joints with the proper fittings and fabricate the concrete envelopes to ensure smooth durable transitions.
8. Conduit joints in concrete may be placed side by side horizontally, but shall be staggered at least 6 in vertically.
9. Pour each run of concrete envelope between manholes or other terminations in one continuous pour. If more than one pour is necessary, terminate each pour in a vertical plane and install 0.75 in reinforcing rod dowels extending 18 in into concrete on both sides of joint near corners of envelope.
10. Pour concrete so that open spaces are uniformly filled. Do not agitate with power equipment unless approved by Resident Engineer.
11. Duct Bank Markers:
    a. Duct bank markers, where required and shown on plans, shall be located at the ends of duct banks except at manholes or pullboxes at approximately every 200 ft along the duct run and at each change in direction of the duct run. Markers shall be placed 2 ft to the right of the duct bank, facing the longitudinal axis of the run in the direction of the electrical load.
    b. The letter ”D” with two arrows shall be impressed or cast on top of the marker. One arrow shall be located below the letter and shall point toward the ducts. The second arrow shall be located adjacent to the letter and shall point in a direction parallel to the ducts. The letter and arrow adjacent to it shall each be approximately 2 in long. The letter and arrows shall be V-shaped, and shall have a width of stroke at least 0.75 in at the top and a depth of 0.25 in.
    c. In paved areas, the top of the duct markers shall be flush with the finished surface of the paving.

d. Where the duct bank changes direction, the arrow located adjacent to the letter shall be cast or impressed with an angle in the arrow equivalent to the angular change of the duct bank.

C. Concrete-Encased Duct and Conduit Identification: Place continuous strip of warning tape approximately 12 in above ducts or conduits before backfilling trenches. Warning tape shall be preprinted with proper identification.

D. Spare Ducts and Conduits: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.

E. Duct and Conduit Cleaning:

1. Upon completion of the duct installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct. The mandrel shall be not less than 12 in long, and shall have a diameter not less than 0.5 in less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.
2. Mandrel pulls shall be witnessed by the Resident Engineer.

F. Duct and Conduit Sealing: Seal the ducts and conduits at building entrances, and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of moisture and gases.

G. Connections to Existing Ducts: Where connections to existing duct banks are indicated, excavate around the duct banks as necessary. Cut off the ducts and remove loose concrete from inside before installing new ducts. Provide a reinforced-concrete collar, poured monolithically with the new ducts, to take the shear at the joint of the duct banks.

H. Partially-Completed Duct Banks: During construction, wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 ft [0.6 M] back into the envelope and a minimum of 2 ft [0.6 M] beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 in [75 mm] from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately

12 in [300 mm] apart. Restrain reinforcing assembly from moving during pouring of concrete.

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SECTION 26 05 71
ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the requirements of the Electrical System Protective Device Study (herein, “the study”).

B. A short-circuit and selective coordination study shall be prepared for the electrical overcurrent devices to be installed under this project.

C. The study shall present an organized time-current analysis of each protective device in series from the branch circuit breakers in the building branch panels back to the campus medium voltage switchgear indicated on the drawings. The study shall reflect the operation of each device during normal and abnormal current conditions.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

B. Section 26 24 11, DISTRIBUTION SWITCHBOARDS: Low-voltage distribution switchboards.

C. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. The protective device study shall be prepared by the equipment manufacturer's qualified engineers or an approved consultant. The contractor is responsible for providing all pertinent information required by the preparers to complete the study.

1.4 SUBMITTALS

A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. Product data on the software program to be used for the study. Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current drawings.

C. Complete short-circuit, arc-flash, and coordination study as described in paragraph 1.6.

D. Protective equipment shop drawings shall be submitted simultaneously with or after the protective device study. Protective equipment shop drawings will not be accepted prior to protective device study.

E. Certification: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
Certification by the contractor that the protective devices have been adjusted and set in accordance with the approved protective device study.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Institute of Electrical and Electronics Engineers (IEEE):
242-01.....Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
399-97.....Recommended Practice for Power Systems Analysis
1584a-04.....Guide for Performing Arc-Flash Hazard Calculations

1.6 REQUIREMENTS

A. The complete study shall include a system one line diagram, short-circuit, and protective coordination plots for all overcurrent protective devices.

B. One Line Diagram:
1. On the one line diagram, show all electrical equipment and wiring to be protected by the overcurrent devices installed under this project.
2. On the one line diagram, also show the following specific information:
a. Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.
b. Breaker and fuse ratings.
c. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
d. Voltage at each bus.

e. Identification of each bus, matching the identification on the construction drawings.

f. Conduit, cable, and busway material and sizes, length, and X/R ratios.

C. Short-Circuit Study:

1. Systematically calculate the fault impedance to determine the available short-circuit and ground fault currents at each bus. Incorporate the motor contribution in determining the momentary and interrupting ratings of the protective devices.

2. The study shall be calculated by means of a computer program. Pertinent data and the rationale employed in developing the calculations shall be incorporated in the introductory remarks of the study.

3. Present the data conclusions of the short-circuit study in a table format. Include the following:

a. Device identification.

b. Operating voltage.

c. Protective device.

d. Device rating.

e. Calculated short-circuit current.

D. Arch-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. No AC Decrement (NACD) ratio.

e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

2. Incident Energy and Flash Protection Boundary Calculations:

a. Arcing fault magnitude.

b. Protective device clearing time.

c. Duration of arc.

d. Arc-flash boundary.

e. Working distance.

f. Incident energy.

g. Hazard risk category.

h. Recommendations for arc-flash energy reduction.

3. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

E. Arc-Flash Warning Labels

1. Comply with requirements in Section 260511 "Requirements for Electrical Installations". Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

2. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

a. Location designation.

b. Nominal voltage.

c. Flash protection boundary.

d. Hazard risk category.

e. Incident energy.

f. Working distance.

g. Engineering report number, revision number, and issue date.

3. Labels shall be machine printed, with no field-applied markings.

F. Coordination Curves:

1. Prepare the coordination curves to determine the required settings of protective devices to ensure selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between series devices, including the utility company upstream device. Plot the specific time-current characteristics of each protective device in such a manner that all upstream devices are clearly depicted on one sheet.

2. The following specific information shall also be shown on the coordination curves:

a. Device identification.

b. Voltage and current ratio for curves.

c. 3-phase and 1-phase ANSI damage points for each transformer.

d. No-damage, melting, and clearing curves for fuses.

e. Cable damage curves.

f. Transformer in-rush points.

g. Maximum short-circuit cutoff point.

3. Develop a table to summarize the settings selected for the protective devices. Include the following in the table:

a. Device identification.

b. Relay CT ratios, tap, time dial, and instantaneous pickup.

c. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.

d. Fuse rating and type.

e. Ground fault pickup and time delay.

1.7 ANALYSIS

A. Analyze the short-circuit and arch-flash calculations, and highlight any equipment determined to be underrated as specified. Propose approaches to effectively protect the underrated equipment. Provide minor modifications to conform with the study (examples of minor modifications are trip sizes within the same frame, the time-current curve characteristics of induction relays, CT ranges, etc.).

B. After developing the coordination curves, highlight areas lacking coordination. Present a technical evaluation with a discussion of the logical compromises for best coordination.

C. Contractor shall select equipment to best meet the intent of system selective coordination.

1.8 ADJUSTMENTS, SETTINGS AND MODIFICATIONS

A. Necessary final field adjustments, settings, and minor modifications shall be made to conform with the study without additional cost to the Government.

B. All final circuit breaker and relay settings and fuse sizes shall be made in accordance with the recommendations of the study.

C. Place arc-flash labels on all required equipment.

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SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 26.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. This Section includes requirements for commissioning the electrical systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

C. The commissioning activities have been developed to support the United States Green Building Council (USGBC) LEED™ rating program and to support delivery of project performance in accordance with the Contract Documents developed with the approval of the VA.

1. Commissioning activities and documentation for the LEED™ section on “Energy and Atmosphere” prerequisite of “Fundamental Building Systems Commissioning”.
2. Commissioning activities and documentation for the LEED™ section on “Energy and Atmosphere” requirements for the “Enhanced Building System Commissioning” credit.
3. Activities and documentation for the LEED™ section on “Measurement and Verification” requirements for the Measurement and Verification credit.

D. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following Electrical systems will be commissioned:

1. Service Entrance Switchboard (Circuit breaker settings, metering, mimic diagram, and controls).
2. Normal Power Distribution Systems (Grounding tests, coordination study review, major circuit breaker settings, meters and gages, and controls).
3. Life Safety Power Distribution Systems).
4. Lighting Controls (Control system hardware and software, scene settings, zone settings, occupancy sensor interface, and unoccupied cycle control).
5. Uninterruptible Power Supply Systems and UPS Power Distribution Systems (Battery chargers, static and dynamic power generators – i.e. inverters, MG sets, metering and controls, system power displays, and distribution panel circuit breakers).

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the Resident Engineer prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the

commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.2 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency

conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF VA PERSONNEL

A. Training of the VA's operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

----- END -----

SECTION 26 09 23
LIGHTING CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Digital Lighting Management (DLM) system as defined under this section covers the following equipment:

1. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relays controllers with 0-10 volt control for ballasts (if applicable) and single relay application-specific plug load controllers.
2. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
3. Digital Switches – Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
4. Digital Photosensors – Single-zone closed loop and multi-zone open loop daylighting sensors with two-way active infrared (IR) communications can provide switching or dimming control for daylight harvesting.
5. Configuration Tools – Handheld remote for room configuration provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow send and receive of room variables and store of occupancy sensor settings. Handheld configuration remote was provided under previous project, coordinate and obtain remote from COR.

1.2 RELATED WORK

A. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Interface of lighting controls with HVAC control systems.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.

C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

E. Section 24 26 16, PANELBOARDS: panelboard enclosure and interior bussing used for lighting control panels.

F. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. In addition to the requirements of Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. Product Data: For each type of lighting control, submit the following information.

1. Manufacturer’s catalog data.
2. Wiring schematic and connection diagram.
3. Installation details.

C. Manuals:

1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the COR.

D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the COR:
   a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Green Seal (GS):

GC-12.....Occupancy Sensors

C. Illuminating Engineering Society of North America (IESNA):

IESNA LM-48.....Guide for Calibration of Photoelectric Control Devices

D. National Electrical Manufacturer's Association (NEMA)

C136.10.....American National Standard for Roadway Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing

ICS-1.....Standard for Industrial Control and Systems General Requirements

ICS-2.....Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment

ICS-6.....Standard for Industrial Controls and Systems Enclosures

E. Underwriters Laboratories, Inc. (UL):

20.....Standard for General-Use Snap Switches

773.....Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting

773A .....Nonindustrial Photoelectric Switches for Lighting Control

98.....Enclosed and Dead-Front Switches

917.....Clock Operated Switches

PART 2 - PRODUCTS

2.1 DIGITAL CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

A. Description: Ceiling-mounting, digital units. All units shall be dual technology type unless noted otherwise on the drawings.

1. Operation: Unless otherwise indicated, lights shall be manually turned on and automatically turn off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Provide contact relays for HVAC automatic temperature controls.
3. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.

B. PIR Type: Detect occupancy by sensing a combination of heat and movement in area of coverage.
   1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in.
   2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
   3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

C. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
   1. Detector Sensitivity: Detect a person of average size and weight moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
   2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
   3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on an 8-foot- high ceiling.
   4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
   5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.

D. Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit. All sensors on project shall be dual technology.

E. Furnish the Company’s system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.

F. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
   1. Digital calibration and pushbutton programming for the following variables:
      a. Sensitivity – 0-100% in 10% increments
      b. Time delay – 1-30 minutes in 1 minute increments
      c. Test mode – Five second time delay
      d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
      e. Walk-through mode
      f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
   2. One or two RJ-45 port(s) for connection to DLM local network.
   3. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
   4. Device Status LEDs including:
      a. PIR Detection
      b. Ultrasonic detection
      c. Configuration mode
      d. Load binding
   5. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
   6. Manual override of controlled loads.

G. Units shall not have any dip switches or potentiometers for field settings.

H. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

2.2 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration; white in color; compatible with wall plates with decorator opening. Wall switches shall include the following features:
   1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.

2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
3. Red configuration LED on each switch that blinks to indicate data transmission.
4. Blue Load/Scene Status LED on each switch button with the following characteristics:
   a. Bi-level LED
   b. Dim locator level indicates power to switch
   c. Bright status level indicates that load or scene is active
5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.

B. Two RJ-45 ports for connection to DLM local network.

C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.

D. The following switch attributes may be changed or selected using a wireless configuration tool:
1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
2. Individual button function may be configured to Toggle, On only or Off only.
3. Individual scenes may be locked to prevent unauthorized change.
4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
5. Ramp rate may be adjusted for each dimmer switch.
6. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.

2.3 LOW VOLTAGE WALL SWITCH, NON-DIGITAL

A. Low voltage momentary pushbutton switches in 1, 3, 5 or 9 button configuration; white in color; compatible with wall plates with decorator opening. Wall switches shall include the following features:
1. Pilot light next to each standard button for remote indication of lighting status.
2. Mounts in single or double gang outlet box.
3. Removable lens cap for labeling each standard button with 3/8" laminated tape.

2.4 ROOM CONTROLLERS

A. Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:
   1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
   2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
   3. Device Status LEDs to indicate:
      a. Data transmission
      b. Device has power
      c. Status for each load
      d. Configuration status
   4. Quick installation features including:
      a. Standard junction box mounting
      b. Quick low voltage connections using standard RJ-45 patch cable
   5. Plenum rated
   6. Manual override and LED indication for each load
   7. Dual voltage (120/277 VAC, 60 Hz)
   8. Zero cross circuitry for each load.
B. On/Off Room Controllers shall include:
   1. One or two relay configuration
   2. Efficient 150 mA switching power supply
   3. Three RJ-45 DLM local network ports
   4. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
      a. One relay configuration only
      b. Automatic-ON/OFF configuration
C. On/Off/Dimming enhanced Room Controllers shall include:
   1. Real time current monitoring
   2. One, two or three relay configuration
   3. Efficient 250 mA switching power supply
   4. Four RJ-45 DLM local network ports.

5. One 0-10 volt analog output per relay for control of compatible ballasts and LED drivers.
6. The following dimming attributes may be changed or selected using a wireless configuration tool:
   a. Establish preset level for each load from 0-100%
   b. Set high and low trim for each load
   c. Set lamp burn in time for each load up to 100 hours
7. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
   a. One relay configuration only
   b. Automatic-ON/OFF configuration

2.5 DIGITAL PHOTOSENSORS

A. Digital photosensors work with room controllers to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller. Closed loop photosensors measure the ambient light in the space and control a single lighting zone. Open loop photosensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.

B. Digital photosensors include the following features:
   1. An internal photodiode that measures only within the visible spectrum, and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
   2. Sensor light level range shall be from 1-10,000 footcandles (fc).
   3. The capability of switching one-third, one-half or all lighting ON and OFF, or raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
   4. For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the “ON Setpoint” and the “OFF Setpoint” that will prevent the lights from cycling after they turn off.

5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user-selectable minimum level.
6. Optional programmable wall switch override to allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise and lower lighting levels for a selected period of time or cycle of occupancy.
7. Infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
8. Red configuration LED that blinks to indicate data transmission.
9. Blue status LED indicates test mode, override mode and load binding.
10. Recessed switch to turn controlled load(s) ON and OFF.
11. One RJ-45 port for connection to DLM local network.
12. An adjustable head and a mounting bracket to accommodate multiple mounting methods and building materials. The photosensor may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox.

C. Closed loop digital photosensors include the following additional features:
1. An internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from bright sources outside of this cone.
2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
3. Automatically establishes setpoints following self-calibration.
4. A sliding setpoint control algorithm for dimming daylight harvesting with a “Day Setpoint” and the “Night Setpoint” to prevent the lights from cycling.

D. Open loop digital photosensors include the following additional features:
1. An internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
2. Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.

3. A proportional control algorithm for dimming daylight harvesting with a “Setpoint” to be maintained during operation.

2.6 ROOM NETWORK (DLM LOCAL NETWORK)

A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building. Digital room devices connect to the network using CAT 5e cables with RJ-45 connectors which provide both data and power to room devices. Features of the DLM local network include:
   1. Plug n’ Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
   2. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
   3. Push n’ Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
   4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

2.7 CONFIGURATIONS TOOLS

A. A configuration tool facilitates optional customization of DLM local networks, and is used to set up open loop daylighting sensors. A wireless configuration tool features infrared communications, while PC software connects to each local network via a USB interface.

B. Features and functionality of the wireless configuration tool shall include:
   1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
   2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
   3. Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers and buttons on digital wall switches.
   4. Save up to nine occupancy sensor setting profiles, and apply profiles to selected sensors.

5. Temporarily adjust light level of any load(s)on the local network, and incorporate those levels in scene setting.
6. Adjust or fine-tune daylighting settings established during auto-commissioning, and input light level data to complete commissioning of open loop daylighting controls.

2.8 ISOLATED RELAY INTERFACE

A. Isolated relay interface is for the DLM system, enabling integration of third party devices such as HVAC systems.

B. Interface device contains a single pole, double throw isolated relay with normally open, normally closed, and common outputs.

C. Features:

1. Integrates with any analog low voltage device.
2. Single LED for relay status.
3. Over-current protection.
4. Two RJ45 ports with hinged dust cover.
5. UL 2043 plenum rated.
6. RoHS compliant.

D. Ratings:

1. Operating Voltage: 24VDC from DLM system.
2. Single Pole/Double Throw Switch: 24VDC/VAC, 1A.

2.9 LIGHTING CONTROL PANEL – RELAY TYPE

A. Controller: Comply with UL 508; programmable, solid-state, astronomic 365-day control unit with non-volatile memory, mounted in preassembled relay panel with low-voltage-controlled, latching-type, single-pole lighting circuit relays. Controller shall be capable of receiving inputs from sensors and other sources, and capable of timed overrides and/or blink-warning on a per-circuit basis. Digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays.

B. Cabinet: Steel with hinged, locking door. Barriers separate low-voltage and line-voltage components. Provide custom over-sized cabinet with barriers to separate normal and normal/emergency circuits.

C. Directory: Identifies each relay as to load controlled.

D. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.

E. Single-Pole Relays: Heavy duty relays, mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A,

125-V ac for tungsten filaments and 20 A, 277-V ac for ballasts, 1.5 HP at 120V, 50,000 cycles at rated capacity. Circuits indicated on drawings shall feed through relay indicated before terminating at electrical panel indicated. If power failure to panel occurs, relay shall fail closed.

F. Panels indicated with emergency relays shall provide certified fail-safe operation of lighting control circuits controlled by relays within the panel.
   1. Operation of emergency relays shall be as follows:
      a. When normal power is lost, all relays controlling emergency circuits shall be individually bypassed automatically by a set of normally closed contacts.
   2. Emergency relays shall meet the following requirements:
      a. UL 924 listed for use on emergency circuits.
      b. 30A normally closed contactors used for shunt operation.
      c. Relay requirements:
         1) Coil voltage, 24VDC, pulse ON and pulse OFF.
         2) Mechanically latched contacts
         3) 1/2" K, O, mounting, low voltage plug connection, individually replaceable.
         4) Endurance, 300,000 mechanical cycles.

F. Panel shall be furnished with communications module to connect and communicate with existing building central energy management system. Confirm exact system protocol with hospital COTR.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.

B. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer’s recommendations.

C. Set occupancy sensor "on" duration to 15 minutes.

D. Locate light level sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the scheduled light level at the typical work plane for that area.

E. All programming of system devices shall be via handheld wireless configuration tool. Once all system programming is complete, hand over configuration tool to COTR.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations.

B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.

D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.

E. Program lighting control panels per schedule on drawings.

3.3 TRAINING

A. Manufacturer representative shall provide one day, eight hours, of on-site training to facility personal. Training shall consist of, but not limited to, programming of devices, adjustment of devices, replacement of devices, and connection of devices.

3.4 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function.

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SECTION 26 12 19
PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of pad-mounted transformers.

B. Pad-mounted transformers shall be complete, outdoor type, continuous duty, integral assembly, grounded, tamper-resistant, and weatherproof, with liquid-immersed transformers.

1.2 RELATED WORK

A. Section 09 06 00, SCHEDULE FOR FINISHES: Finishes for electrical equipment.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

C. Section 26 05 13, MEDIUM-VOLTAGE CABLES: Medium-voltage cables.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground currents.

E. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Pull-boxes, and duct lines for underground raceway systems.

F. Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY: Short-circuit and coordination study.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

Transformers shall be thoroughly tested at the factory to ensure that there are no electrical or mechanical defects. Tests shall be conducted as per UL and ANSI Standards. Factory tests shall be certified. The following tests shall be performed:

1. Perform insulation-resistance tests, winding-to-winding and each winding-to-ground.
2. Perform turns-ratio tests at all tap positions.

1.5 SUBMITTALS

A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. Shop Drawings:

1. Clearly present sufficient information to determine compliance with drawings and specifications.
2. Include electrical ratings, nameplate data, impedance, outline drawing with dimensions and front, top, and side views, weight, mounting details, decibel rating, termination information, temperature rise, no-load and full-load losses, regulation, overcurrent protection, connection diagrams, and accessories.
3. Complete nameplate data, including manufacturer’s name and catalog number.

C. Manuals:

1. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   a. Identify terminals on wiring diagrams to facilitate installation, maintenance, and operation.
   b. Indicate on wiring diagrams the internal wiring for each piece of equipment and interconnections between the pieces of equipment.
   c. Approvals will be based on complete submissions of manuals, together with shop drawings.
2. Two weeks prior to the final inspection, submit four copies of the final up-dated maintenance and operation manuals to the Resident Engineer.
   a. Update the manual to include any information necessitated by shop drawing approval.
   b. Show all terminal identification.
   c. Include information for testing, repair, trouble-shooting, assembly, disassembly, and recommended maintenance intervals.
   d. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
   e. Furnish manuals in loose-leaf binder or manufacturer’s standard binder.

D. Certifications:

Two weeks prior to the final inspection, submit four copies of the following certifications to the Resident Engineer:

1. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
2. Certification by the contractor that the materials have been properly installed, connected, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Concrete Institute (ACI):

318-05.....Building Code Requirements for Structural Concrete

C. American National Standards Institute (ANSI):

C37.47-00.....High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches

C57.12.00-00.....General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers

C57.12.25-90.....Transformers-Pad-Mounted, Compartmental-Type, Self Cooled, Single-Phase Distribution Transformers with Separable Insulated High Voltage Connectors; High Voltage, 34500 Grd Y/19920 Volts and Below; Low-Voltage 240/120 Volts; 167 kVA and Smaller Requirements

C57.12.28-05.....Pad-Mounted Equipment Enclosure Integrity

C57.12.29-99.....Pad-Mounted Equipment – Enclosure Integrity for Coastal Environments

C57.12.34-04.....Pad-Mounted, Compartmental-Type, Self Cooled, Three-Phase Distribution Transformers, 2500kVA and Smaller – High Voltage 34500 Grd Y/19920 Volts and Below; Low-Voltage 480 Volts and Below

D. American Society for Testing and Materials (ASTM):

D3487-08.....Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus

E. Institute of Electrical and Electronic Engineers (IEEE):

C2-07.....National Electrical Safety Code

C62.11-99.....Metal-Oxide Surge Arresters for Alternating Current Power Circuits

48-09.....Test Procedures and Requirements for Alternating Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5kV Through 765kV or Extruded Insulation Rated 2.5kV Through 500kV

386-06.....Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V

592-96.....Standard for Exposed Semiconducting Shields on High Voltage Cable Joints and Separable Insulated Connectors

F. National Electrical Manufacturers Association (NEMA):

C57.12.26-87.....Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34500 Grd Y/19920 Volts and Below; 2500 kVA and Smaller

LA1-92.....Surge Arresters

TP1-02.....Guide for Determining Energy Efficiency for Distribution Transformers

TR1-00.....Transformers, Regulators, and Reactors

G. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

H. Underwriters Laboratories Inc. (UL):

467-07.....Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 EQUIPMENT, GENERAL

A. Equipment shall be in accordance with ANSI, ASTM, IEEE, NEMA, NFPA, UL, as shown on the drawings, and as specified herein. The transformer shall be assembled as an integral unit by a single manufacturer.

B. Ratings shall not be less than shown on the drawings.

C. Provide transformers designed to withstand the mechanical stresses caused by rough handling during shipment in addition to the electrical and mechanical stresses that may occur during operation.

D. Completely fabricate transformers at the factory so that only the external cable connections are required at the job site.

E. Thoroughly clean, phosphatize, and finish all the metal surfaces at the factory with a rust-resistant primer and dark green enamel finish coat, except where a different color is specified in Section 09 06 00, SCHEDULE FOR FINISHES. All surfaces of the unit that will be in contact with the concrete pad shall be treated with corrosion-resistant compounds and epoxy resin or a rubberized sealing compound.

2.2 COMPARTMENTS

A. Construction:

1. Enclosures shall be in accordance with ANSI C57.12.28.
2. The medium- and low-voltage compartments shall be separated with a steel barrier that extends the full height and depth of the compartments.
3. The compartments shall be constructed of sheet steel (gauge to meet ANSI requirements) with bracing, reinforcing gussets, and jig-welding to ensure rectangular rigidity.
4. Use cadmium or zinc plated bolts, nuts, and washers.
5. Sufficient space shall be provided for equipment, cabling, and terminations within the compartments.
6. Affix transformer nameplate permanently within the low-voltage compartment. Voltage and kVA rating, connection configuration, impedance, date of manufacture, and serial number shall be shown on the nameplate.

B. Doors:

1. Provide a separate door for each compartment with provisions for a single padlock to secure all doors. Provide each compartment door with open-position doorstops and corrosion-resistant tamperproof hinges welded in place. The medium-voltage compartment door shall be mechanically prevented from opening unless the low-voltage compartment door is open.
2. The secondary compartment door shall have a one-piece steel handle and incorporate three-point locking mechanisms.

2.3 BIL RATING

A. 15 kV class equipment shall have a minimum 95 kV BIL rating.

2.4 TRANSFORMER FUSE ASSEMBLY

A. The primary fuse assembly shall be load-break combination fuse and dry-well fuse holder rated for system voltage, rated for 10 load makes and 10 load breaks, with rated 200 amp load current at 75% power factor, 10,000 symmetrical A close-in on fault duty, and 95 kV BIL. The entire fuse assembly shall be removable through the use of hot stick.

1. The fuses shall be concealed, hot stick removable, 50,000 A symmetrical interrupting, non-expulsion, current-limiting primary distribution type, of the size and voltage class as recommend by transformer manufacturer. Fuse size shown on the drawings are for bidding purposes only. The fuses shall operate within the fuse holder as a unit disconnecting means. Fuses shall be in accordance with ANSI C37.47.
2. Transformers shall not have internal "weak link" fuses that require transformer tank cover removal for replacement.

2.5 PRIMARY CONNECTIONS

A. Primary connections shall be 200 A dead-front load break wells and inserts for cable sizes shown on the drawings.

B. Surge Arresters: Distribution class, one for each primary phase, complying with IEEE C62.11 and NEMA LA 1, supported from tank wall.

2.6 MEDIUM-VOLTAGE TERMINATIONS

A. Terminate the medium voltage cables in the primary compartment with loadbreak premolded rubber elbow connectors, suitable for submersible applications. Elbow connectors shall have a minimum of 0.125 in [3 mm] semi-conductive shield material covering the housing. The separable connector system shall include the loadbreak elbow, the bushing insert, and the bushing well. Separable connectors shall comply with the requirements of IEEE 386, and shall be interchangeable between suppliers. Loadbreak elbow and bushing insert shall be from the same manufacturer. Allow sufficient slack in medium-voltage cable, ground, and drain wires to permit elbow connectors to be moved to their respective parking stands. Elbow connectors shall be rated as follows:

1. Voltage: 15kV phase-to-phase.
2. Continuous current: 200 A RMS.

B. Ground metallic cable shields with a device designed for that purpose, consisting of a solderless connector enclosed in watertight rubber housing covering the entire assembly.

C. Provide insulated cable supports to relieve any strain imposed by cable weight or movement.

2.7 LOW-VOLTAGE EQUIPMENT

A. Mount the low voltage bushings and hot stick in the low voltage compartment.

B. The low-voltage leads shall be brought out of the tank by epoxy pressure tight bushings, and shall be standard arrangement per ANSI.

C. Tin-plate the low-voltage neutral terminal and isolate from the transformer tank. Provide a removable ground strap sized in accordance with the NEC and connect between the neutral and ground pad.

2.8 TRANSFORMERS

A. Transformers shall be three-phase, liquid-immersed, isolated winding, and self-cooled by natural convection.

B. The kVA ratings shown on the drawings are for continuous duty without the use of cooling fans.

C. Temperature rises shall not exceed the NEMA TR1 standards of 149˚ F [65˚ C] by resistance, and 180˚ F [80˚ C] hotspot at rated kVA.

D. Transformer insulating material shall be less flammable, dielectric, and UL listed as complying with NFPA 70 requirements for fire point of not less than 600˚ F [300 C] when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.

E. Transformer impedance shall be not less than 4.5% for sizes 150 kVA and larger. Impedance shall be as shown on the drawings.

F. Sound levels shall conform to NEMA TR1 standards.

G. Primary and Secondary Windings for Three-Phase Transformers:

1. Primary windings shall be delta-connected.
2. Secondary windings shall be wye-connected, except where otherwise indicated on the drawings. Provide isolated neutral bushings for secondary wye-connected transformers.
3. Secondary leads shall be brought out through pressure-tight epoxy bushings.

H. Primary windings shall have four 2.55 full-capacity voltage taps; two taps above and two taps below rated voltage.

I. Core and Coil Assemblies:
   1. Cores shall be grain-oriented, non-aging, and silicon steel to minimize losses.
   2. Core and coil assemblies shall be rigidly braced to withstand the stresses caused by rough handling during shipment, and stresses caused by any possible short-circuit currents.
   3. Coils shall be continuous-winding type without splices except for taps. Material shall be copper.
   4. Coil and core losses shall be optimum for efficient operation.
   5. Primary, secondary, and tap connections shall be brazed or pressure type.
   6. Provide end fillers or tiedowns for coil windings.

J. The transformer tank, cover, and radiator gauge thickness shall not be less than that outlined in ANSI.

K. Accessories:
   1. Provide standard NEMA features, accessories, and the following:
      a. No-load tap changer (Provide warning sign).
      b. Lifting, pulling, and jacking facilities.
      c. Globe-type valve for oil filtering and draining, including sampling device.
      d. Pressure relief valve.
      e. Liquid level gauge and filling plug.
      f. A grounding pad in the medium- and low-voltage compartments.
      g. A diagrammatic nameplate and operating instructions enclosed by a transparent cover located in the low-voltage compartment.
      h. Dial-type liquid thermometer with a maximum reading pointer and an external reset.
      i. Hot stick. Securely fasten hot stick within low-voltage compartment.
   2. The accessories shall be made accessible within the compartments without disassembling trims and covers.

L. Transformers shall meet the minimum energy efficiency values per NEMA TP1:

KVA	(%)
75	98.1
112.5	98.3
150	99.0
225	99.0
300	99.0
500	99.1
750	99.2
1000	99.2
1500	99.3
2000	99.4
2500	99.4

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install transformers as shown on the drawings, in accordance with the NEC, and as recommended by the manufacturer.

B. Foundation:

1. Provide foundation of reinforced concrete, Type C, 21mPa (3000 psi minimum, 28 day compressive strength), complying with the ACI 318.
2. Locate the top of foundation pads 6 in [150 mm] above the adjacent finished grade, unless otherwise shown on the drawings. Refer to drawings for size, location, and structural steel reinforcing required.
3. Grade the adjacent terrain so that surface water will flow away from the foundation.
4. Anchor transformers with cadmium- or zinc-plated bolts, nuts, and washers. Bolts shall not be less than 0.5 in [12 mm] diameter.

C. Grounding:

1. Ground each transformer in accordance with the requirements of the NEC. Install ground rods per the requirements of Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS, to maintain a maximum resistance of 5 ohms to ground.

2. Connect the ground rod to the ground pads in the medium- and low-voltage compartments, and to the secondary neutral with not less than a No. 2/0 AWG bare copper conductor.
3. Independently connect cable shield grounding devices ground wires to ground with sufficient slack to permit elbow connector operation. Connect elbow connectors with a No. 14 AWG bare copper drain wire from its grounding eye to the related cable shield grounding device ground wire. Do not connect drain wires in any manner that could permit circulating currents, or cable fault currents, to pass through them.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform tests in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections.

B. Transformers:

1. Compare equipment nameplate data with specifications and approved shop drawings.
2. Inspect physical and mechanical condition. Check for damaged or cracked bushings and liquid leaks.
3. Verify that control and alarm settings on temperature indicators are as specified.
4. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections, or perform thermographic survey after energization under load.
5. Verify correct liquid level in transformer tank.
6. Perform specific inspections and mechanical tests as recommended by manufacturer.
7. Verify correct equipment grounding per the requirements of Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
8. Verify the presence of transformer surge arresters, if provided.
9. Verify that the tap-changer is set at specified ratio.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the transformers are in good operating condition and properly performing the intended function.

3.4 SPARE PARTS

Deliver the following spare parts for the project to the Resident Engineer two weeks prior to final inspection:

1. Six stand-off insulators.
2. Six insulated protective caps.
3. One spare set of medium-voltage fuses for each size fuse used in the project.

3.5 INSTRUCTIONS

The contractor shall instruct maintenance personnel, for not less than one 2-hour period, on the maintenance and operation of the equipment on the date requested by the Resident Engineer.

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SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 – GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of dry-type general-purpose transformers.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items common to more than one section of Division 26.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. Shop Drawings:

1. Clearly present sufficient information to determine compliance with drawings and specifications.
2. Include electrical ratings, impedance, dimensions, weight, mounting details, decibel rating, terminations, temperature rise, no load and full load losses, and connection diagrams.
3. Complete nameplate data, including manufacturer’s name and catalog number.

C. Manuals:

1. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical data sheets and wiring diagrams.

2. If changes have been made to the maintenance and operating manuals originally submitted, then submit four copies of the updated maintenance and operating manuals to the Resident Engineer two weeks prior to final inspection.

D. Certifications: Two weeks prior to the final inspection, submit four copies of the following to the Resident Engineer:

1. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
2. Certification by the contractor that the equipment has been properly installed and tested.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

C. National Electrical Manufacturers Association (NEMA):

ST20-92.....Dry-Type Transformers for General Applications

TP1-02.....Guide for Determining Energy Efficiency for Distribution Transformers

TR1-00.....Transformers, Regulators, and Reactors

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE DRY-TYPE TRANSFORMERS

A. Unless otherwise specified, dry-type transformers shall be in accordance with NEMA, NEC, and as shown on the drawings. Transformers shall be UL-listed and labeled.

B. Dry-type transformers shall have the following features:

1. Transformers shall be self-cooled by natural convection, isolating windings, indoor dry-type. Autotransformers will not be accepted.
2. Rating and winding connections shall be as shown on the drawings.
3. Transformers shall have copper windings.
4. Ratings shown on the drawings are for continuous duty without the use of cooling fans.

5. Insulation systems:
   a. Transformers 30 kVA and larger: UL rated 220° C system with an average maximum rise by resistance of 150 ° C in a maximum ambient of 40 ° C.
6. Core and coil assemblies:
   a. Rigidly braced to withstand the stresses caused by short-circuit currents and rough handling during shipment.
   b. Cores shall be grain-oriented, non-aging, and silicon steel.
   c. Coils shall be continuous windings without splices except for taps.
   d. Coil loss and core loss shall be minimized for efficient operation.
   e. Primary and secondary tap connections shall be brazed or pressure type.
   f. Coil windings shall have end filters or tie-downs for maximum strength.
7. Certified sound levels determined in accordance with NEMA, shall not exceed the following:

Transformer Rating	Sound Level Rating
0 - 9 KVA	40 dB
10 - 50 KVA	45 dB
51 - 150 KVA	50 dB
151 - 300 KVA	55 dB
301 - 500 KVA	60 dB

8. If not shown on drawings, nominal impedance shall be as permitted by NEMA.
9. All transformers rated 30 kVA and larger shall have two 2.5% full capacity taps above, and four 2.5% full capacity taps below normal rated primary voltage.
10. Core assemblies shall be grounded to their enclosures with adequate flexible ground straps.
11. Enclosures:
    a. Comprised of not less than code gauge steel.
    b. Outdoor enclosures shall be NEMA 3R.

c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
d. Ventilation openings shall prevent accidental access to live components.
e. The enclosure at the factory shall be thoroughly cleaned and painted with manufacturer's prime coat and standard finish.

12. Standard NEMA features and accessories, including ground pad, lifting provisions, and nameplate with the wiring diagram and sound level indicated on it.
13. Dimensions and configurations shall conform to the spaces designated for their installations.
14. Transformers shall meet the minimum energy efficiency values per NEMA TP1 as listed below:

kVA Rating	Output efficiency (%)
15	97
30	97.5
45	97.7
75	98
112.5	98.2
150	98.3
225	98.5
300	98.6
500	98.7
750	98.8

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.
B. Install transformers with manufacturer's recommended clearance from wall and adjacent equipment for air circulation. Minimum clearance shall be 6 in.

C. Install transformers on vibration pads designed to suppress transformer noise and vibrations.

D. Use flexible metal conduit to enclose the conductors from the transformer to the raceway systems.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform tests in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections.

1. Compare equipment nameplate data with specifications and approved shop drawings.
2. Inspect physical and mechanical condition.
3. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections.
4. Perform specific inspections and mechanical tests as recommended by manufacturer.
5. Verify correct equipment grounding.
6. Verify proper secondary phase-to-phase and phase-to-neutral voltage after energization and prior to connection to loads.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the transformers are in good operating condition and properly performing the intended function.

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SECTION 26 24 11
DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of the distribution switchboards.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for Personnel Safety and to provide a low impedance path for possible fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and outlet boxes.

E. Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY: Coordination study of overcurrent protection devices.

F. Section 26 43 13, TRANSIENT-VOLTAGE SURGE SUPPRESSION: TVSS equipment for distribution switchboards.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

A. Distribution switchboards shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects. Tests shall be conducted as per NEMA PB 2 and UL 891. Factory tests shall be certified.

B. The following additional tests shall be performed:

1. Verify that circuit breaker sizes and types correspond to drawings and coordination study.
2. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data.
3. Exercise all active components.

4. Perform a dielectric withstand voltage test on each bus section, each phase-to-ground with phases not under test grounded, in accordance with manufacturer’s published data.
5. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable, or as required if solid-state components or control devices cannot tolerate the applied voltage.
6. If applicable, verify correct function of control transfer relays located in the switchboard with multiple control power sources.
7. Perform phasing checks on double-ended or dual-source switchboards to insure correct bus phasing from each source.

C. Furnish four (4) copies of certified manufacturer's factory test reports to the Resident Engineer prior to shipment of the switchboards to ensure that the switchboards have been successfully tested as specified.

1.5 SUBMITTALS

Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:

A. Shop Drawings:
1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, sectional views, bus work, circuit breaker frame sizes, trip and short-circuit rating, long-time, short-time, instantaneous and ground fault settings, coordinated breaker and fuse curves, accessories, and device nameplate data.
3. Show the size, ampere-rating, number of bars per phase and neutral in each bus run (horizontal and vertical), bus spacing, equipment ground bus, and bus material.

B. Manuals:
1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.

a. Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.
c. Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the equipment.
d. Approvals will be based on complete submissions of manuals together with shop drawings.

2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manuals to the Resident Engineer.
   a. The manuals shall be updated to include any information necessitated by shop drawing approval.
   b. Complete "As Installed" wiring and schematic diagrams shall be included which show all items of equipment and their interconnecting wiring.
   c. Show all terminal identification.
   d. Include information for testing, repair, trouble shooting, assembly, disassembly, and recommended maintenance intervals.
   e. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
   f. Furnish manuals in loose-leaf binder or manufacturer's standard binder.

C. Certifications:
1. Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
   a. Certification by the Contractor that the assemblies have been properly installed, adjusted and tested, including circuit breakers settings.
   b. Certified copies of all of the factory design and production tests, field test data sheets and reports for the assemblies.

1.6 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent

referenced. Publications are referenced in the text by basic designation only.

A. Institute of Engineering and Electronic Engineers (IEEE):

C37.13.....Low Voltage AC Power Circuit Breakers Used in Enclosures

C57.13.....Instrument Transformers

C62.41.....Surge Voltage in Low Voltage AC Power Circuits

C62.45.....Surge Testing for Equipment connected to Low-Voltage AC Power Circuits

B. National Electrical Manufacturer's Association (NEMA):

PB-2.....Dead-Front Distribution Switchboards.

PB-2.1.....Instructions for Proper Handling, Installation, Operation, and Maintenance of Switchboards

AB-1.....Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures

C. National Fire Protection Association (NFPA):

70.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

67.....Panelboards

489.....Molded Case Circuit Breakers and Circuit Breakers Enclosures

891.....Dead-Front Switchboards

1283.....Electromagnetic Interference Filters

1449.....Transient Voltage Surge Suppressors

PART 2 - PRODUCTS

2.1 GENERAL

A. Switchboards shall be in accordance with UL, NEMA, NEC, IEEE, and as shown on the drawings.

B. Switchboards shall be provided complete, ready for operation including, but not limited to housing, buses, circuit breakers, instruments and related transformers, fuses, and wiring.

C. Switchboard dimensions shall not exceed the dimensions shown on the drawings.

D. Manufacturer’s nameplate shall include complete ratings of switchboard in addition to the date of manufacture.

2.2 BASIC ARRANGEMENT

A. Type I: Switchboard shall be front accessible with the following features:
   1. Device mounting:
      a. Main breaker: Individually mounted and compartmented.
      b. Feeder breakers: Group mounted.
   2. Section alignment: As shown on the drawings.
   3. Accessibility:
      a. Main section line and load terminals: Front.
      b. Distribution section line and load terminals: Front.
      c. Through bus connections: Front and end.
   4. Bolted line and load connections.
   5. Full height wiring gutter covers for access to wiring terminals.
   6. Short Circuit Current Rating: As shown on the drawings.

2.3 HOUSING

A. Provide a completely enclosed, free standing, steel enclosure not less than the gage required by the ANSI and UL standards. The enclosure is to consist of the required number of vertical sections bolted together to form one metal enclosed rigid switchboard. The sides, top and rear shall be covered with removable screw on sheet steel plates.

B. Provide ventilating louvers where required to limit the temperature rise of current carrying parts. All openings shall be protected against entrance of falling dirt, water, or foreign matter.

C. Enclosure shall be thoroughly cleaned, phosphate treated, and primed with rust-inhibiting paint. Final finish coat shall be the manufacturers standard gray. Provide a quart of finish paint for touch-up purposes.

D. For applications where doors are provided on switchboards, doors shall be hinged “door in door” type with:
   1. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
   2. Outer hinged door shall be securely mounted to the switchboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand-operated latches are not acceptable.
   3. Push inner and outer doors shall open left to right.

2.4 BUSES

A. General: Buses shall be arranged for 3 phase, 4 wire distribution. Main phase buses (through bus), full size neutral bus, and ground bus shall be full capacity the entire length of the switchboard. Provide for future extensions by means of bolt holes or other approved method. Brace the bus to withstand the available short circuit current at the particular location and as shown on the drawings. No magnetic material shall be used between buses to form a magnetic loop.

B. Material and Size: Buses and connections shall be hard drawn copper of 98 percent conductivity. Bus temperature rise shall not exceed 65 degrees C (149 degrees F). Section busing shall be sized based on UL and NEMA Switchboard Standards.

C. Bus Connections: All contact surfaces shall be copper. Provide a minimum of two plated bolts per splice. Where physical bus size permits only one bolt, provide a means other than friction to prevent turning, twisting or bending. Torque bolts to the manufacturer's recommended values.

D. Neutral Bus: Provide bare or plated bus and mount on insulated bus supports. Provide neutral disconnect link to permit isolation of neutral bus from the common ground bus and service entrance conductors.

E. Ground Bus: Provide an uninsulated 6 mm by 50 mm (1/4 inch by 2 inch) copper equipment ground bus bar sized per UL 891 the length of the switchboard and secure at each section.

F. Main Bonding Jumper: Connect an uninsulated 1/4 inch by 2 inch (6mm by 50 mm) copper bus between the neutral and ground buses to establish the system common ground point

2.5 TRANSIENT VOLTAGE SURGE SUPPRESSION

Refer to Section 26 43 13, TRANSIENT-VOLTAGE SURGE SUPPRESSION.

2.6 METERING

A. Where indicated on the drawings, provide a digital line Meter Monitor device having the features and functions specified below. In addition, the device shall meet the accuracy portion of ANSI C12.16 Class 10 for revenue metering. The device shall consist of a single microprocessor-based unit capable of monitoring and displaying the functions listed below with the accuracy indicated. The device shall have the capability to communicate data via twisted pair network, more specifically MODBUS

protocol. The device shall be UL listed, CSA and CE certified and also meet ANSI standard C37.90.1 for surge withstand.

B. Where shown on the drawings, switchboards shall be supplied with a meter that is installed in the switchboard cabinet.

C. The device display shall mount in a standard DIN 96 mm x 96 mm square cutout or a standard ANSI round 100 mm cutout and shall offer a display via a standard Category 5 cable. The meter base shall be capable of being remote panel or DIN-rail mountable or mounting directly to the display. The membrane faceplate shall be designed and tested to allow mounting in NEMA 1 enclosures. The device display shall be a 4 x 20 character LED backlit LCD display to allow simultaneous viewing of multiple parameters.

D. All monitored parameters shall be viewable at the display or via network communications. The meter shall be completely programmable using the display keypad or via network communications. All set points and recorded minimum and maximums shall be stored in non-volatile memory.

E. Metered Values shall be as follows with accuracy in percent of full scale as indicated:

1. AC Phase Voltage and Amperes	+/- 0.5%
2. Watts, VA, Vars	+/- 1.0%
3. Power Factor	+/- 2.0%
4. Frequency	+/- 0.1 Hz
5. Watthours, VA, Varhours	+/- 1.0%

6. Watt Demand with 10-, 15-, 20-, 25-, 30-, 45-, 60-minute interval
7. Minimum/Maximum Voltage, Current, Power, Power Factor, Frequency
8. Peak Demand

F. Input ranges of the device shall accommodate external current transformers with ranges from 5/5 through 8000/5 amperes. Provide current transformers with rating to match panelboard as indicated on the drawings. Fused potential transformers shall be internal for voltages up to 600 volts.

G. Control power shall be capable of being supplied from the monitored incoming ac line without the need for a separate ac supply control circuit.

H. A solid-state relay KYZ pulse output shall be provided for use with a watthour pulse recorder or totalizer.

2.7 NAMEPLATES AND MIMIC BUS

A. Nameplates: For Normal Power system, provide laminated black phenolic resin with white core with 1/2 inch engraved lettered nameplates next to each circuit breaker. For Essential Electrical System, provide laminated red phenolic resin with white core with 1/2 inch engraved lettered nameplates next to each circuit breaker. Nameplates shall indicate equipment served, spaces, or spares in accordance with one line diagram shown on drawings, and where equipment is fed from. Nameplates shall be mounted with plated screws on front of breakers or on equipment enclosure next to breakers. Mounting nameplates only with adhesive is not acceptable.

B. Mimic Bus: Provide an approved mimic bus on front of each switchboard assembly. Color shall be black for the Normal Power system and red for the Essential Electrical System, either factory-painted plastic or metal strips. Plastic tape shall not be used. Use symbols similar to one line diagram shown on drawings. Plastic or metal strips shall be mounted with plated screws.

2.8 PROVISION FOR FUTURE

Where "provision for", "future", or "space" is noted on drawings, the space shall be equipped with bus connections to the future overcurrent device with suitable insulation and bracing to maintain proper short circuit rating and physical clearance. Provide buses for the ampere rating as shown for the future device.

2.9 MAIN CIRCUIT BREAKERS

A. Type I Switchboard: Provide UL listed and labeled molded case circuit breakers in accordance with NEC and as shown on the drawings. Circuit breakers shall be the solid state adjustable trip type.

1. Trip units shall have field adjustable tripping characteristics as follows:
   a. Ampere setting (continuous).
   b. Long time band.
   c. Short time trip point.
   d. Short time delay.
   e. Instantaneous trip point.
   f. Ground fault trip point.
   g. Ground fault trip delay.

2. Trip settings shall be as shown on the electrical system protective device study.
3. Breakers, which have same rating, shall be interchangeable with each other.

2.10 FEEDER CIRCUIT BREAKERS

A. Provide UL listed and labeled molded case circuit breakers, in accordance with the NEC, as shown on the drawings, and as herein specified.

B. Non-adjustable Trip Molded Case Circuit Breakers:
   1. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 ampere frame size or less. Magnetic trip shall be adjustable from 3X to 10X for breakers with 600 ampere frame size and higher. Factory setting shall be LOW unless otherwise noted.
   2. Breaker features shall be as follows:
      a. A rugged, integral housing of molded insulating material.
      b. Silver alloy contacts.
      c. Arc quenchers and phase barriers for each pole.
      d. Quick-make, quick-break, operating mechanisms.
      e. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
      f. Electrically and mechanically trip free.
      g. An operating handle which indicates ON, TRIPPED and OFF positions.
      h. Line and load connections shall be bolted.
      i. Interrupting rating shall not be less than the maximum short circuit current available at the line.
      j. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.

C. Adjustable Trip Molded Case Circuit Breakers:
   1. Where shown, provide molded case, solid state adjustable trip type circuit breakers.
   2. Trip units shall have field adjustable tripping characteristics as follows:
      a. Ampere setting (continuous).
      b. Long time band.

c. Short time trip point.

d. Short time delay.

e. Instantaneous trip point.

f. Ground fault trip point.

g. Ground fault trip delay.

3. Trip settings shall be shown on the electrical system protective device study.

4. Breakers, which have same rating, shall be interchangeable with each other.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the switchboard in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.

B. Anchor switchboard to the slab with plated 1/2 inch [12.5mm] minimum anchor bolts, or as recommended by the manufacturer.

C. Interior Location. Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 4 inches [100mm] thick. The top of the concrete slab shall be approximately 4 inches [100mm] above finished floor. Edges above floor shall have 1/2 inch [12.5mm] chamfer. The slab shall be of adequate size to project at least 8 inches [200mm] beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 3 inches [75mm] above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:

1. Visual and Mechanical Inspection

a. Compare equipment nameplate data with specifications and approved shop drawings.

b. Inspect physical, electrical, and mechanical condition.

c. Confirm correct application of manufacturer's recommended lubricants.

d. Verify appropriate anchorage, required area clearances, and correct alignment.

e. Verify that circuit breaker sizes and types correspond to approved shop drawings.
f. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
g. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
h. Clean switchboard.
i. Inspect insulators for evidence of physical damage or contaminated surfaces.
j. Verify correct shutter installation and operation.
k. Exercise all active components.
l. Verify the correct operation of all sensing devices, alarms, and indicating devices.
m. If applicable, verify that vents are clear.
n. If applicable, inspect control power transformers.

2. Electrical Tests
   a. Perform insulation-resistance tests on each bus section.
   b. Perform overpotential tests.
   c. Perform insulation-resistance test on control wiring; do not perform this test on wiring connected to solid-state components.
   d. Perform phasing check on double-ended switchboard to ensure correct bus phasing from each source.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the switchboard is in good operating condition and properly performing the intended function. Circuit breakers shall be tripped by operation of each protective device.

3.4 INSTRUCTION

Furnish the services of a factory certified instructor for one 4 hour period for instructing personnel in the operation and maintenance of the switchboard and related equipment on the date requested by the Resident Engineer.

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SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of distribution and branch panelboards.

1.2 RELATED WORK

A. Section 09 91 00, PAINTING: Identification and painting of panelboards.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.

C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.

F. Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY: Requirements for installing the over-current protective devices to ensure proper equipment and personnel protection.

G. Section 26 09 23, LIGHTING CONTROLS: Lighting controls integral to panelboards.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. In addition to the requirements of Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

1. Shop Drawings:

   a. Sufficient information, shall be clearly presented to determine compliance with drawings and specifications.

   b. Include electrical ratings, dimensions, mounting details, materials, wiring diagrams, accessories, and weights of equipment. Complete nameplate data, including manufacturer’s name and catalog number.

2. Manuals:
   a. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical data sheets and wiring diagrams.
   b. If changes have been made to the maintenance and operating manuals that were originally submitted, then submit four copies of updated maintenance and operating manuals to the COR two weeks prior to final inspection.
3. Certification: Two weeks prior to final inspection, submit four copies of the following to the COR:
   a. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
   b. Certification by the contractor that the materials have been properly installed, connected, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Electrical Manufacturers Association (NEMA):
   PB-1-06.....Panelboards
   250-08.....Enclosures for Electrical Equipment (1000V Maximum)

C. National Fire Protection Association (NFPA):
   70-2005 .....National Electrical Code (NEC)
   70E-2004.....Standard for Electrical Life Safety in the Workplace

D. Underwriters Laboratories, Inc. (UL):
   50-95.....Enclosures for Electrical Equipment
   67-09.....Panelboards
   489-09.....Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 BRANCH PANELBOARDS

A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.

B. Panelboards shall be standard manufactured products.

C. All panelboards shall be hinged “door in door” type with:
   1. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
   2. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand-operated latches are not acceptable.
   3. Push inner and outer doors shall open left to right.
D. Unless noted otherwise, all new panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories. Include one-piece removable, inner dead front cover, independent of the panelboard cover.
E. Panelboards shall have main breaker, bus size, voltage, phase, top or bottom feed, and flush or surface mounting as scheduled on the drawings.
F. Panelboards shall conform to NEMA PB-1, NEMA AB-1, and UL 67 and have the following features:
   1. Non-reduced size copper bus bars with current ratings as shown on the panel schedules, rigidly supported on molded insulators.
   2. Bus bar connections to the branch circuit breakers shall be the “distributed phase” or “phase sequence” type.
   3. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys of sizes suitable for the conductors to which they will be connected.
   4. Neutral bus shall be 100% rated, mounted on insulated supports.
   5. Grounding bus bar shall be equipped with screws or lugs for the connection of grounding wires.
   6. Buses shall be braced for the available short-circuit current. Bracing shall be as noted on schedules and not be less than 10,000 A symmetrical for 120/208 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.
   7. Branch circuit panelboards shall have buses fabricated for bolt-on type circuit breakers.
   8. Protective devices shall be designed so that they can easily be replaced.

9. Where designated on panel schedule "spaces," include all necessary bussing, device support, and connections. Provide blank cover for each space.
10. Series-rated panelboards are not permitted.

2.2 DISTRIBUTION PANELBOARDS

A. Panelboards: NEMA PB 1, power and feeder distribution type.

B. Doors: Door-in-door construction with hinged front panels and hinged doors; secured with flush latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

2.3 CABINETS AND TRIMS

A. Cabinets:

1. Provide galvanized steel cabinets to house panelboards. Cabinets for outdoor panelboards shall be factory primed and suitably treated with a corrosion-resisting paint finish meeting UL 50 and UL 67.
2. Cabinet enclosure shall not have ventilating openings.
3. Cabinets for panelboards may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.

2.3 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS

A. Circuit breakers shall be per UL 489, in accordance with the NEC, as shown on the drawings, and as specified.

B. Circuit breakers in panelboards shall be bolt-on type.

C. Molded case circuit breakers shall have interrupting rating equal to the panelboard rating in which the breaker is being installed in, but not less than:

1. 120/208 V Panelboard: 22,000 A symmetrical.
2. 277/480 V Panelboard: 14,000 A symmetrical.

D. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 A frame or lower. Magnetic trip shall be adjustable from 3x to 10x for breakers with 600 A frames and higher. Factory setting shall be HI, unless otherwise noted.

E. Adjustable Trip Molded Case Circuit Breakers:

1. Where shown, provide molded case, solid state adjustable trip type circuit breakers.
2. Trip units shall have field adjustable tripping characteristics as follows:

a. Ampere setting (continuous).
b. Long time band.
c. Short time trip point.
d. Short time delay.
e. Instantaneous trip point.
f. Ground fault trip point.
g. Ground fault trip delay.

3. Trip settings shall be shown on the electrical system protective device study.
4. Breakers, which have same rating, shall be interchangeable with each other.

F. Breaker features shall be as follows:

1. A rugged, integral housing of molded insulating material.
2. Silver alloy contacts.
3. Arc quenchers and phase barriers for each pole.
4. Quick-make, quick-break, operating mechanisms.
5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates ON, TRIPPED, and OFF positions.
8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where indicated.
10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer’s instructions, the NEC, as shown on the drawings, and as specified.

B. Locate panelboards so that the present and future conduits can be conveniently connected.

C. Nameplates: For Normal Power system, provide laminated black phenolic resin with white core with 1/2 inch engraved lettered nameplates displaying panel name and where panel is fed from. For Normal/Emergency Electrical System, provide laminated red phenolic resin with white core with 1/2 inch engraved lettered nameplates displaying panel name and where panel is fed from. Mounting nameplates only with adhesive is not acceptable.

D. Install a printed schedule of circuits in each panelboard after approval by the COTR. Schedules shall be printed on the panelboard directory cards, installed in the appropriate panelboards, and incorporate all applicable contract changes. Information shall indicate outlets, lights, devices, or other equipment controlled by each circuit, and the final room numbers served by each circuit.

E. Mount the fully-aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78 in. Mount panelboards that are too high such that the bottom of the cabinets will not be less than 6 in above the finished floor.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:

1. Visual and Mechanical Inspection
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Verify appropriate anchorage and required area clearances.
   d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
   e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
   f. Clean panelboard.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

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SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of wiring devices.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlets boxes.

C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. In addition to the requirements of Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

1. Shop Drawings:
   a. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
   b. Include electrical ratings, dimensions, mounting details, construction materials, grade and termination information.
2. Manuals: Two weeks prior to final inspection, deliver four copies of the following to the COR: Technical data sheets and information for ordering replacement units.
3. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent

referenced. Publications are referenced in the text by basic designation only.

B. National Fire Protection Association (NFPA):
70.....National Electrical Code (NEC)

C. National Electrical Manufacturers Association (NEMA):
WD 1.....General Color Requirements for Wiring Devices
WD 6 .....Wiring Devices – Dimensional Requirements

D. Underwriter’s Laboratories, Inc. (UL):
5.....Surface Metal Raceways and Fittings
20.....General-Use Snap Switches
231.....Power Outlets
467.....Grounding and Bonding Equipment
498.....Attachment Plugs and Receptacles
943.....Ground-Fault Circuit-Interrupters

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. General: All receptacles shall be listed by Underwriters Laboratories, Inc., and conform to NEMA WD 6.
   1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
   2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four min.) and side wiring from four captively held binding screws.

B. Duplex Receptacles: Convenience Receptacles, light industrial specification grade 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and FS W-C-596. The duplex type shall have break-off feature for two-circuit operation. The ungrounded pole of each receptacle shall be provided with a separate terminal.
   1. Bodies shall be ivory in color.
   2. Duplex Receptacles on Emergency Circuit:
      a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.

C. Ground Fault Interrupter Duplex Receptacles: General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. Duplex GFCI Convenience Receptacles, 125 V, 20 A. Where required by the National Electrical Code Receptacle shall be stamped with a 'WR' on the face of the receptacle.

a. Ground fault interrupter shall consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of five milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or – 1 milliamp) on the load side of the device. Device shall have a minimum nominal tripping time of 1/30th of a second.

D. Safety Type Duplex Receptacles:

1. Bodies shall be gray in color.
   a. Shall permit current to flow only while a standard plug is in the proper position in the receptacle.
   b. Screws exposed while the wall plates are in place shall be the tamperproof type.

E. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete with appropriate cord grip plug. Devices shall meet UL 231.

2.2 TOGGLE SWITCHES

A. Toggle Switches: Shall be totally enclosed tumbler type with bodies of phenolic compound. Toggle handles shall be ivory in color unless otherwise specified. The rocker type switch is not acceptable and will not be approved.

1. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
2. Ratings:
   a. 120 volt circuits: 20 amperes at 120-277 volts AC.

2.3 WALL PLATES

A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.

B. Color shall be ivory unless otherwise specified.

C. Standard NEMA design, so that products of different manufacturers will be interchangeable. Dimensions for openings in wall plates shall be accordance with NEMA WD 6.

D. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

E. In psychiatric areas, wall plates shall be 302 stainless steel, have tamperproof screws and beveled edges.

F. Wall plates for data, telephone or other communication outlets shall be as specified in the associated specification.

G. Duplex Receptacles on Emergency Circuit:

1. Bodies and wall plates shall be red in color.

2.4 FLOOR SERVICE FITTINGS

A. Service fittings in first paragraph below are available for voice and data communication cabling as well as for power.

B. Type: Modular, flush-type, dual-service units suitable for wiring method used. Units shall be suitable for installation in slab-on-grade floor construction.

C. Compartments: Barrier separates power from voice and data communication cabling.

D. Service Plate: Rectangular, solid brass with satin finish.

E. Power Receptacle: NEMA WD 6 configuration 5-20R, ivory in color, unless otherwise indicated

F. Voice and Data Communication Outlet: Refer to detail on drawings for voice and data communication outlet layout in floor boxes.

2.5 MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.

2. Wiremold Company (The).

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Wire: No. 12 AWG THHN/THWN.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC and as shown as on the drawings.

B. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the green equipment grounding conductor.

C. Outlet boxes for light and dimmer switches shall be mounted on the strike side of doors.

D. Provide barriers in multigang outlet boxes to separate systems of different voltages, Normal Power and Emergency Power systems, and in compliance with the NEC.

E. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.

F. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades. In addition, check for exact direction of door swings so that local switches are properly located on the strike side.

G. Install wall switches 48 inches above floor, OFF position down.

H. Install wall dimmers 48 inches above floor; derate ganged dimmers as instructed by manufacturer; do not use common neutral.

I. Install convenience receptacles 18 inches above floor, and 6 inches above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.

J. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

K. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

L. Test GFCI devices for tripping values specified in UL 1436 and UL 943.

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SECTION 26 29 11
MOTOR STARTERS

PART 1 - GENERAL

1.1 DESCRIPTION

All motor starters and variable speed motor controllers, including installation and connection (whether furnished with the equipment specified in other Divisions or otherwise), shall meet these specifications.

1.2 RELATED WORK

A. Other sections which specify motor driven equipment, except elevator motor controllers.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, weights, mounting details, materials, running over current protection, size of enclosure, over current protection, wiring diagrams, starting characteristics, interlocking and accessories.

C. Manuals:

1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams and information for ordering replacement parts.
   a. Wiring diagrams shall have their terminals identified to facilitate installation, maintenance and operation.
   b. Wiring diagrams shall indicate internal wiring for each item of equipment and interconnections between the items of equipment.

c. Elementary schematic diagrams shall be provided for clarity of operation.

2. Two weeks prior to the project final inspection, submit four copies of the final updated maintenance and operating manual to the COR.

D. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certifications to the COR:

1. Certification that the equipment has been properly installed, adjusted, and tested.
2. Certification by the manufacturer that medium voltage motor controller(s) conforms to the requirements of the drawings and specifications. This certification must be furnished to the COR prior to shipping the controller(s) to the job site.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Electrical and Electronic Engineers (IEEE):

519.....Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

C37.90.1.....Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

C. National Electrical Manufacturers Association (NEMA):

ICS 1.....Industrial Control and Systems General Requirements

ICS 1.1.....Safety Guidelines for the Application, Installation and Maintenance of Solid State Control

ICS 2.....Industrial Control and Systems, Controllers, Contactors and Overload Relays Rated 600 Volts DC

ICS 6.....Industrial Control and Systems Enclosures

ICS 7.....Industrial Control and Systems Adjustable-Speed Drives

ICS 7.1.....Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems

D. National Fire Protection Association (NFPA):

70.....National Electrical Code (NEC)

E. Underwriters Laboratories Inc. (UL):
   508.....Industrial Control Equipment

PART 2 - PRODUCTS

2.1 MOTOR STARTERS, GENERAL

A. Shall be in accordance with the requirements of the IEEE, NEC, NEMA (ICS 1, ICS 1.1, ICS 2, ICS 6, ICS 7 and ICS 7.1) and UL.
B. Shall have the following features:
   1. Separately enclosed unless part of another assembly.
   2. Overload current protective devices:
      a. Overload relay (solid state type).
      b. One for each pole.
      c. Manual reset on the door of each motor controller enclosure.
      d. Correctly sized for the associated motor's rated full load current.
      e. Check every motor controller after installation and verify that correct sizes of protective devices have been installed.
      f. Deliver four copies of a summarized list to the COR, which indicates and adequately identifies every motor controller installed. Include the catalog numbers for the correct sizes of protective devices for the motor controllers.
   3. Enclosures:
      a. Shall be the NEMA types shown on the drawings for the motor controllers and shall be the NEMA types which are the most suitable for the environmental conditions where the motor controllers are being installed.
C. Provide a disconnecting means or safety switch near and within sight of each motor. Provide all wiring and conduit required to facilitate a complete installation.

2.2 MANUAL MOTOR STARTERS

A. Shall be in accordance with applicable requirements of 2.1 above.
B. Fractional horsepower manual motor starters.
   1. Starters shall be general-purpose Class A, manually operated with full voltage controller for fractional horsepower induction motors.
   2. Units shall include thermal overload protection, red pilot light and toggle operator.

2.3 MAGNETIC MOTOR STARTERS

A. Shall be in accordance with applicable requirements of 2.1 above.
B. Starters shall be general-purpose, Class A magnetic controllers for induction motors rated in horsepower. Minimum size 0.

C. Where combination motor starters are used, combine starter with protective or disconnect device in a common enclosure.

D. Provide phase loss protection for each starter, with contacts to de-energize the starter upon loss of any phase.

E. Unless otherwise indicated, provide full voltage non-reversing across-the-line mechanisms for motors less than 75 HP, closed by coil action and opened by gravity. For motors 75 HP and larger, provide reduced voltage starters. Equip starters with 120V AC coils and individual control transformer unless otherwise noted. Locate "reset" button to be accessible without opening the enclosure.

2.4 VARIABLE SPEED MOTOR CONTROLLERS

A. Shall be in accordance with applicable portions of 2.1 above.

B. Shall be solid state, micro processor-based with adjustable frequency and voltage, three phase output capable of driving standard NEMA B design, three phase alternating current induction motors at full rated speed. The drives shall utilize a full wave bridge design incorporating diode rectifier circuitry with pulse width modulation (PWM). Other control techniques are not acceptable. Silicon controlled rectifiers (SCR) shall not be used in the rectifying circuitry. The drives shall be designed to be used on variable torque loads and shall be capable of providing sufficient torque to allow the motor to break away from rest upon first application of power.

C. Unit shall be capable of operating within voltage parameters of plus 10 to minus 10 percent of line voltage, and be suitably rated for the full load amps of the maximum watts (HP) within its class.

D. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:

1. Ambient Temperature: 0 to 40 deg C.
2. Humidity: Less than 90 percent (noncondensing).
3. Altitude: Not exceeding 3300 feet.

E. Controllers shall have the following features:

1. Isolated power for control circuits.
2. Manually re-settable motor overload protection for each phase.
3. Adjustable current limiting circuitry to provide soft motor starting. Maximum starting current shall not exceed 200 percent of motor full load current.
4. Independent acceleration and deceleration time adjustment, manually adjustable from 2 to 30 seconds. (Set timers to the equipment manufacturer's recommended time in the above range.)

5. Provide 4 to 20 ma current follower circuitry for interface with mechanical sensor devices.
6. Automatic frequency adjustment from 20 Hz to 60 Hz.
7. Provide circuitry to initiate an orderly shutdown when any of the conditions listed below occur. The controller shall not be damaged by any of these electrical disturbances and shall automatically restart when the conditions are corrected. The drive shall be able to restart into a rotating motor operating in either the forward or reverse direction and matching that frequency.
   a. Incorrect phase sequence.
   b. Single phasing.
   c. Over voltage in excess of 10 percent.
   d. Under voltage in excess of 10 percent.
   e. Running over current above 110 percent (shall not automatically reset for this condition.)
   f. Instantaneous overcurrent above 150 percent (shall not automatically reset for this condition).
   g. Surge voltage in excess of 1000 volts.
   h. Short duration power outages of 12 cycles or less (i.e., distribution line switching, generator testing, and automatic transfer switch operations.)
8. Provide automatic shutdown on receipt of a power transfer warning signal from an automatic transfer switch. Controller shall automatically restart motor after the power transfer. Contractor shall be responsible in coordinating with transfer switch manufacturer in providing the correct wiring from switch to drive.
9. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
10. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
11. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

F. Minimum efficiency shall be 95 percent at 100 percent speed and 85percent at 50 percent speed.

G. The displacement power factor of the controller shall not be less than 95 percent under any speed or load condition.

H. Controllers shall include a door interlocked fused safety disconnect switch or door interlocked circuit breaker switch which will disconnect all input power.

I. Controller shall include a 3% line reactor, and RFI/EMI filter.

J. The following accessories are to be door mounted:

1. AC Power on light.
2. Ammeter (RMS motor current).
3. HAND-OFF-AUTOMATIC switch.
4. Manual speed control in HAND mode.
5. System protection lights indicating that the system has shutdown and will not automatically restart.
6. System protection light indicating that the system has shutdown but will restart when conditions return to normal.
7. Manual variable speed controller by-pass switch.
8. Diagnostic shutdown indicator lights for each shutdown condition.
9. Provide two N.O. and two N.C. dry contacts rated 120 volts, 10 amperes, 60 HZ for remote indication of the following:
   a. System shutdown with auto restart.
   b. System shutdown without auto restart.
   c. System running.
10. Incorporate into each control circuit a 120-volt, time delay relay (ON delay), adjustable from 0.3-10 minutes, with transient protection. Provide transformer/s for the control circuit/s.
11. Controller shall not add any current or voltage transients to the input AC power distribution system nor shall transients from other devices on the AC power distribution system affect the controller. Controllers shall be protected to comply with IEEE C37.90.1 and UL-508. Line noise and harmonic voltage distortion shall not exceed the values allowed by IEEE 519.

K. Hardware and software to enable the BAS to monitor, control, and display controller status and alarms.

L. Network Communications Ports: Ethernet and RS-422/485.

M. Embedded BAS Protocols for Network Communications: As specified in Division 22.

N. Bypass Operation: Manually transfers motor between power converter output and bypass circuit, manually, automatically, or both. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter. Transfer between power

converter and bypass contactor and retransfer shall only be allowed with the motor at zero speed.

O. Bypass Controller: Provide contactor-style bypass, arranged to isolate the power converter input and output and permit safe testing of the power converter, both energized and de-energized, while motor is operating in bypass mode. Motor overload protection shall be provided.
   1. Bypass Contactor: Load-break NEMA-rated contactor.
   2. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
   3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motor control equipment in accordance with manufacturer’s recommendations, the NEC, NEMA and as shown on the drawings.

B. Furnish and install heater elements in motor starters and to match the installed motor characteristics. Submit a list of all motors listing motor nameplate rating and heater element installed.

C. Motor Data: Provide neatly-typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, voltage/phase rating and heater element installed.

D. Install all motor starters/drives in accessible locations. Where the VA determines a starter drive has been installed in an un-accessible location, i.e. above ceilings, the contractor shall relocate the starter/drive to an accessible location at no cost to the VA.

E. Examine control diagrams indicated before ordering motor controllers. Should conflicting data exist in specifications, drawings and diagrams, request corrected data prior to placing orders.

F. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

3.2 ADJUSTING

A. Set field-adjustable overload-relay pickup and trip ranges.

3.3 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:
   1. Visual and Mechanical Inspection

a. Compare equipment nameplate data with specifications and approved shop drawings.
b. Inspect physical, electrical, and mechanical condition.
c. Clean motor starters/controllers.
d. Verify overload element ratings are correct for their applications.
e. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data.

3.4 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the motor starters and variable speed motor controllers are in good operating condition and properly performing the intended functions.

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SECTION 26 29 21
DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of low voltage disconnect switches.

1.2 RELATED WORK

A. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

C. Cables and wiring: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).

D. Motor rated toggle switches: Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

E. Requirements for personnel safety and to provide a low impedance path for possible ground faults: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Shop Drawings:

1. Include sufficient information, clearly presented to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting details, materials, enclosure types, fuse type and class.
3. Show the specific switch and fuse proposed for each specific piece of equipment or circuit.

C. Manuals:

1. Provide complete maintenance and operating manuals for disconnect switches, including technical data sheets, wiring diagrams, and information for ordering replacement parts. Deliver four copies to the COTR two weeks prior to final inspection.
2. Identify terminals on wiring diagrams to facilitate maintenance and operation.
3. Wiring diagrams shall indicate internal wiring and any interlocking.

D. Certification: Two weeks prior to final inspection, deliver to the COTR four copies of the certification that the equipment has been properly installed, adjusted, and tested.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA):
KS l-01.....Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

C. National Fire Protection Association (NFPA):
70-05.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):
98-98.....Enclosed and Dead-Front Switches
198C-89.....High-Interrupting-Capacity Fuses, Current Limiting Types
198E-94.....Class R Fuses
977-99.....Fused Power-Circuit Devices

PART 2 - PRODUCTS

2.1 LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS

A. Shall be quick-make, quick-break type in accordance with UL 98, NEMA KS 1 and NEC.

B. Shall have a minimum duty rating, NEMA classification General Duty (GD) for 208 volts and NEMA classification Heavy Duty (HD) for 277/480 volts.

C. Shall be horsepower rated.

D. Shall have the following features:
1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the OFF position.
3. An arc chute for each pole.
4. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.
6. Fuse holders for the sizes and types of fuses specified.
7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground Lugs: One for each ground conductor.

9. Enclosures:
   a. Shall be the NEMA types shown on the drawings for the switches.
   b. Where the types of switch enclosures are not shown, they shall be the NEMA types which are most suitable for the environmental conditions where the switches are being installed. Unless otherwise indicated on the plans, all outdoor switches shall be NEMA 3R.
   c. Shall be finished with manufacturer’s standard gray baked enamel paint over pretreated steel (for the type of enclosure required).

2.2 LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS

Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, but no fuses.

2.3 MOTOR RATED TOGGLE SWITCHES

Refer to Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for motor rated toggle switches.

2.4 IDENTIFICATION SIGNS

A. Install nameplate identification signs on each disconnect switch to identify the equipment controlled.
B. Nameplates shall be laminated black phenolic resin with a white core, with engraved lettering, a minimum of 1/4-inch high. Secure nameplates with screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches in accordance with the NEC and as shown on the drawings.
B. Fusible disconnect switches shall be furnished complete with fuses.
C. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

3.2 SPARE PARTS

Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fusible disconnect switch installed on the project. Deliver the spare fuses to the COTR.

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SECTION 26 32 53

UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of the central uninterruptible power supply (UPS). The UPS system shall consist of UPS module, battery system, static bypass transfer switch, controls and monitoring.

1.2 RELATED WORK

A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for Seismic Restraint for Nonstructural Components.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and Wiring.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduct and outlet boxes.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

A. Uninterruptible power supplies shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.

B. The UPS system shall be factory full-load tested to meet the requirements specified using a test battery (not the battery to be supplied with the system) with ac input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Should a malfunction occur, the problem shall be corrected and the test shall be repeated. The tests shall encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings.

C. Furnish four (4) copies of certified manufacturer's factory test reports to the Resident Engineer prior to shipment of the UPS equipment to ensure that the UPS equipment has been successfully tested as specified.
D. Provide IEEE Std 450 battery installation certification.
E. The Resident Engineer shall have an option to witness factory tests. The Resident Engineer shall be notified in writing at least 2 weeks before testing. All expenses of the Resident Engineer’s trip to witness the testing will be paid by the Government.

1.5 SUBMITTALS

A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
B. Shop Drawings:
   1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
   2. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, wiring and connection diagrams, plan, front, side, and rear elevations, accessories, and device nameplate data.
C. Manuals:
   1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
      a. Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
      b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.
      c. Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the equipment.
      d. Approvals will be based on complete submissions of manuals together with shop drawings.
   2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manuals to the Resident Engineer.
      a. The manuals shall be updated to include any information necessitated by shop drawing approval.
      b. Complete "As Installed" wiring and schematic diagrams shall be included which show all items of equipment and their interconnecting wiring.
      c. Show all terminal identification.

d. Include information for testing, repair, trouble shooting, assembly, disassembly, and recommended maintenance intervals.
e. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
f. Furnish manuals in loose-leaf binder or manufacturer's standard binder.

D. Certifications:
1. Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
a. Certification by the Contractor that the assemblies have been properly installed, adjusted and tested.
b. Certified copies of all of the factory design and production tests, field test data sheets and reports for the assemblies.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):
C57.110.....(1998; R 2004) Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents
C62.41.1....(2002) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
C62.41.2....(2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
Std 450.....(2002; Errata 2004) Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
Std 485.....(1997; R 2003) Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications

C. National Electrical Manufacturers Association (NEMA):
PE 1.......(2003; R 2003) Uninterruptible Power Systems -- Specification and Performance Verification

D. National Fire Protection Association (NFPA):
70.....National Electrical Code (NEC).

1.7 DELIVERY, STORAGE, AND HANDLING

Store UPS indoors in clean dry space with uniform temperature to prevent condensation. Protect UPS from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 - PRODUCTS

2.1 RATINGS

A. System Capacity: Unless stated otherwise, the parameters listed are under full output load at 0.8 power factor, with batteries fully charged and floating on the dc bus and with nominal input voltage. Overall 15kVA, 12kW, non-redundant, at 40 degrees C.

B. Battery Capacity: Discharge time to end voltage: 15 minutes, at 25 degrees C 77 degrees F. Battery shall be capable of delivering 125 percent of full rated UPS load at initial start-up.

C. Static Switch: // // amperes, // // amperes symmetrical interrupting capacity.

D. System Bus Bracing: Braced for 30,000 amperes symmetrical interrupting capacity.

E. AC Input

1. Nominal Voltage: 208 volts, three-phase, 4 wires plus ground, 60 Hz.
2. AC Input Voltage Window: +15%, -20% of nominal (while providing nominal charging to the battery system).
3. Short Circuit Withstand Rating: 30,000 symmetrical amperes.
4. Maximum Frequency Range: 40 to 70 Hz.
5. Input Power Factor:
   a. 0.98 for loads greater than 50%.
   b. 0.95 for loads greater than 15%.
6. Input Current Distortion With No Additional Filters: Less than 5% at 100% load.
7. Soft-Start: Shall be linear from 0% to 100% input current and shall not exhibit inrush. This shall take place over a 15 second time period when transferring from battery operation to mains operation.

F. AC Output

1. AC Output Nominal Output: 208/120 volts, three-phase, 4 wires plus ground, 60 Hz.
2. AC Output Voltage Regulation: ±1% for 100% linear or non-linear load.
3. Voltage Transient Response: ±5% maximum for 100% linear load step.
4. Voltage Transient Recovery: Within less than 60 milliseconds.
5. Output Voltage Harmonic Distortion:
   a. Less than 1.5% THDU maximum for a 100% linear load.

b. Less than 3.5% THDU maximum for a 100% non-linear load.

6. Phase Angle Displacement:
   a. 120 degrees ±0.1 degree for balanced load.
   b. 120 degrees ±0.1 degree for 50% imbalanced load.
   c. 120 degrees ±0.3 degrees for 100% imbalanced load.
7. Overload Rating:
   a. Normal Operation:
      1) 150% for 1 minute.
      2) 125% for 10 minutes.
      3) 100% continuous.
   b. Bypass Operation:
      1) 110% continuous.
      2) 800% for 500 milliseconds.
8. System AC-AC Efficiency: Greater than 93% at full load with 208 volt supply.
9. Output Power Factor Rating: 0.8 at full load.
10. Slew Rate: 0.25 to 1 Hz/second.

2.2 UPS

A. Basis of Design: Product specified is “MGE Galaxy 3500” as manufactured by APC by Schneider Electric. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Engineer will be the sole judge of the basis of what is equivalent.

B. General Description: UPS module shall consist of a rectifier/charger unit and a 3-phase inverter MODULE unit with their associated synchronizing equipment, protective devices and accessories as required for operation.

C. Modes of operation:
   1. Normal: The input converter and output inverter shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.
   2. Battery: Upon failure of the AC input source, the critical load shall continue being supplied by the output inverter, which shall derive its power from the battery system. There shall be no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.

3. Recharge: Upon restoration of the AC input source, the UPS shall simultaneously recharge the battery and provide regulated power to the critical load.
4. Static Bypass: The static bypass shall be used to provide transfer of critical load from the inverter output to the bypass source. This transfer, along with its retransfer, shall take place with no power interruption to the critical load. In the event of an emergency, this transfer shall be an automatic function. The UPS shall be able to recharge the batteries while supplying full power to the load via the static bypass switch.
5. Internal Mechanical Bypass: As a standard feature, the UPS shall be equipped with an internal, make-before-break, bypass switch. This switch shall mechanically bypass the UPS for times where maintenance is required.

D. Input power converter shall adhere to the following:
1. General: The input power converters of the system shall constantly control the power imported from the mains input of the system, to provide the necessary UPS power for precise regulation of the DC bus voltage, battery charging, and main inverter regulated output power.
2. Input Current Total Harmonic Distortion: The input current THDI shall be held to 5% or less at full system load, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting loads of both a linear or non-linear type. This shall be accomplished with no additional filters, magnetic devices, or other components.
3. Soft-Start Operation: As a standard feature, the UPS shall contain soft-start functionality, capable of limiting the input current from 0% to 100% of the nominal input over a default 15 second period, when returning to the AC utility source from battery operation. The change in current over the change in time shall take place in a linear manner throughout the entire operation (di/dt = constant).
4. Magnetization Inrush Current: The UPS shall exhibit 0 inrush current as a standard product.
5. Input Current Limit: The system input current limit, shall be designed to provide 100% load while fully charging the batteries at 10% of the system rating. The system shall be capable of this with up to a +15%, -20% variation of the nominal input voltage.

6. Charging:
   a. The battery charging shall keep the DC bus float voltage of ±220 volts, ±1%.
   b. The battery charging circuit shall contain a temperature compensation circuit, which shall regulate the battery charging to optimize battery life.
   c. The battery charging circuit shall remain active when in static bypass and in normal operation.
   d. The UPS shall be capable of limiting the energy sourced from the mains for purposes of battery charging. As a default setting, the battery charge energy shall be set to 100% of its nominal value. When signaled by a dry contact, (such as from an emergency generator) the UPS shall be capable of limiting the battery charge energy taken from the mains. This shall take place in Owner-selectable increments of 75%, 50%, 25%, 10% and 0% of the nominal charge power. The selection shall be made from the UPS front panel display/control unit.
7. Back-Feed Protection: The logic-controlled input contactor shall provide the back-feed protection required by UL 1778.

E. Output inverter shall adhere to the following:
1. General: The UPS output inverter shall constantly recreate the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT driven power converters. In both normal operation and battery operation, the output inverters shall create an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages, shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output inverters.
2. Overload Capability: Steady-state overload conditions, of up to 150% of system capacity, shall be sustained by the inverter for 60 seconds in normal and battery operation. Overloads of 125% shall be sustainable by the inverter for up to 10 minutes. Should overloads persist past the outlined time limitation; the critical load shall be switched to the automatic static bypass output of the UPS.
3. Output Contactor: The output inverter shall be provided with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter shall be removed from the critical bus.

4. Battery Protection: The inverter shall be provided with monitoring and control circuits to limit the level of discharge on the battery system.

2.3 STATIC BYPASS

A. General: As part of the UPS, a system static bypass switch shall be provided. The system static bypass shall provide no break transfer of the critical load from the inverter output to the static bypass input source during times where maintenance is required, or the inverter cannot support the critical bus. Such times may be due to prolonged or severe overloads, or UPS failure.

B. Design: The design of the static switch power path shall consist of silicon controlled rectifiers (SCR) with a continuous duty rating of 110% of the UPS output rating.

C. Automatic Transfers: An automatic transfer of load to static bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from static bypass back to normal operation shall take place when the overload condition is removed from the critical bus output of the system. Automatic transfers of load to static bypass shall also take place if for any reason the UPS cannot support the critical bus.

D. Manual Transfers: Manually initiated transfers to and from static bypass shall be initiated through the UPS display interface.

E. Overloads: The static bypass shall be rated and capable of handling overloads equal to or less than 110% of the rated system output continuously. For instantaneous overloads caused by inrush current from magnetic devices, or short circuit conditions, the static bypass shall be capable of sustaining overloads of 800% of system capacity for periods of up to 500 milliseconds.

F. System Protection: As a requirement of UL 1778, back-feed protection in the static bypass circuit shall also be incorporated in the system design. To achieve back-feed protection, a mechanical contactor in series with the bypass SCR(s) shall be controlled by the UPS/static switch, to open immediately upon sensing a condition where back-feeding of the static switch by any source connected to the critical output bus of the system is occurring. One such condition could be a result of a shorted SCR.

G. Dual Feed: For purposes of increased reliability, the static bypass shall be capable of being fed from a separate feed from the input power converter.

2.4 INTERNAL MECHANICAL BYPASS

A. General: An internal, make-before-break, maintenance bypass switch shall be provided as an integral part of the UPS and located within the UPS module. The maintenance bypass switch shall provide the capability to continuously support the critical load from the bypass ac power source while the UPS is isolated for maintenance. The maintenance bypass switch shall be housed in an isolated compartment inside the UPS cabinet. Switch shall contain a maintenance bypass protective device and a module isolation protective device.

B. Load Transfer: The maintenance bypass switch shall provide the capability of transferring the critical load from the UPS static bypass transfer switch to maintenance bypass and then back to the UPS static bypass transfer switch with no interruption to the critical load.

2.5 DISPLAY AND CONTROLS

A. Display Unit: A microprocessor-controlled display unit shall be located on the front of the system. The display shall consist of an alphanumeric display with backlight, an alarm LED, and a keypad consisting of pushbutton switches.

B. Metered Data: The following metered data shall be available on the alphanumeric display:
   1. Year, month, day, hour, minute, second of occurring events.
   2. Source input voltage.
   3. Output AC voltage.
   4. Output AC current.
   5. Input frequency.
   6. Battery voltage.
   7. Highest internal battery temperature.

C. Event Log: The display unit shall allow the Owner to display a time and date stamped log for the 64 most recent status and alarm events.

D. Alarms: The display unit shall allow the Owner to display a log of all active alarms. The following minimum set of alarm conditions shall be available:
   1. Static bypass switch on.
   2. EPO active.
   3. Mechanical bypass activated.
   4. External bypass switch (Q3) activated.
   5. Battery discharged.
   6. Return from low battery.
   7. Low battery.
   8. Load not powered from UPS.

9. UPS in bypass.
10. Runtime calibration aborted.
11. Runtime calibration started.
12. Runtime calibration complete.
13. Battery self-test aborted.
14. Battery self-test started.
15. Battery self-test completed.
16. Number of battery modules decreased.
17. Number of battery modules increased.
18. Fan fault.
19. SBS fault.
20. System not in sync.
21. Bypass not available, frequency/voltage out of range.
22. Mains voltage/frequency out of range.
23. Site wiring fault.
24. Low battery voltage shut down.
25. XR battery breaker or fuse open.
26. Defective battery detected.
27. Runtime is below alarm threshold.
28. Load is above alarm threshold.
29. Battery over-voltage warning.
30. Battery over-temperature warning.
31. Emergency power supply fault.
32. Output overloaded.

E. Controls: The following controls or programming functions shall be accomplished by use of the display unit. Pushbutton membrane switches shall facilitate these operations.

1. Silence audible alarm.
2. Set the alphanumeric display language.
3. Display or set the date and time.
4. Enable or disable the automatic restart feature.
5. Transfer critical load to and from static bypass.
6. Test battery condition on demand.
7. Set intervals for automatic battery tests.
8. Adjust set points for different alarms.
9. Program the parameters for remote shutdown.

F. Front Panel Interface: The following shall make up the UPS front panel user interface.
   1. Indicating LED's:
      a. Load On: When green, this LED shall indicate the load is being supported by the UPS output.
      b. On Battery: When yellow, this LED shall indicate the UPS is running from battery power.
      c. Bypass: When yellow, this LED shall indicate the load is being supported by static bypass/mechanical bypass.
      d. Fault: When red, this LED shall indicate there is a fault condition present in the UPS.
   2. Pushbutton User Controls:
      a. Up arrow.
      b. Down arrow.
      c. Help key.
      d. Escape key.
      e. Enter key.

G. Communication Interface: For purposes of remote communications with the UPS the following shall be available and contained within the UPS on a removable, hot-swappable smart-slot interface card:
   1. RJ-45 interface port for remote communications with a network via web browser or SNMP, or APC InfraStruXure Manager.
   2. Environmental monitoring feature, capable of locally monitoring temperature and humidity as well as one additional generic set of Owner-determined dry contacts capable of taking an input signal from a third party on/off signal, such as water detection, smoke detection, motion, or fire detection.

2.9 BATTERY SYSTEM

A. General: A storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration shall be provided for each UPS module. The cells shall be provided with flame arrestor vents, intercell connectors and cables, cell-lifting straps, cell-numbering sets, and terminal grease. Intercell connectors shall be sized to maintain terminal voltage within voltage window limits when supplying full load under power failure conditions. Cell and connector hardware shall be stainless steel of a type capable of resisting corrosion from the electrolyte used. The UPS battery shall be of modular construction made up of Owner-replaceable, hot swappable, fused, battery modules.

B. Battery Ratings
   1. Type: lead calcium.
   2. Specific gravity when fully charged: 1.215.
   3. End voltage 1.6-1.75 volts per cell.
   4. Float voltage: 2.17 to 2.26 volts per cell.
   5. Equalizing voltage: 2.33 to 2.38 volts per cell.

C. Battery Construction: The battery shall be of the valve-regulated, sealed, non-gassing, recombinant type.

D. Battery Cabinet: The battery pack assembly shall be furnished in a battery cabinet matching the UPS cabinet. The battery cabinet shall be designed to allow for checking the torque on the connections in the battery system. The battery cabinet shall be provided with smoke and high temperature alarms.

E. Battery Disconnect: Each battery pack assembly shall have a fused disconnect switch provided in a NEMA 1 enclosure. Switch shall be rated 600 V dc, 60 amperes, 3-pole with interrupting rating as required by system capacity, and shall have an external operator that is lockable in the "off" position.

F. Each battery module shall be monitored to determine the highest battery unit temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry. Monitoring information shall be accessible via front panel display unit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The UPS system shall be set in place, wired and connected in accordance with the approved shop drawings and manufacturer's instructions.

3.2 ACCEPTANCE CHECKS AND TESTS

A. A manufacturer's representative shall supervise the installation, adjustment and testing of the equipment. The field tests shall be witnessed by the Government.
   1. Field Tests: As a minimum, the startup and field test procedures shall include the following:
      a. Compare equipment nameplate data with specifications and approved shop drawings.
      b. Ensure that shipping members have been removed.
      c. Inspect physical, electrical, and mechanical condition.
      d. Clean the UPS.
      e. Attach a phase rotation meter to the UPS input, output and bypass buses, and observe proper phase sequences.
      f. Torque test bus and battery connections at shipping splits.

g. Check each electrical bus for proper phasing and identification.
h. Check and test selector switches and meters for proper operation.
i. Check doors for proper alignment and operation.
j. Check and test each protective device for proper mechanical and electrical operation.
k. Verify protective device overcurrent trip settings against approved coordination study.
l. Verify the correct operation of all sensing devices, alarms, and indicating devices.
m. Perform manufacturer’s onsite field test procedures.

2. Load Test: The installed system shall be load tested for a continuous 24 hour period by means of resistive load banks, provided by equipment manufacturer. The system shall be continuously tested at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. Instrument readings shall be recorded every half hour for the following:
   a. Input voltage and current (all three phases, for each module).
   b. Input and output frequency.
   c. Battery voltage for each module.
   d. Output voltage and current (all three phases, for each module).
   e. Output kilowatts for each module.
   f. Output voltage and current (all three phases).
   g. Output kilowatts.

B. Full Load Burn In Test: The installed system shall undergo an additional full load burn-in period of 24 continuous hours. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour as above. During the burn-in period, the following tests shall be performed:
   1. With the UPS carrying maximum continuous design load and supplied from the normal source, switch 100 percent load on and off a minimum of five times within the burn-in period.
   2. With the UPS carrying maximum continuous design load and supplied from the emergency source, repeat the switching operations described. Also, verify that the UPS module rectifier charger unit(s) go into the second-step current limit mode.
   3. With the UPS carrying maximum continuous design load and operating on battery power, repeat the switching operations described above.
   4. Continue operation on battery power for 1 minute, then restore normal power.

C. Battery Discharge Test: With the battery fully charged, the system shall undergo a complete battery discharge test to full depletion and a recharge to nominal conditions. Instrument readings shall be recorded every minute during discharge for the following:

1. Battery voltage and current for each module.
2. Output voltage and current(all three phases) for each module.
3. Output kilowatts for each module.
4. Output voltage and current (all three phases - system output).
5. Output kilowatts (system output).
6. Output frequency.

3.3 POSTING FRAMED DATA AND INSTRUCTIONS

Framed data and instructions containing wiring and control diagrams under acrylic glass shall be posted where directed. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system.

3.4 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the central uninterruptible power supply is in good operating condition and properly performing the intended function.

3.5 INSTRUCTION

A field training course shall be provided by a certified factory-trained technician for designated Government personnel. Training shall be provided for a total period of 8 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance test. Field training shall cover the items contained in the operating and maintenance manuals.

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SECTION 26 32 54

CENTRALIZED EMERGENCY LIGHTING INVERTER

PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification defines the electrical and mechanical characteristics and requirements for an uninterruptible stored emergency power supply system. The system as specified herein includes all the components required to deliver reliable, high quality uninterruptible power for emergency illumination and related life safety equipment. The system shall incorporate an on-line, dual conversion, microprocessor controlled, high frequency, IGBT PWM rectifier/charger and inverter, high speed automatic bypass transfer device, battery charging system, energy storage battery platform, a local display monitor and diagnostic panel, and all the related hardware components and software to facilitate a functional centralized system. The emergency power supply system shall provide immunity from all line disturbances and power interruptions. The system shall include an uninterrupted, normally on output power section and provisions to include a normally off standby output power section, thus enabling compatibility with emergency lighting fixtures operating in normally on and standby mode(s). A self-diagnostic monitoring alarm system shall continuously advise of system status and battery condition.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and Wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduct and outlet boxes.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

A. Emergency lighting inverter power supplies (ELIPS) shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.

B. The ELIPS system shall be factory full-load tested to meet the requirements specified using a test battery (not the battery to be supplied with the system) with ac input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Should a malfunction occur, the problem shall be corrected and the test shall be repeated. The tests shall encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings.

C. Furnish four (4) copies of certified manufacturer's factory test reports to the Resident Engineer prior to shipment of the UPS equipment to ensure that the UPS equipment has been successfully tested as specified.

D. Provide IEEE Std 450 battery installation certification.

1.5 SUBMITTALS

A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, wiring and connection diagrams, plan, front, side, and rear elevations, accessories, and device nameplate data.

C. Manuals:

1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   a. Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
   b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.

c. Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the equipment.
d. Approvals will be based on complete submissions of manuals together with shop drawings.

2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manuals to the Resident Engineer.
   a. The manuals shall be updated to include any information necessitated by shop drawing approval.
   b. Complete "As Installed" wiring and schematic diagrams shall be included which show all items of equipment and their interconnecting wiring.
   c. Show all terminal identification.
   d. Include information for testing, repair, trouble shooting, assembly, disassembly, and recommended maintenance intervals.
   e. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
   f. Furnish manuals in loose-leaf binder or manufacturer's standard binder.

D. Certifications:
   1. Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
      a. Certification by the Contractor that the assemblies have been properly installed, adjusted and tested.
      b. Certified copies of all of the factory design and production tests, field test data sheets and reports for the assemblies.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):
   C57.110.....(1998; R 2004) Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents

C62.41.1....(2002) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits

C62.41.2....(2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

Std 450.....(2002; Errata 2004) Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications

Std 485.....(1997; R 2003) Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications

C. National Electrical Manufacturers Association (NEMA):

PE 1.......(2003; R 2003) Uninterruptible Power Systems -- Specification and Performance Verification

D. National Fire Protection Association (NFPA):

70-02.....National Electrical Code (NEC).

E. Underwriter's Laboratory (UL):

924 - Listed UL Standards UL 924 Emergency Lighting Equipment with 90 minutes, UL 1778 UPS Equipment and C-UL listing to CSA C22.2, No. 107.1-M01 Canadian Standards for UPS Equipment.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store Inverter indoors in clean dry space with uniform temperature to prevent condensation. Protect inverter from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 - PRODUCTS

2.1 EMERGENCY LIGHTING INVERTER POWER SUPPLY

A. The system shall be designed and manufactured to assure maximum reliability, serviceability and performance. The system shall include one main control module for rapid service or replacement. The local display monitor shall be mounted on the front of the system for easy observation of system status and battery condition. The system is to be furnished with an internally located AC input circuit breaker and output circuit breaker. The battery and DC conductors shall be DC fuse protected. All conductors and transformer windings shall be copper constructed. Cabinets are floor mountable, constructed of steel, front accessible through a hinged, key lockable door and shall be NEMA 1 rated for indoor use. Cabinet dimensions shall not exceed 36”W x 24”D x 80”H.

1. Systems shall operate in accordance with requirements as specified herein to support any combination of fluorescent ballast fixtures, incandescent lamps, electronic and high power factor fluorescent ballasts, HID fixtures or other approved loads up to the rating of the system. “Normally on” AC output bus shall be 100% rated and limited only by the system maximum KW output rating.
2. Normal Operation: The load shall be supplied with regulated power derived from the normal AC power input terminals through the rectifier charger and inverter. The rectifier charger shall be fully rated to charge the batteries and supply sufficient DC energy for the inverter when under full load. The battery shall be connected in parallel with the rectifier charger output.
3. Uninterrupted Emergency Operation: Upon the failure or unacceptable deviation of commercial AC power, energy shall be supplied by the battery through the inverter and continue to supply power to the load without switching loss or disturbance. When power is restored at the AC input terminals of the system, the rectifier charger shall continue to supply power to the load through the inverter and simultaneously recharge the batteries. There shall be no break or interruption of power to the load upon failure or restoration of the commercial AC power.
4. Automatic Bypass Operation: The system shall include an automatic bypass switch for fault clearing, instantaneous overload conditions and/or to connect the load to the normal utility source in the event of a system rectifier charger or inverter failure.
5. Secure Bypass Switch: The system shall include an integral, secure, make-before-break bypass switch accessible via the front of the inverter enclosure through a hinged, key lockable door. The secure bypass switch shall incorporate a push-to-turn function. Pushing the bypass switch shall invoke the inverter’s static bypass and indicate that it is safe to turn the switch to the bypass mode. The secure bypass switch shall provide complete isolation of the inverter output terminals from external circuits. When the load is supplied from the utility through the secure bypass switch, the AC supply terminals shall remain energized to permit operational checking of the inverter, but the inverter output shall remain isolated from the load.

6. System Power Output Capability: The stored emergency power supply system output power rating shall be 5000 watts.
7. Battery Time Reserve Capacity: Battery shall be capable of producing emergency power for 90 minutes at full rated watts.
8. Reliability: MTBF 100,000 hours. MTTR, 1 Hour.

B. Input Specifications
1. Input Voltage: 120 VAC.
2. Input Voltage Operating Range: +12% to -15% at full load without battery usage.
3. Extended Range: The unit shall incorporate the use of variable range logic in conjunction with the load percentage to extend the input range up to +12% to -30% without battery usage while maintaining a regulated, usable output voltage.
4. Frequency Range: 57.5 Hz to 62.5 Hz.
5. Power Factor: Self correcting to >0.97 (approaching unity).
6. Input Current Harmonics: <5% THD (total harmonic distortion).

C. Output Specifications
1. Output Voltage: 120 VAC.
2. Sine Wave Voltage: Maximum 3% harmonic distortion under linear load.
3. Frequency: 60 hertz ± 0.5% under full load while in the battery operation mode.
4. Harmonic Attenuation: Reflected load generated harmonics shall be attenuated at the input.
5. Voltage Regulation: +/-2%.
6. Output Power Rating: KVA at 1.0 power factor (unity). KVA = KW

D. Battery Specifications
1. Battery time: 90 Minutes at full rated kilowatt output capability, UL 924 Compliant.
2. Battery Type: Integral, valve regulated, sealed lead calcium, maintenance free.
3. Charger: 4 stage, temperature compensated, 700 watts, 1% ripple filtered.
4. Recharge Time: 24hrs, UL 924, NFPA 101 compliant.
5. Bus Voltage: 120 VDC.

E. Performance Specifications

1. Overload Rating: 125% for 2 minutes, 150% for 30 seconds, 200% for 15 cycles when fed from AC power source.
2. On Battery Overload Rating: 125% for 30 cycles, 150% for 3 cycles.
3. Voltage Regulation: The output voltage shall be regulated to within ±2% during input voltage changes from +12% to – 15% with reference to nominal, and when the output is loaded from no load to full rated load.
4. Common Mode (isolation transformer units only): 120 dB (10^6 : 1 ground noise attenuation).
5. Transverse Mode (isolation transformer units only): 70 dB (3160 : 1 line noise attenuation).
6. Reactive Power Correction: Load at .6 pf corrected to > 0.97 at input (automatically correcting).
7. Efficiency: 86% typical under full rated load.
8. Reliability: 100,000 hours MTBF.

F. Environmental Specifications

1. Operating Temperature: 0°C (32°F) to 40°C (104°F).
2. Storage Temperature: -20°C to 50°C
3. Relative Humidity: 95% non-condensing.
4. Elevation: 5,000 feet, 1,500 meters without de-rating.
5. Weight and Cabinet Sizes: 1459 lbs. – 36"W x 24"D x 80"H.
6. Audible Noise Level: Not greater than 50 dba at 1 meter.
7. Enclosure: NEMA 1

G. Display Monitor and Diagnostics

1. Display Panel – Systems shall include a local, front mounted, sealed, LED display panel to indicate system status and battery condition. Display shall include provisions to automatically monitor inverter input voltage normal, inverter input voltage high, inverter input voltage low, inverter on bypass, % load, battery in use, battery full, battery low and check battery.
2. Audible Alarm – The display panel shall include an audible alarm with alarm silence for system on battery, low battery, check battery, over temperature warning, system fault, inverter overloaded.

3. Control Functions – Push button for inverter on, fail safe dual push buttons for inverter off, alarm silence push button and push button for system battery testing.
4. Communications Port (RS232) – Include communications port for remote monitoring access to electrical measurements, system set point programming and system log.
5. Electrical Measurements (RS232) – Electrical measurements shall include: Input voltage L1-neutral, Input voltage L2- neutral, Input voltage L1-L2, output voltage L1-neutral, output voltage L2-neutral, output voltage L1-L2, output current (amps) L1-neutral, output current (amps) L2-neutral, output watts L1- neutral, output watts L2-neutral, output watts L1-L2, output volt amperes L1-neutral, output volt amperes L2-neutral, output volt amperes L1-L2, % load L1-neutral, % load L2-neutral, battery voltage, DC charging current and output frequency.
6. System Set Points (RS232) – Include provision to program the following: The percentage point at which the display panel indicates the low battery alarm, sag point at which battery usage is to occur, surge point at which battery usage is to occur, and points at which automatic battery tests are to be performed (7 day intervals, 30 day intervals, or 90 day intervals).
7. System Log (RS232) – System shall include provision to log power outages with date and time, and system overloads with date and time.
8. Automatic Self-Testing – System shall provide a 5 minute automatic battery test programmable for every 7, 30, or 90 days in compliance with NFPA 101.
9. Manual Battery Testing – System shall provide a push to test feature in the event that a manual battery test is required.

H. Relay Communications Interface

1. Status / Alarm relay interface normally open contacts shall be provided for optional remote annunciator panel or automatic message dialer. Include potential free, 120vac @ 0.5amps, contacts for inverter on battery, low battery warning, general alarm, and system on bypass.

I. Accessories

1. Include automatic message dialer for telephone messaging to inform maintenance personnel of system alarm conditions for system on emergency battery power, low battery warning, or general alarm.
2. Include remote annunciator panel for remote status indication of system alarm conditions for system on emergency battery power, low battery warning, general alarm, and on static bypass. The annunciator panel shall be provided with an interface cable of 200 feet to connect to the inverter communication port.
3. Include network device SNMP / MODBUS TCP & RS485 / Ethernet TCP/IP adapter for network communication of inverter system status and electrical measurement data.
4. Include (quantity) pre-installed, 20 amp output circuit breakers for use with normally ON AC output bus.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The ELIPS system shall be set in place, wired and connected in accordance with the approved shop drawings and manufacturer's instructions.

3.2 ACCEPTANCE CHECKS AND TESTS

A. A manufacturer's representative shall supervise the installation, adjustment and testing of the equipment. The field tests shall be witnessed by the Government.

1. Field Tests: As a minimum, the startup and field test procedures shall include the following:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Ensure that shipping members have been removed.
   c. Inspect physical, electrical, and mechanical condition.
   d. Clean the ELIPS.
   e. Attach a phase rotation meter to the UPS input, output an bypass buses, and observe proper phase sequences.
   f. Torque test bus and battery connections at shipping splits.
   g. Check each electrical bus for proper phasing and identification.
   h. Check and test selector switches and meters for proper operation.
   i. Check doors for proper alignment and operation.

j. Check and test each protective device for proper mechanical and electrical operation.
k. Verify protective device overcurrent trip settings against approved coordination study.
l. Verify the correct operation of all sensing devices, alarms, and indicating devices.
m. Perform manufacturer’s onsite field test procedures.

2. Load Test: The installed system shall be load tested for a continuous 24 hour period by means of resistive load banks, provided by equipment manufacturer. The system shall be continuously tested at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. Instrument readings shall be recorded every half hour for the following:
   1. Input voltage and current (all three phases, for each module).
   2. Input and output frequency.
   3. Battery voltage for each module.
   4. Output voltage and current (all three phases, for each module).
   5. Output kilowatts for each module.
   6. Output voltage and current (all three phases).
   7. Output kilowatts.

B. Full Load Burn In Test:
The installed system shall undergo an additional full load burn-in period of 24 continuous hours. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour as above. During the burn-in period, the following tests shall be performed:
1. With the ELIPS carrying maximum continuous design load and supplied from the normal source, switch 100 percent load on and off a minimum of five times within the burn-in period.
2. With the ELIPS carrying maximum continuous design load and operating on battery power, repeat the switching operations described above.
3. Continue operation on battery power for 1 minute, then restore normal power.

C. Battery Discharge Test:
With the battery fully charged, the system shall undergo a complete battery discharge test to full depletion and a recharge to nominal

conditions. Instrument readings shall be recorded every minute during discharge for the following:

1. Battery voltage and current for each module.
2. Output voltage and current(all three phases) for each module.
3. Output kilowatts for each module.
4. Output voltage and current (all three phases - system output).
5. Output kilowatts (system output).
6. Output frequency.

3.3 POSTING FRAMED DATA AND INSTRUCTIONS

Framed data and instructions containing wiring and control diagrams under acrylic glass shall be posted where directed. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system.

3.4 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the central uninterruptible power supply is in good operating condition and properly performing the intended function.

3.5 INSTRUCTION

A field training course shall be provided by a certified factory-trained technician for designated Government personnel. Training shall be provided for a total period of 8 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance test. Field training shall cover the items contained in the operating and maintenance manuals.

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SECTION 26 41 00
FACILITY LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing and installation of a complete master labeled lightning protection system, complying with NFPA 780, UL 96 and UL 96A.

1.2 RELATED WORK

A. Section 07 60 00, FLASHING AND SHEET METAL: penetrations through the roof.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground faults.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. Shop Drawings:

1. Isometric and plan views showing layout and connections to the required metal surfaces.
2. Show the methods of mounting the system to the adjacent construction.

C. Qualifications: Submit proof that the installer of the lightning protection system is a certified Lighting Protection Institute (LPI) installer, and has had suitable and adequate experience installing other lightning protection systems, and is capable of installing the system as recommended by the manufacturer of the equipment.

D. Certification: Two weeks prior to final inspection, submit four copies of the following certifications to the Resident Engineer:

1. Certification that the lightning protection system has been properly installed and tested.

2. Certification that the lightning protection system has been inspected by a UL representative and has been approved by UL without variation.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Fire Protection Association (NFPA):

70.....National Electrical Code (NEC)

780.....Standard for the Installation of Lightning Protection Systems

C. Underwriters Laboratories, Inc. (UL):

96.....Lightning Protection Components

96A.....Installation Requirements for Lightning Protection Systems

UL 467 .....Standard for Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 MATERIALS

A. Attach master labels to each item by its manufacturer as evidence that the materials have been manufactured in conformance with the UL Standards for master label lightning protection materials.

B. In additional to conformance to UL 96, the component material requirements are as follows:

1. Conductors: Electrical grade copper. Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable.
2. Air terminals: Solid copper, 18 inches long, not less than 3/8 inch diameter, with sharp nickel-plated points.
3. Ground rods: solid copper, not less than 1/2 inch diameter by 8 feet long. Rods made of copper-clad steel shall conform to UL 467 and galvanized ferrous rods shall conform to IEEE C135.30. Ground rods of copper-clad steel, steel, stainless steel, galvanized ferrous, and solid copper shall not be mixed on the project.
4. Ground plates: Solid copper, not less than 1/16 inch thick.
5. Tubing: Stiff copper or brass.

C. Anchors and fasteners: Bolt type which are most suitable for the specific anchor and fastener installations. Clamp-type connectors for splicing conductors shall conform to UL 96, class as applicable, and, Class 2, style and size as required for the installation. Clamp-type connectors shall only be used for the connection of the roof conductor to the air terminal and to the guttering. All other connections, bonds, and splices shall be done by exothermic welds or by high compression fittings. The exothermic welds and high compression fittings shall be listed for the purpose. The high compression fittings shall be the type which require a hydraulically operated mechanism to apply a minimum of 10,000 psi.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be coordinated with the roofing manufacturer and installer.

B. Install the conductors as inconspicuously as practical and with the proper bends.

C. Install the vertical conductors within the concealed cavity of exterior walls. Run the conductors to the exterior at elevations below the finished grade and make the ground connections to the earth outside of the building or stack perimeter.

D. Make connections of dissimilar metal with bimetallic type fittings to prevent electrolytic action.

E. Use the exothermic welding type connections that form solid metal joints in the main vertical and horizontal conductors, and for connections that are not exposed in the finish work.

F. Protect copper conductors with stiff copper or brass tubing, which enclose the conductors from the top to the bottom of the tubing, between one foot below and seven feet above the finished grade. The conductor shall be bonded to the top and bottom of the tubing.

G. Sheath copper conductors, which pass over cast stone, cut stone, architectural concrete and masonry surfaces, with not less than a 1/16 inch thickness of lead to prevent staining of the exterior finish surfaces.

H. For the earth connections, install ground rods and ground plates, and the conductor connections to them and the main water pipes in the presence of the Resident Engineer. For the conductors located outside

of the building or stack, install the conductors not less than two feet below the finished grade.

I. For structural steel buildings, connect the steel framework of the buildings to the main water pipe near the water system entrance to the building.

J. Connect lightning protection cables to all metallic projections, equipment, and components above the roof as indicated on the drawings.

K. Connect exterior metal surfaces, located within three feet of the lightning protection system conductors, to the lightning protection system conductors to prevent flashovers.

L. Maintain horizontal or downward coursing of main conductor and insure that all bends have at least an 8-inch radius and do not exceed 90 degrees.

M. Conductors shall be rigidly fastened every three feet along the roof and down to the building to ground.

N. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Install air terminal bases, cable holders and other roof-system supporting means without piercing roof metal.

O. Use clamp supports to secure supporting means to roof standing seams only.

P. Use through-roof connectors for down-conductor attachment to roof system. Provide flashing in accordance with Section 07 60 00, FLASHING AND SHEET METAL.

Q. Down-conductors coursed on or in reinforced concrete columns or on structural steel columns shall be connected to the reinforcing steel or the structural steel member at its upper and lower extremities. In the case of long vertical members an additional connection shall be made at intervals not exceeding 100 feet.

R. A counterpoise, where shown, shall be of No. 1/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 2 feet deep at a distance not less than 3 feet nor more than 8 feet from the nearest point of the structure.

S. On construction utilizing post tensioning systems to secure precast concrete sections, the post tension rods shall not be used as a path for

lightning to ground. Down conductors shall be provided on structures using post tensioning systems. Down conductors shall have sufficient separation from post tension rods to prevent side-flashing. Post tension rods shall be bonded to the lightning protection and grounding systems only at the base of the structure; this bonding shall be performed in strict accordance with the recommendations of the post tension rod manufacturer, and shall be done by, or in the presence of, a representative of the manufacturer.

T. Grounding: Test the ground resistance to earth by standard methods and conform to the ground resistance requirements specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

U. Where shown, use the structural steel framework or reinforcing steel as the main conductor:
   1. Weld or bond the non-electrically-continuous sections together and make them electrically continuous.
   2. Verify the electrical continuity by measuring the ground resistances to earth at the ground level, at the top of the building or stack, and at intermediate points with a sensitive ohmmeter. Compare the resistance readings.
   3. Connect the air terminals together with an exterior conductor connected to the structural steel framework at not more than 60 foot [18m] intervals.
   4. Install ground connections to earth at not more than 60 foot [18m] intervals around the perimeter of the building.
   5. Weld or braze bonding plates, not less than 8 inches [200mm] square, to cleaned sections of the steel and connect the conductors to the plates.
   6. Do not pierce the structural steel in any manner. Connections to the structural steel shall conform to UL Publication No. 96A.

V. When the lightning protection systems have been installed, have the systems inspected by a UL representative. Obtain and install a UL numbered master label for each of the lightning protection systems at the location directed by the UL representative and the Resident Engineer.

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SECTION 26 43 13
TRANSIENT-VOLTAGE SURGE SUPPRESSION

PART 1 - GENERAL

1.1 DESCRIPTION

Section includes transient voltage surge suppression equipment for low-voltage power distribution and control equipment.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.

B. Section 26 24 11, DISTRIBUTION SWITCHBOARDS: For factory-installed TVSS.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

B. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.

C. Warranties: Sample of special warranties.

D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:

   a. Certification by the Contractor that the assemblies have been properly installed, adjusted and tested.3.

   b. Certified copies of all of the factory design and production tests, field test data sheets and reports for the assemblies.

1.5 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplement and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

A. Institute of Engineering and Electronic Engineers (IEEE):

IEEE C62.41.2.....Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

IEEE C62.45.....Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

B. National Electrical Manufacturers Association (NEMA):

NEMA LS 1.....Low Voltage Surge Protective Devices

C. Underwriters Laboratories, Inc. (UL):

UL 1283.....Electromagnetic Interference Filters

UL 1449 – 3rd Edition.....Surge Protective Devices

D. National Fire Protection Association (NFPA):

NFPA 70.....National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 SWITCHBOARD SUPPRESSORS

A. Surge Protection Devices:

1. Comply with UL 1449 3rd edition.
2. Modular design with field-replaceable modules.
3. Fuses, rated at 200-kA interrupting capacity.
4. Fabrication using bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. Redundant replaceable modules.
8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. Four-digit transient-event counter set to totalize transient surges.

B. Peak Single-Impulse Surge Current Rating: 320 kA per mode/640 k per phase.

C. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

D. Protection modes and UL 1449 SVR for grounded wye circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
2. Line to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
3. Neutral to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.

E. Protection modes and UL 1449 SVR for 240/120 V, single-phase, 3-wire circuits shall be as follows:
1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

F. Protection modes and UL 1449 SVR for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

G. Protection modes and UL 1449 SVR for 240 V or 480 V, 3-phase, 3-wire, delta circuits shall be as follows:
1. Line to Line: 2000 V for 480 V, 1000 V for 240 V.
2. Line to Ground: 2000 V for 480 V, 1000 V for 240 V.

2.2 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TVSS devices at switchboard on load side, with ground lead bonded to service entrance ground.
1. Provide a circuit breaker, sized by manufacturer, as a dedicated disconnecting means for TVSS unless otherwise shown on drawings.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:
1. Visual and Mechanical Inspection
a. Compare equipment nameplate data with specifications and approved shop drawings.
b. Inspect physical, electrical, and mechanical condition.

c. Verify that disconnecting means and feeder size and maximum to TVSS unit correspond to approved shop drawings.
d. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.
e. Clean TVSS unit.
f. Complete startup checks according to manufacturer's written instructions.
g. Verify the correct operation of all sensing devices, alarms, and indicating devices.

3.3 STARTUP

A. Do not energize or connect switchboards to their sources until TVSS devices are installed and connected.
B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 SPARE PARTS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Replaceable Protection Modules: One of each size and type installed.

3.5 INSTRUCTION

Provide factory certified technician to train Government maintenance personnel to maintain TVSS devices. Training shall be provided for a total period of 4 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance test. Training shall cover all essential items contained in the operation and maintenance manual.

- - -END OF SECTION - - -

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies the furnishing, installation and connection of the interior lighting systems.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

D. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. In addition to the requirements of Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

1. Product Data: For each type of lighting fixture (luminaire) designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of fixture designation, submit the following information.
   a. Material and construction details include information on housing, optics system and lens/diffuser.
   b. Physical dimensions and description.
   c. Wiring schematic and connection diagram.
   d. Installation details.
   e. Energy efficiency data.
   f. Photometric data based on laboratory tests complying with IESNA Lighting Measurements, testing and calculation guides.
   g. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours) and color temperature (degrees Kelvin).
   h. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts and total harmonic distortion (THD).

2. Manuals:
   a. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
   b. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the COR.
3. Certifications:
   a. Two weeks prior to final inspection, submit four copies of the following certifications to the COR:
      1. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Institute of Electrical and Electronic Engineers (IEEE):
   C62.41-91.....Guide on the Surge Environment in Low Voltage (1000V and less) AC Power Circuits

C. National Fire Protection Association (NFPA):
   70.....National Electrical Code (NEC)
   101.....Life Safety Code

D. National Electrical Manufacturer's Association (NEMA):
   C82.1-97.....Ballasts for Fluorescent Lamps - Specifications
   C82.2-02.....Method of Measurement of Fluorescent Lamp Ballasts
   C82.11-02.....High Frequency Fluorescent Lamp Ballasts

E. Underwriters Laboratories, Inc. (UL):
   496-96.....Edison-Base Lampholders
   542-99.....Lampholders, Starters, and Starter Holders for Fluorescent Lamps
   924-95.....Emergency Lighting and Power Equipment
   935-01.....Fluorescent-Lamp Ballasts
   1598-00.....Luminaires
   8750-08.....Light Emitting Diode (LED) Light Sources for Use in Lighting Products

F. Federal Communications Commission (FCC):
Code of Federal Regulations (CFR), Title 47, Part 18

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES (LUMINAIRES)

A. Shall be in accordance with NFPA 70 and UL 1598, as shown on drawings, and as specified.

B. Sheet Metal:

1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved) and parallel to each other as designed.
2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
3. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
4. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, latches shall function easily by finger action without the use of tools.

C. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.

D. Lamp Sockets:

1. Fluorescent: Lampholder contacts shall be the biting edge type or phosphorous-bronze with silver flash contact surface type and shall conform to the applicable requirements of UL 542. Lamp holders for bi-pin lamps shall be of the telescoping compression type, or of the single slot entry type requiring a one-quarter turn of the lamp after insertion.

E. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

F. Metal Finishes:

1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of

stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.

2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
3. Exterior finishes shall be as shown on the drawings.

G. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

H. Light Transmitting Components for Fluorescent Fixtures:
1. Shall be 100 percent virgin acrylic.
2. Flat lens panels shall have not less than 1/8 inch of average thickness. The average thickness shall be determined by adding the maximum thickness to the minimum un-penetrated thickness and dividing the sum by 2.
3. Unless otherwise specified, lenses, diffusers and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction of the lens without distortion or cracking.

I. Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballast integral to the fixture. Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures (not the lamp). Fixtures shall be designed for lamps as specified.

2.2 BALLASTS

A. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 – 277V) electronic program, rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated; including the following features:
1. Lamp end-of-life detection and shutdown circuit (T5 lamps only).
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: 10 percent or less.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. Ballast Factor: 1.0 for T5 unless otherwise indicated.
9. Power Factor: 0.98 or higher.

10. Interference: Comply with 47 CFT 18, Ch.1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
11. To facilitate multi-level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.
12. Where three-lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two-lamp ballast to operate the center lamp in pairs of adjacent units that are mounted in a continuous row. The ballast fixture and slave-lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single-lamp ballast for operation of the center lamp.
13. Dimming ballasts shall be as per above, except dimmable from 100% to 1% (for T5 lamps) of rated lamp lumens.
14. Ballasts for Low-Temperature Environments:
    a. Temperatures 0 Deg F and Higher: Electronic low temperature type rated for 0 deg F starting and operating temperature with indicated lamp types.

2.3 LAMPS

A. Linear T5 Fluorescent Lamps:
   1. Rapid start fluorescent lamps shall comply with ANSI C78.1; and instant-start lamps shall comply with ANSI C78.3.
   2. Chromacity of fluorescent lamps shall comply with ANSI C78.376.
   3. Except as indicated below, lamps shall be low-mercury energy saving type, have a color temperature of 4100°K, a Color Rendering Index (CRI) of greater than 70, average rated life of 20,000 hours, and be suitable for use with dimming ballasts, unless otherwise indicated. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.

B T5HO rapid-start, high-output lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100K, and average rated life of 20,000 hours unless otherwise indicated.

2.4 LED FIXTURES

A. Fixtures shall be manufactured and assembled in the United States and meets the buy American requirements within the American Recovery and Reinvestment Act and be UL Listed.

B. Light Emitting Diodes shall be manufactured by Cree, Lumiled, or Nachia; no approved equal.

C. Drivers shall be manufactured by Osram/Sylvania, Phillips/Advance, or ADL Technology and be capable of accepting the voltage indicated on the drawings and capable of dimming if required. The driver shall meet the following requirements:

1. Class A Sound Rating
2. Total Harmonic Distortion of less than 20 percent.
3. Operating temperature between -40 degree Celsius and 40 degrees Celsius.
4. Driver shall not contain any Polychlorinated Biphenyl (PCB).

D. All LED fixtures shall be tested to IESNA LM-79-2008 and LM-80-2008 and meet the following:

1. Fixture Efficacy (Lumens per watt): 60 or greater.
2. Color Accuracy: Color Rendering Index (CRI): 70 or greater.
3. Light Color: As indicated on lighting fixture schedule.
4. LEDs, driver and all components shall have a system lifetime of 50,000 hours or more at 25 degrees Celsius.
5. Fixture shall have a minimum of a five year warranty on all components and finishes.

2.5 EXIT LIGHT FIXTURES

A. Exit light fixtures shall meet applicable requirements of NFPA 101 and UL 924.

B. Housing and Canopy:

1. Shall be made of material as specified in lighting fixture schedule.
2. Optional steel housing shall be a minimum 20 gauge thick or equivalent strength aluminum.
3. Steel housing shall have baked enamel over corrosion resistant, matte black or ivory white primer.

C. Door frame shall be cast or extruded aluminum, and hinged with latch.

D. Finish shall be satin or fine-grain brushed aluminum.

E. There shall be no radioactive material used in the fixtures.

F. Fixtures:

1. Maximum fixture wattage shall be 1 watt or less.
2. Inscription panels shall be cast or stamped aluminum a minimum of 0.090 inch thick, stenciled with 6 inch high letters, baked with red

color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass. The LED shall be rated minimum 25 years life.

3. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
4. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltages: Refer to Lighting Fixture Schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
B. Align, mount and level the lighting fixtures uniformly.
C. Lighting Fixture Supports:
1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
2. Shall maintain the fixture positions after cleaning and relamping.
3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
4. Hardware for recessed fluorescent fixtures:
a. Where the suspended ceiling system is supported at the four corners of the fixture opening, hardware devices shall clamp the fixture to the ceiling system structural members, or plaster frame at not less than four points in such a manner as to resist spreading of the support members and safely lock the fixture into the ceiling system.
b. Where the suspended ceiling system is not supported at the four corners of the fixture opening, hardware devices shall independently support the fixture from the building structure at four points.

D. Furnish and install the specified lamps for all lighting fixtures installed.
E. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and

installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.

F. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

G. Exercise electronic dimming ballasts over full range of dimming capability by operating the control devices(s) in the presence of the COR. Observe for visually detectable flicker over full dimming range.

H. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless a lesser period is specifically recommended by lamp manufacturer. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage. Replace any lamps and ballasts which fail during burn-in.

I. At completion of project, relamp/reballast fixtures which have failed lamps/ballasts. Clean fixtures, lenses, diffusers and louvers that have accumulated dust/dirt/fingerprints during construction. Replace damaged lenses, diffusers and louvers with new.

J. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

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SECTION 27 05 11
REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section, Requirements for Communications Installations, applies to all sections of Division 27.

B. Furnish and install communications cabling, systems, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable, and other items and arrangements for the specified items are shown on drawings.

1.2 MINIMUM REQUIREMENTS

A. References to industry and trade association standards and codes are minimum installation requirement standards.

B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.3 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.4 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COR a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the COR prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.5 EQUIPMENT REQUIREMENTS

Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.6 EQUIPMENT PROTECTION

A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:

1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.

2. Damaged equipment shall be, as determined by the COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.7 WORK PERFORMANCE

A. Job site safety and worker safety is the responsibility of the contractor.

B. For work on existing stations, arrange, phase and perform work to assure communications service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

D. Coordinate location of equipment and pathways with other trades to minimize interferences. See the GENERAL CONDITIONS.

1.8 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.9 EQUIPMENT IDENTIFICATION

A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.

B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as

a standard catalog item, or where other method of identification is herein specified, are exceptions.

1.10 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.

C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of

systems or equipment test, and furnish the remaining manuals prior to contract completion.

2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
   a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
   b. A control sequence describing start-up, operation, and shutdown.
   c. Description of the function of each principal item of equipment.
   d. Installation and maintenance instructions.
   e. Safety precautions.
   f. Diagrams and illustrations.
   g. Testing methods.
   h. Performance data.
   i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
   j. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

G. Approvals will be based on complete submission of manuals together with shop drawings.

H. After approval and prior to installation, furnish the COR with one sample of each of the following:
   1. A 12 inch length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
   2. Each type of conduit and pathway coupling, bushing and termination fitting.
   3. Raceway and pathway hangers, clamps and supports.
   4. Duct sealing compound.

I. In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

1.11 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.12 TRAINING

A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

B. Training shall be provided for the particular equipment or system as required in each associated specification.

C. A training schedule shall be developed and submitted by the contractor and approved by the COR at least 30 days prior to the planned training.

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SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Work of this Section shall consist of the labor, materials, and equipment required for furnishing and installing cable and equipment for complete and operating telecommunications system extended from the existing telecommunications infrastructure.

1.2 DESCRIPTION OF WORK

A. The work generally consists of furnishing and installing inside Technology and equipment as indicated on the drawings.

B. All items shall be furnished and installed to provide complete and operating systems extended from the existing infrastructure.

C. Contractor shall furnish and install the following:

1. Unless noted, conduits, raceways, cable tray, sleeves, pull boxes, and outlet boxes.
2. Grounding busbars, ground wires and ground clamps
3. A #14 fish wire or Jet Line No. 232 pull rope in each spare run of conduit.
4. Outlet boxes.
5. Conduits from outlet boxes to above accessible ceilings (or to accessible location if ceilings are not accessible). Refer to Electrical Drawings for locations of conduit stub-outs
6. Copper cables.
7. Fiber optic cables.
8. Jacks, wallplates and connectors, both copper and fiber.
9. Fiber optic cable management ring.
10. Racks including patch panels and wire management panels.
11. Testing of all cable, copper and fiber optic
12. Innerduct
13. Fire stops in sleeves

1.3 SUBMISSIONS

A. In addition to the requirements of section 27 05 11, the Contractor shall provide product data and shop drawings for all materials proposed for installation under this Contract. The product data and shop drawings shall be submitted to the Owner for approval before such equipment is delivered to the site. The Contractor shall submit

samples as may be required by the Owner of any article or materials to be used under this Contract, which samples, if approved, may be used on the work after serving their purpose as samples.

B. Identify submittals with the following information permanently adhered to or noted on each separate component of each submittal and also noted on the transmittal form. Mark each copy of each submittal identically, with the following:
   1. Project title and location.
   2. The Section number of the Section by which the proposed equipment is specified.
   3. The Drawing number or numbers of the Drawing or Drawings by which the proposed equipment is indicated.
   4. The name, address and telephone number of the supplier and the associated manufacturer.
   5. Submittals presented on sheets 8-1/2 inch (21.6 cm) x 11 inch (27.9 cm) or less shall be presented as part of a bound volume.
   6. Refer to the article titled "SUBSTITUTIONS" for all products which are not specified by manufacturer and catalog number and are intended to be submitted.
   7. Where products are listed by manufacturer and model number, the listing shall represent a standard of performance. These listings shall <u>not</u> be construed as proprietary specifications. Equivalent products may be submitted for approval and use as described in the article titled “SUBSTITUTIONS”.
   8. Contractor shall submit as-built information outlet schedules in a format determined by the Owner indicating individual jacks after the building is occupied.

1.4 SUBSTITUTIONS

A. The submissions are the Contractor's documents and the Architect's approval constitutes an acknowledgment that the documents have been submitted and nothing more. It is the Contractor's responsibility to check his own submissions for compliance with the Contract Documents and job conditions.

B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalog number in order to establish standards of quality and performance and not for the purpose of limiting competition. Unless specifically stated otherwise, the bidder may

assume the phrase "or approved equal," except that the burden is upon the bidder to prove such equality. If the bidder elects to prove such equality, he must request the Architect's approval in writing to substitute such item for the specified item, and shall submit supporting data, and samples if required, to permit a fair evaluation of the proposed substitution with respect to quality, serviceability and warranty.

C. When this Contractor desires to furnish equipment of a manufacturer other than that specified or intended, he shall include a complete specification of the substituted item, along with each submission copy of shop drawings, indicating the necessary modifications to the substituted product to satisfy the requirements of the contract specifications. Manufacturer's specifications shall be written as close as possible to the contract specifications and each paragraph shall bear the same paragraph number as the contract specifications so that close comparison can be made.

D. The verification specification shall include the exact wording of the contract specification and the revised wording identified properly indicating all the deviations proposed. Each paragraph shall be denoted as "TOTALLY COMPLIES", "PARTIALLY COMPLIES", or "DOES NOT COMPLY". If no deviations are noted, the Contractor must furnish the material or equipment in accordance with the contract specifications.

E. Also, when the Contractor submits equipment or materials of the manufacturers specified, verification specifications must be submitted at the request of the Architect.

F. The Contractor is responsible for confirming that all specified products will be available in a timely manner to meet the contract schedule. Should the delivery time schedule of any specified product be an issue that could adversely affect the project schedule, the Contractor shall notify the Owner, in writing, within 14 days following the award of the Contract. Documentation as to when specified products were ordered and anticipated delivery dates will be required to be submitted to the Owner at this time. Failing to comply with this paragraph will prohibit the Contractor from substituting a specified product based on delivery time issues.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Contractor shall submit all products per drawings and specifications for review by the Owner prior to installation. Subject to compliance with specific design and specification requirements. Manufacturers:

B. Subject to compliance with requirements, provide products by the following:
   1. Leviton.
   2. Panduit.
   3. Approved equal

2.2 WIRING PATHWAY AND EQUIPMENT MOUNTING ELEMENTS

A. Cable Trays: Comply with Division 26 Section "Cable Trays for Electrical Systems".

B. Raceways, Boxes, and Cabinets: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems".

C. Cable Pulling Lubrication and Lubricant
   1. The cable jacket and/or conduit innerduct walls shall be completely lubricated when cable is pulled into conduit. The lubricant shall be applied immediately before or during the pull.
   2. The cable lubricant shall meet the following performance specifications:
      a. The lubricant shall be UL or CSA listed.
      b. The lubricant shall produce no deleterious effects on physical or electrical properties of cable jackets.
      c. The lubricant shall produce no stress cracking on LDPE cable jackets when tested per IEEE Standard 1210, Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable.
      d. Cable jacket materials LLDPE, XLPE, CPE, and PVC heat aged in lubricant shall pass tensile and elongation compatibility requirements from IEEE Standard 1210, Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable.
      e. The lubricant shall contain no waxes, greases, silicones, or polyalkylene glycol oils or waxes.

f. The lubricant shall not phase-out after five freeze/thaw cycles or 5-day exposure at 60 degrees C.

g. A 200-gram sample of the lubricant, when placed in a one-foot, split metal conduit and fully dried for 24 hours at 105 degrees C., shall not ignite with a pilot flame and continuously burn for more than one minute at a continued heat flux of 40 kW/m^2. Total time of test shall be one-half hour.

h. A 200-gram sample of the lubricant, when placed in a one-foot, split metal conduit and fully dried for 24 hours at 105 degrees C., shall not spread a flame more than three inches beyond a point of ignition at a continued heat flux of 40 kW/ m^2. Total time of test shall be one-half hour.

2.3 GROUNDING

A. See Division 26 Section – Grounding and Bonding.

2.4 MISCELLANEOUS HORIZONTAL CABLING COMPONENTS

A. This section includes description of and requirements for horizontal telecommunications cabling.

B. General

1. The horizontal cabling is the portion of the telecommunications cabling system that extends from the work area information outlet/connector to the horizontal cross-connect in the telecommunications room. The horizontal cabling includes the horizontal cables, the information outlet/connector in the work area, the mechanical termination, and patch cords or jumpers located in the telecommunications room.

   a. NOTE - The term "horizontal" is used since typically the cable in this part of the cabling system runs horizontally along the floor(s) or ceiling(s) of a building.

2. Topology

   a. The horizontal cabling shall be a star topology. Each work area information outlet/connector shall be connected to a horizontal cross-connect in the TR/MER. Each work area shall be served by a telecommunications room.

      1) NOTE - Cabling between telecommunication rooms for the purpose of creating "bus" and "ring" topologies is considered part of the backbone cabling.

3. Horizontal Cabling Distances
   a. The maximum horizontal distance shall be 295 feet (90 m), independent of media type. This is the cable length from the mechanical termination of the media at the horizontal cross-connect in the telecommunications room to the information outlet/connector in the work area.
4. Recognized Cable Types
   a. The following types of cables are recognized by this specification for use in the horizontal cabling system. These cables are:
      1) Four-pair Category 6 unshielded twisted-pair (UTP) cables.
      2) RG-6/U Coaxial cable
      3) RG-11/U Coaxial cable.
   b. The specific performance characteristics for the recognized cables, associated connecting hardware, and cross-connect jumpers and patch cords are described elsewhere.
   c. Hybrid cables, consisting of more than one of the recognized cables listed herein, under a common sheath, may be used in the horizontal cabling system provided that they meet the established requirements.

C. Information Outlets
1. General
   a. An information outlet is the location of the connection point between the horizontal cable and patch cords connecting devices in the work area. Connected devices are typically items such as telephones, personal computers, and graphic or video terminals, each of which may require access to the horizontal distribution facility via the information outlet.
   b. Information outlet locations shall be coordinated with the furniture layout. Wall-mounted outlets are typically installed at the same height as the power outlet.
   c. Information Outlet Locations
      1) Information outlets shall be located, as required, in mechanical and electrical spaces to accommodate the building automation system, fire alarm system, and security system.

2) Additional information outlets will be required in areas where phones may be required for maintenance, such as mechanical rooms and electrical rooms.
3) Consideration shall be made for the installation of pay phones in areas of public access. Where pay phones are to be provided, an information outlet shall be provided.
4) Location of information outlets at cubicles shall be coordinated with the Owner.

D. Cross Connections and Interconnections

1. General

a. Horizontal voice and data cables shall be terminated on connecting hardware that meets the requirements of this specification. These cable terminations shall not be used to administer cabling system moves, adds, and changes. All connections between horizontal and backbone cables shall be made through a horizontal cross-connect.

b. Products for this installation shall be furnished in new and factory packaged condition. Each product shall be inspected by the Contractor to ensure completeness and that no damage was incurred during shipping. The contractor shall return to the manufacturer, any product found to be deficient. The cost of the return and replacement product shall be borne by the Contractor. All products provided for this installation shall meet the following minimum criteria.

2.5 4 PAIR CATEGORY 6 UTP CABLE

A. General

1. These requirements are for cables of four unshielded twisted pairs of 24 AWG copper, thermoplastic insulated solid conductors enclosed by a thermoplastic jacket.
2. All cable will conform to the requirements defined by Article 800 of the National Electrical Code and shall be Plenum rated. Plenum rated cable is defined as cables installed in ducts, plenums and other spaces used for environmental air and shall conform to specifications for CMP 50 (limited combustible cable) and C(UL)FT-6.
3. All conductor insulation shall be FEP.

B. Physical Characteristics:

1. Shall be plenum rated and meet applicable requirements of ANSI/ICEA S-80-576. All 4 pairs must be insulated with F.E.P. No constructions that use mixed insulation materials will be allowed.
2. The diameter of the insulated conductor materials will be allowed.
3. Shall consist of (4) 22-26 AWG twisted pairs.
4. Shall be suitable for the environment in which they are to be installed.
5. The color coding pairs shall be:

Pair 1	W-BL; BL
Pair 2	W-O; 0
Pair 3	W-G; G
Pair 4	W-BR; BR

6. The overall diameter of the cable shall be no larger than 0.240 inches.
7. The ultimate breaking strength measured in accordance with ASTM D 4565 shall be 295 lb/f minimum.
8. Cable shall withstand a bend radius of 1 inch at -4°F without jacket or insulation cracking.
9. Cable shall be third party verified to meet TIA/EIA Category 6.

C. Transmission Characteristics:

1. DC resistance of any conductor shall not exceed 9.38 Ohms per 328 ft max. at 68°F. Measured in accordance with ASTM D 4566.
2. The mutual capacitance of any pair at 1 kHz for 328 ft cable shall not exceed 4.4 nF nominal.
3. DC resistance unbalanced any two conductors of any pair shall not exceed 5% when measured or corrected to 68°F in accordance with ASTM D 4566.
4. The maximum Attenuation @ 68°F ± 5.5° of any pair shall be less than the following values: (See Table 1)
5. The SRL swept measurement for 100m or longer shall meet or exceed the following values: (See Table 1)
6. The RL @ 68°F ± 5.5° between pairs in a cable for a length of 328 ft shall meet or exceed the following values: (See Table 1)
7. The NEXT coupling loss @ 68°F ± 5.5° between pairs in a cable shall be greater than or equal to the following values: (See Table 1)

8. The PSNEXT loss @ 68°F ± 5.5° between pairs in a cable for a length of 328 ft shall be greater than or equal to the following values: (See Table 1)
9. The ELFEXT loss @ 68°F ± 5.5° between pairs in a cable for a length of 328 ft shall be greater than or equal to the following values: (See Table 1)
10. The PSELFEXT loss @ 68°F ± 5.5° between pairs in a cable for a length of 328 ft shall not exceed the following values: (See Table 1)
11. The propagation delay of any pair at 10 MHz shall not exceed 5.7 ns/m.

Freq MHz	Attenuation (dB)max/ 100m	SRL (dB)min	RL (dB)min	NEXT (dB)min	PS-NEXT (dB)min	ELFEXT (dB)min	PS-ELFEXT (dB)min	ACR (dB)min / 100m	PS-ACR (dB)min / 100m
1.0	2.0	25.5	20.0	78	76	75	72	76	74
4.0	3.8	25.5	23.0	69	67	63	60	65	63
10.0	6.0	25.5	25.0	63	61	55	52	57	55
16.0	7.6	25.5	25.0	60	58	51	48	52	50
20.0	8.5	25.5	25.0	58	56	49	46	50	48
31.25	10.7	24.5	23.6	55	53	45	42	44	42
62.5	15.4	23.0	21.5	51	49	39	36	36	34
100.0	19.8	22.0	20.1	48	46	35	32	28	26
200.0	29.0	20.5	18.0	44	42	29	26	15	13
250.0	32.8	20.0	18.3	42	40	27	24	10	8
350.0	39.8	19.3	16.3	40	38	--	--	--	--
400.0	43.0	19.0	15.8	39	37	--	--	--	--
500.0	48.9	18.5	15.2	38	36	--	--	--	--

Table 1

D. Quality Control

1. Every Reel shall be tested for all characteristics listed in Table 1. This testing shall be performed using a sweep test method and include frequencies from 1 MHz to 500 Mhz.
2. Every reel shall be provided with the nominal velocity of propagation value to be used in testing.

E. Test Report

1. A test report shall be attached to each reel of cable indicating the Reel number, the date of the test, and test results for each pair. At a minimum, test results will be shown for the parameters listed above for SRL, Attenuation, Crosstalk (NEXT), Power Sum Next. Characteristic impedance shall be shown for each pair. Nominal velocity of propagation shall be shown.

F. Cable Jacket

1. Non-plenum rated cables shall have a PVC jacket.
2. Plenum rated cables shall have an FEP jacket (listed limited combustible).

2.6 INFORMATION OUTLET CONSTRUCTION

A. Outlet Plates

1. The outlet plate shall be mounted to a single gang surface or flush mounted box, and/or surface-mounted floor unit provided by the contractor. Outlet plates shall be thermoplastic in all locations except in mechanical/electrical rooms where stainless steel type shall be used.. The outlet plates shall accept machine generated labeling. Outlet plate color shall be coordinated with Architect and Owner.
2. Modular furniture outlet plates shall be compatible with the modular furniture used for these renovations. The outlet plate shall accept 4 unshielded Cat 6 jacks or combination of jacks and blanks. The outlet plates shall accept machine generated labeling. Outlet plate color shall be coordinated with the Architect and Owner.

B. Category 6 UTP Jacks

1. Jacks shall be selected to compliment the enhanced performance characteristics of the cable.
2. Jacks must be capable of supporting inline power per IEEE 802.3af Standard for Powered Ethernet.
3. Eight-wire, eight-position modular jacks shall be used for all information outlets. Unless noted otherwise, each jack shall be fed by a separate four pair cable sheath. Unless noted otherwise, all four pairs shall be wired to the jack using TIA/EIA-568B wiring scheme. The jacks shall employ 110 style IDC contacts for termination of the wire.

4. Jack housings shall be polycarbonate complying to UL 94V-2 flammability rating. Contact material shall be gold plating over base metal on mating area. Jack pins shall be specifically designed to not deform or have degradation of service occur, when a 4 or 6 pin modular plug is inserted into an 8 pin modular jack.
5. All Category 6 outlets shall conform to TIA/EIA 568B or latest edition Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and be part of the UL LAN Certification and Follow-up Program, and shall meet or exceed the following electrical and mechanical specifications:
   a. Electrical Specifications:
      1) TIA/EIA 568B Category 6 enhanced minimum requirements.
      2) Insulation Resistance: 500 MΩ minimum.
      3) Dielectric withstand voltage 1,000 VAC RMS, 60 Hz minimum, contact-to-contact and 1,500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface.
      4) Contact Resistance: 20 mΩ maximum.
      5) Current Rating: 1.5A at 68 degrees F. per IEC Publication 512-3, Test 5b.

Frequency	Worst Pair NEXT (maximum) MPS100 Outlet Power Sum **	Attenuation (maximum) (dB) MPS100 Outlet Power Sum **
1.00 MHz	87	0.02
4.00 MHz	75 dB	0.02
8.00 MHz	69 dB	0.02
10.00 MHz	67 dB	0.02
16.00 MHz	63 dB	0.03
20.00 MHz	61 dB	0.03
25.00 MHz	58 dB	0.03
31.25 MHz	56 dB	0.04
62.50 MHz	49 dB	0.08
100.00 MHz	42.9 dB	0.07

   b. Mechanical Performance:
      1) Plug Insertion Life: 750 insertions.
      2) Contact Force: 3.5 oz. minimum using FCC-Approved modular plug.
      3) Plug Retention Force: 20 lb. minimum between modular plug and jack.
      4) Temperature Range: -40 degrees to 150 degrees F.

6. UL Verified Category 6 Electrical Performance
   a. Comply with FCC Part 68
   b. ISO 9001 Certified Manufacturer

C. UTP Plugs with Enhanced Performance Characteristics
   1. Eight-wire, eight-position modular plugs shall be used for all UTP cable assemblies.
   2. Plugs must be capable of supporting inline power per IEEE 802.3af standard for powered Ethernet.
   3. Plug housings shall be polycarbonate complying with UL 94V-2 Flammability rating. Contact material shall be gold over base metal plating on mating area and termination end.
   4. Plugs shall be rated for Category 6.

2.7 COAXIAL CABLE

A. RG-11/U: NFPA 70, Type CATV.
   1. No. 14 AWG, solid, copper-covered steel conductor.
   2. Gas-injected, foam-PE insulation.
   3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
   4. Jacketed with sunlight-resistant, black PVC or PE.
   5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

B. RG-6/U: NFPA 70, Type CATV or CM.
   1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
   2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
   3. Jacketed with black PVC or PE.
   4. Suitable for indoor installations.

C. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
   1. CATV Plenum Rated: Type CATVP, complying with NFPA 262.

2.8 COAXIAL CABLE HARDWARE

A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.9 MISCELLANEOUS BACKBONE CABLING COMPONENTS

A. This Section includes description of and requirements for telecommunications cabling backbones.

B. General

1. The function of the backbone cabling is to provide interconnections between telecommunications rooms, communications equipment rooms, and entrance facilities in the telecommunications cabling system structure. Backbone cabling consists of the backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection. Backbone cabling also includes cabling between buildings.
2. In planning the routing and support structure for the backbone copper cabling, care shall be taken to avoid areas where sources of high levels of EMI, such as motors and transformers, may exist. ANSI/TIA/EIA-569 specifies separation of the backbone cabling pathways from typical sources of EMI.
3. The backbone cabling shall also include those cables that run from the TR's wall field to the network racks.

C. Topology

1. Star Topology
   a. The backbone cabling shall use the conventional hierarchical star topology wherein each horizontal cross-connect in a telecommunications room is cabled to a main cross-connect or an intermediate cross-connect then to a main cross-connect, except as noted. There shall be no more than two hierarchical levels of cross-connects in the backbone cabling. From the horizontal cross-connect, no more than one cross-connect shall be passed through to reach the main cross-connect. Therefore, interconnections between any two horizontal cross-connects shall pass through three or fewer cross-connects. Only a single cross-connect shall be passed through to reach the main cross-connect.
   b. Backbone cabling cross-connects may be located in telecommunications rooms, equipment rooms, or at entrance facilities. Bridged taps shall not be used as part of the backbone cabling.

2. Accommodation of Non-Star Configurations
   a. Systems that are designed for non-star configurations such as ring, bus, or tree, can be accommodated by the star topology through the use of appropriate interconnections, electronics, or adapters in the telecommunications rooms.

D. Backbone Cabling Distances
1. The distance between the entrance point and the main cross-connect shall be included in the total distance calculations. The length and type of media (including gauge size for copper), shall be recorded and be provided to the Owner.
2. In the main cross-connect, jumper and patch cord lengths shall not exceed 65 feet (20 m). In the intermediate cross-connect, jumper and patch cord lengths shall not exceed 65 feet (20 m).
3. Telecommunications equipment that connects directly to main or intermediate cross-connects should do so via cables of 98 feet (30.5 m) or less.
4. The maximum distance shall be 295 feet (90 m), for Category 6 UTP media. This is the cable length between the mechanical terminations of the media at each horizontal cross-connect. Length limitations for cross-connect jumpers and patch cords in the cross-connect facilities, including cross-connects, jumpers, and patch cords that connect horizontal cabling with equipment or backbone cabling, shall not exceed 20 feet (6 m) in length.

E. Recognized Cable Types
1. The following types of cables are recognized for use in the backbone cabling system. These cables are:
   a. Multimode: 50/125 micron optical fiber (inside plant).
   b. High Pair count, unshielded twisted-pair (UTP) copper cables.
2. The specific performance characteristics for the recognized cables, associated connecting hardware, and cross-connect jumpers and patch cords are described elsewhere.
3. Hybrid cables, consisting of more than one of the recognized cables listed herein, under a common sheath, may be used in the backbone cabling system provided that they meet the established requirements.

F. Cross Connections & Interconnections

1. General

a. Horizontal and backbone building cables shall be terminated on connecting hardware that meets the requirements of this specification. These cable terminations shall not be used to administer cabling system moves, adds, and changes. All connections between horizontal and backbone cables shall be made through a horizontal cross-connect.

b. Equipment cables that consolidate several ports on a single connector shall be terminated on dedicated connecting hardware. Equipment cables that extend a single port appearance may either be permanently terminated or interconnected directly to horizontal or backbone terminations.

c. Products for this installation shall be furnished in new and factory packaged condition. Each product shall be inspected by the Contractor to ensure completeness and that no damage was incurred during shipping. The Contractor shall return to the manufacturer, any product found to be deficient. The cost of the return and replacement product shall be borne by the Contractor. All products provided for this installation shall meet the following minimum criteria.

d. Rack and/or wall mounted termination blocks shall be provided for termination of high pair count Cat 3 cables. These termination blocks shall employ 110 Style IDC hardware.

e. Only 110 style of IDC hardware shall be permitted for all connections.

f. Contractor shall provide 110 to 8P8C modular patch cords. Provide quantities of (1), (2), (3), or (4) pair 110's as required by the Owner.

G. Backbone Distribution Cable Requirements

1. Backbone distribution cables shall be installed between the main and intermediate (horizontal) cross-connect patch panels. Backbone distribution cables shall be manufactured in compliance with the specifications.

2. All cables shall be furnished in full, factory packaged reels. The reels shall be marked with the respective cable part number and lot number by the manufacturer. The supplier shall provide

manufacturer's proof of compliance with the required manufacturing guidelines presented in the aforementioned standards. Each reel shall be visually inspected upon receipt and prior to installation to ensure that no damage was incurred during shipment. Any damaged cable shall be returned to the manufacturer for replacement of the entire reel. The cost for replacement cable shall not be passed on to the Owner.

2.10 50/125 MICRON MULTI-MODE OPTICAL FIBER

A. Optical fiber requiring the use of mode conditioning patch cords when using a laser transmitter shall not be acceptable.

B. General:

1. All fibers in the cable shall be usable and meet this specification. The entire cable shall be replaced for a single failure at no additional cost to the Owner.
2. Each optical fiber shall consist of a doped silica core surrounded by a concentric glass cladding. The fiber shall be matched clad design.
3. The fiber shall be designed to support IEEE 802.3ae performance criteria, including laser based 10 gigabit ethernet for 10GBASE-SX to 300 meters, IEEE 802.3 performance criteria, including laser based gigabit Ethernet for both 1000 BASE-SX at 1000 meters and 1000 BASE-LX at 600 meters
4. All optical fiber provided shall be of the same manufacturer and part number throughout the installation.
5. All connectors, hardware, and fiber assemblies shall be Laser Optimized 50um.

C. Optical Parameters

1. Attenuation
   a. The attenuation, of the cabled fiber, shall not exceed 3.5 dB/km at 850 nm and 1.0 dB/km at 1300 nm. The typical attenuation values should be 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm.
   b. Attenuation measurements shall be made in accordance with either ANSI/EIA/TIA-455-46 (Spectral Attenuation Measurement for Long-Length Graded-Index Optical Fibers) or with ANSI/EIA/TIA-455-61 (Measurement of Fiber or Cable Attenuation Using an OTDR).

2. Bandwidth
   a. The minimum LED over filled launch bandwidth shall not be less than 1500 MHz-km at 850 nm and 500 Mhz-km at 1300 nm.
   b. The minimum Effective Modal Bandwidth (EMB) of 2000 MHz*km @850 nm with laser performance specified to achieve 1000 meters for gigabit ethernet (IEEE, 802.3Z) standard compliant links.
3. Numerical Aperture
   a. The numerical aperture shall be .200 ± 0.015.
4. Macrobending Attenuation
   a. The maximum induced attenuation shall be less than or equal 0.5 dB at 850 and 1300 nm when wound 100 turns on a 75 mm diameter mandrel.
5. Group Refractive Index
   a. The group refractive index shall be 1.496 at 850 nm and 1.487 at 1300 nm.

D. Geometrical Parameters
1. Cladding Diameter
   a. The cladding outside diameter shall be 125.0 ± 2.0 µm.
   b. The cladding diameter shall be measured in accordance with ANSI/TIA/EIA-455-176 (Method for Measurement of Geometry by Automated Grey-Scale Analysis).
2. Cladding Non-Circularity
   a. The cladding non-circularity shall be less than 5%.
   b. The cladding non-circularity shall be measured in accordance with ANSI/TIA/EIA-455-176 (Method for Measurement of Geometry by Automated Grey-Scale Analysis).
3. Core/Cladding Concentricity
   a. The offset between the center of the core and the center of the cladding shall be less than 3.0 µm.
4. Coating
   a. The coating shall be a U.V. curable acrylate and shall be 245 µm ± 10 microns in diameter. The coating shall be readily removable with commercially available stripping tools.
   b. Measurements shall be in accordance with either EIA-455-55A, Methods for Measuring the Coating Geometry of Optical Fibers.

5. Coating Non-Circularity and Concentricity Error
   a. The coating non-circularity shall be less than or 2%.
   b. Measurements shall be in accordance with either EIA-455-55A, Methods for Measuring the Coating Geometry of Optical Fibers.
6. Core Diameter
   a. The core diameter shall be 50um ± 3.0 µm.
   b. The core diameter shall be measured in accordance with EIA/TIA-455-58 (Core Diameter Measurement of Graded-Index Optical Fibers).
7. Core Non-Circularity
   a. The core non-circularity shall be less than or equal 5%.
   b. The core non-circularity shall be measured in accordance with ANSI/TIA/EIA-455-176 (Method for Measurement of Geometry by Automated Grey-Scale Analysis).
8. Fiber Tensile Proof Test
   a. The individual fibers shall be subjected to minimum proof stress of 0.70 GN/m2 (100 kpsi).
   b. Testing shall be in accordance with EIA-455-31A.

E. Cable Jacket
   1. Non-plenum rated cables shall have a PVC jacket.
   2. Plenum rated cables shall have a plenum rated PVC jacket.
   3. Cable Jacket color shall be Aqua.

F. Cable shall be supplied with 2 000 mm of extra length at both ends. The inner end, shall be fastened so as to prevent the cable from becoming loose during shipping and installation.

G. Cable Jacket:
   1. Non-plenum rated cables shall have a PVC jacket.
   2. Plenum rated cables shall have a plenum rated PVC jacket.
   3. The cable jacket shall be printed with the following information: Manufacturer, Manufacturer's part number, cable type, number of strands, UL Type, and sequential footage markings.
   4. Cables not installed in conduit, or solid bottom cable tray with a solid cover, shall be plenum rated and enclosed in an unjacketed interlocking steel armor which shall be painted orange. The armor shall be marked per NEC and TIA requirements.

H. Cable shall be supplied with no more than 5 feet (1525 mm) of extra length at each end.

2.11 HIGH PAIR COUNT, UTP COPPER CABLE

A. Description: 100-ohm, 100-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with TIA/EIA-568-B.1 for performance specifications.
   3. Comply with TIA/EIA-568-B.2,Category 6.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
      a. Type requirements in subparagraphs below are minimum requirements and may be revised to suit Project. Retain options if "permitted substitutions," as defined in NFPA 70, are appropriate for this Project.
      b. Communications, General Purpose: Type CM or CMG.
      c. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
      Communications, Riser Rated: Type CMR, complying with UL 1666.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements to receive cable. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Installers: Subject to compliance with the below requirements:
   1. Contractor shall be recognized by the manufacturer providing the data system performance warranty as an approved/certified installer of their products. Furnish a certificate from the manufacturer with the shop drawings.
   2. Contractor must have at least 5 years experience in providing certified communication Technology Programs.
   3. Contractor Program team which includes, as a minimum, the Program manager, and foreman. Note on the list the personnel that have been trained and certified by the data system manufacturer along with a brief description of their experience and training.

4. Contractor must have at least one full time employee with a current RCDD status that is part of the Program team. Furnish a copy of the employee's RCDD certificate with the shop drawings.
5. Contractor must have personnel trained and certified in both Cat 6 cable installation and testing and fiber optic Technology, splicing, termination and testing techniques. Personnel must have experience using a Cat 6 cable tester, a light meter, and OTDR. Include personnel that will be assigned to this Program on the Program team list along with a brief description of their experience and training.
6. Contractor and service organization shall be no greater than 100 miles from the Program site.
7. Installation shall be under the direct supervision of a Level 2 installer, who shall be present at all times when work of this section is performed at the project site

B. Install raceway components as indicated, according to manufacturer's written instructions. Use techniques, practices, and methods that are consistent with EIA/TIA-569A.

C. Separation of Wires: Comply with EIA/TIA-569A rules for separation of unshielded copper voce and data system cables from potential EMI sources, including electrical power lines and equipment. Insure that all communication outlet locations in wall, surface mounted raceways, or floor boxes have adequate backbox enclosures to house communication wiring.

D. Horizontal Cable Installation
1. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
2. All cables shall be installed in the following manner:
   a. Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type. Cabling shall be installed within raceway where no wire basket cable tray is accessible. Where cable tray is accessible, install cabling within tray.
   b. Cables shall be installed in continuous lengths from origin to destination (no splices - field or factory).
   c. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.

d. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

e. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

f. Cables shall be identified by a self-adhesive label or sleeve in accordance with this specification. The cable label shall be applied to the cable behind the faceplate, on a section of cable that can be accessed by removing the cover plate, and at the patch panel, near the end of the cable so it can be viewed, and properly associated with the termination, without the need to unbundle cables. Cable labels within the bundle shall not be accepted.

g. Cables shall not be allowed to lay on the ceiling slab or ceiling support structure.

3. In addition, different cable types shall be installed under the following provisions:

a. Unshielded Twisted Pair

1) Unshielded twisted pair cable shall be installed so that there are no bends less than four times the cables outside diameter (4 X cable O.D.) at any point in the run and at the termination field.

2) Pulling tension on 4-pair UTP cables shall not exceed 25 lbs. for a single cable or cable bundle.

E. Outlet Installation

1. All outlets shall be installed in the following manner:

a. Wall mounted outlets shall be attached to 4 inches (10 cm) x 4 inches (10 cm) x 2-1/2 inches (6.4 cm) deep boxes with raised extension (flush mount) and 4 inches (10 cm) x 4 inches (10 cm) x 2-3/4 inches (7 cm) (surface mount).

b. Wall mounted outlets shall be installed with the center of the plate at 18 inches (45.7 cm) above finished floor (AFF) unless otherwise indicated. The faceplates shall be installed in a vertical orientation.

c. Any unused faceplate positions shall be covered/filled with a blank insert made of the same or compatible material as the faceplate.

d. Location of outlets in modular furniture shall be coordinated with Owner.

e. Mounting of outlets in modular furniture shall be coordinated with furniture manufacturer and Owner.

f. Contractor shall provide modular furniture outlet plate bezel and Category 5E Enhanced UTP Jacks that meet all the requirements of the specifications.

F. Backbone Cable Installation

1. General

a. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

b. All cables terminated on rack mounted equipment shall be strain relieved to allow patch panel to be removed and worked on from the front.

2. All cables within conduit shall be installed in the following manner:

a. Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type. Cabling shall be installed within raceway where no wire basket cable tray is accessible. Where cable tray is accessible, install cabling within tray.

b. Cables shall be installed in continuous lengths from origin to destination (no splices - field or factory).

c. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.

d. Cable shall not be attached to the fire system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

e. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

f. Cables shall be identified by a self-adhesive label or sleeve in accordance with this specification. The cable label shall be applied to the cable on a section of cable near the end that can

be viewed, and properly associated with the termination, without the need to unbundle cables. Cable labels within the bundle shall not be accepted.

3. All cables within cable tray and on cable runway shall be installed in the following manner:
   a. Cables installed in cable tray and on cable runway shall be organized into bundles no larger than 2.50 inches (6.4 cm) in diameter. Hook and loop ties shall be spaced no farther than 5 feet (152 cm) on center in a horizontal line and no farther than 12 inches (30.5 cm) on center in a vertical line. Crosses and drops shall be neat and organized.
4. In addition, different cable types shall be installed under the following provisions:
   a. Unshielded Twisted Pair
      1) Unshielded twisted pair cable shall be installed so that there are no bends less than four times the cables outside diameter (4 X cable O.D) at any point in the run and at the termination field.
      2) Pulling tension on 4-pair UTP cables shall not exceed 25 lb/f for a single cable or cable bundle.
      3) Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-B document or most current documentation, manufacturer's recommendations and/or best industry practices.
      4) Pair untwist at the termination shall not exceed .50 inch (1.27 cm).
      5) The cable jacket shall be maintained as close as possible to the termination point.
      6) All modular jacks shall be oriented with the locking tab slot towards the floor.
      7) All terminations shall be made using industry standard tools that insert and trim the wires.
      8) All terminations shall be made according to the T568B wiring scheme.

b. Inside Plant - Copper:
   1) All placement shall conform to industry standards with regard to anchoring, cable support and separation from other facilities.
   2) Cables and innerduct shall not sag or droop but shall be installed so as to maintain a flat plane with smooth transitions from one level or direction to another.
   3) All cables shall be sufficiently racked and supported in order to eliminate stress on the cable.

c. Backbone Copper Cables:
   1) Secure all backbone cables to wall within 12 inches (30.5 cm) of all terminations.
   2) UTP backbone cables shall be installed in conduit, cable tray, on cable runway, or cable trough.
   3) Cables above drywall ceilings shall be installed in conduit. Cables in exposed areas other than MER and TR shall be installed in conduit or surface raceway.
   4) Cables shall not be allowed to lay on the ceiling slab or ceiling support structure. They must be anchored in such a way as to not interfere with other services or space access.

d. Optical Fiber Cable
   1) All fiber cables shall be terminated with LC Duplex style connectors, multimode.
   2) All fiber cables shall provide no more than 5 feet of spare cable at each end.
   3) No splices will be acceptable in fiber cables, except for the installation of factory pigtails.
   4) All fiber cables shall be neatly dressed and secured at racks and cabinets.
   5) All pulls of fiber optic cable shall be made with a recording tension meter and breakaway swivel.
   6) Where 250 micron coated fiber is field terminated, breakout kits that build up the fiber to a minimum 900 microns shall be used.

e. Inside Plant - Fiber:

1) Plenum and Riser Rated Optical Fiber Cables:

a) All fiber optic cable shall be installed in conduit innerduct, cable tray, on cable runway, or cable trough.

b) Maintain polarization for entire system as described in ANSI/EIA/TIA-568-B Section 12.7.1, or most current documentation.

c) Cable shall be continuous from patch panel to patch panel.

d) Leave a 5 feet service loop in the optical fiber runs within all telecommunications closets.

e) Adhere to all manufacturers' requirements regarding pulling tension and allowable lubricants.

f) The Contractor shall be responsible for verifying the actual lengths and distances.

g) The Contractor shall be responsible for verifying that conduits and raceways are "ready for occupancy" before cable placement.

h) The Contractor shall assume the responsibility for any difficulties or damage to the cable during placement.

i) Where fiber optic cable passes through a vertical backbone room, secure fiber to wall vertically every 48 inches. Review fasteners, strain relief and routing with Engineer.

j) Provide end caps on all optical fiber during installation.

3.3 GROUNDING

A. Comply with Division 16 Section "Grounding and Bonding for Electrical Systems".

B. Contractor shall furnish and install a minimum of one copper telecommunications grounding bus bar (TGB) per TIA/EIA 568B, 569A, and J-STD-607 standards, in each new telecommunications room or space.

C. Each TR shall use a copper stranded green insulated jumper interconnecting to the TMGB.

3.4 CABLE SYSTEM TESTING

A. Quality Assurance:

1. Comply with UL.
2. Comply with NFPA 70.
3. Comply with ANSI/TIA/EIA 568-B.

4. Tester Qualification: All personnel performing testing shall be trained and certified in the operation of the test equipment and in the analysis of the results, by the equipment manufacturer.
5. Testing Conference: Meet with the Owner's Representative on approval of the testing plan to develop a mutual understanding of the detail. Provide seven days advance notice of scheduled meeting time and location.
   a. Agenda Items: Include at least the following:
      1) Submittal distribution requirements.
      2) Contract documents examination report.
      3) Testing plan.
      4) Work schedule and project site access requirements.
      5) Coordination and cooperation of trades and subcontractors.
      6) Coordination of documentation and communication flow.
6. Certify the testing results for accuracy and compliance with the specifications.
7. Calibrate instruments at least every six months.

B General:

1. All copper cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions in compliance with TIA/EIA 568-B. All conductors of each installed cable shall be verified usable by the contractor prior to system acceptance. Any defect in the cable system installation including but not limited to cable, connectors, feedthrough couplers, patch panels, and connector blocks shall be repaired or replaced, at no cost to the Owner, in order to ensure 100% useable conductors in all cables installed.
2. Test leads for all tests shall be of the same manufacturer, grade, and type as the test subject.
3. Test instrument data shall be submitted in accordance with Division 1 requirements. In addition, all test instruments utilized on this project shall be consistent throughout the duration of the project and shall be turned over complete to the Owner upon completion.
4. All optical fiber cable strands and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions in compliance with TIA/EIA 568-B. All strands of each installed cable shall be verified

useable by the Contractor prior to system acceptance. Any defect in the cable system installation including, but not limited to, cable, connectors, feedthrough couplers, and patch panels shall be repaired or replaced, at no cost to the Owner, in order to ensure 100% useable strands in all cables installed.

C. Copper Cables:

1. Each cable shall be tested for continuity on all pairs and/or conductors. Twisted-pair data cables shall be tested for the all of the above requirements, plus tests that indicate installed cable performance. These data cables shall be tested using a Class I cable analyzer.
2. Each pair of each installed cable shall be tested using a "green light" test set that shows opens, shorts, polarity and pair-reversals. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance at no cost to the Owner.
3. Each installed cable shall be tested for installed length using a TDR type device. The cable length shall conform to the maximum distances set forth in the TIA/EIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number.
4. High speed unshielded twisted pair (UTP) data cable shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above, shall be performed Bi-directionally and provide results for the following tests:
   a. Near End Cross-Talk (NEXT)
   b. Attenuation
   c. Ambient Noise
   d. Attenuation to Cross-Talk Ratio (ACR)
   e. Power Sum NEXT
   f. Propagation Delay
   g. Propagation Delay Skew
   h. Power Sum ACR

i. ELFEXT

j. Power Sum ELFEXT

k. Return Loss

5. Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA Standard, and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed, the expected test result and the actual test result achieved. Hard and soft copies of the results shall be provided to the Owner in the format requested by the Owner.
6. Results which are marginal and cause 'flags' or other identifiers on the test results are unacceptable. These types of results are often referred to as Pass* by test equipment manufacturers. Cable installations providing Pass* results shall be corrected as necessary without additional cost to the Owner.

D. Optical Fiber Cables

1. Each fiber strand shall be tested for attenuation with an optical power meter and light source. Cable length and splice attenuation shall be verified using an OTDR.
2. Multimode optical fiber attenuation shall be measured at 850 nanometers (nm) and 1300 nm using an LED light source and power meter. Tests shall be performed at both wavelengths on each strand of fiber. The set-up and test shall be conducted in accordance with EIA/TIA-526-14 Standard, Method B. Two meter patch cords shall be used as test references and for the actual test. This test method uses a one jumper reference, two jumper test to estimate the actual link loss of the installed cables plus two patch cords. Test evaluations for the panel to outlet (horizontal) shall be based on the values set forth in the EIA/TIA-568-B Annex H, Optical Fiber Link Performance Testing.
3. Singlemode optical fiber attenuation shall be measured at 1310 nm and 1550 nm using a laser light source and power meter. Tests shall be performed at both wavelengths in two directions on each strand of fiber for a total of four tests per strand. The setup and test shall be performed in accordance with EIA/TIA-526-7 Standard, Method

1A. Two meter patch cords shall be used as test references and for the actual test. This test method utilizes a one jumper reference, two jumper test to estimate the actual link loss of the installed cable plus two patch cords.

4. Test evaluation for the panel to panel (backbone) shall be based on the values set forth in the EIA/TIA-568-B Annex H, Optical Fiber Link Performance Testing.
5. Each strand shall be tested with an Optical Time Domain Reflectometer (OTDR) to verify installed cable length and splice losses. The OTDR measurements for length shall be performed in accordance with EIA/TIA-455-60. The measurements to determine splice loss shall be performed in accordance with manufacturers' recommendations and best industry practices.
6. Cable Tests:
   a. Test 1 - every strand shall be tested in one direction only, with an Optical Time Domain Reflectometer (OTDR) at a wavelength of 850 nm for multi-mode and 1310 nm for single-mode. The OTDR tests are to be printed out from the test equipment and delivered to the Owner with the other documents. This test can be performed utilizing a lab splice.
   b. Test 2 - each strand is to be tested with an Optical Time Domain Reflectometer (OTDR), at wavelengths of 850 nm and 1300 nm for multi-mode and 1310 nm and 1550 nm for single-mode. The OTDR tests are to be printed out from the test equipment and delivered to the Owner with the other documents.
   c. Test 3 - each strand is to be tested with an Optical Power Source (transmitter) and an Optical Power Meter (receiver) measured at wavelengths of 850 nm and 1300 nm for multi-mode and 1310 nm and 1550 nm for single-mode. The results of this test shall be recorded by the technician and delivered to the Owner with the other documents
7. Cable Testing - Pre Construction:
   a. Perform Test 1
   b. All strands of optical fiber cable shall be tested by the cabling contractor before it is installed. Every strand shall be tested with an Optical Time Domain Reflectometer (OTDR) at a wavelength of 1310 nm.

c. If a single strand is found damaged, the cable will be considered a bad cable and must be replaced at no additional cost to the Owner.

8. Cable Testing - After Installation - Before Splicing or Termination:
   a. Perform Test 1
   b. All strands for each cable segment shall be tested after they are installed and before they are spliced
   c. If a single strand is found damaged, the cable will be considered a bad cable and must be replaced at no additional cost to the Owner.
   d. Test the new segment to demonstrate acceptability.
9. Cable Testing - After Splicing and Terminating:
   a. Perform Test 2
   b. Perform Test 3
   c. If a single strand is found to exceed the performance criteria, the source of the problem must be identified and rectified or the cable will be considered a bad cable and must be replaced. The Owner shall not bear any additional expense to rectify the problem or to replace the cable.
   d. The results of the above tests are to be certified reports, provided in both hard copy and soft copy format. The soft copy shall be accompanied by all software necessary to fully utilize the test results. Tests are to be witnessed by the owner's field representative and manually recorded.
   e. Test results shall be organized in a manner that is acceptable to the Owner.

3.5 CABLE SYSTEM LABELING

A. General
   1. This section describes the administration of cables, termination hardware, termination positions, and splices within the administrative jurisdiction. As changes are made to the wiring system, affected labels, records, reports, and drawings shall be updated.
   2. Identical cables spliced together shall be administered as a single cable.
   3. Termination hardware contains one or more termination positions. For example, an 8-pin modular connector on a panel may be

administered as one termination position on its associated termination hardware.

4. This section describes the administration of the wiring hierarchy specified in ANSI/TIA/EIA-606A.
5. All labeling shall utilize machine generated characters. No hand written labels shall be accepted.

B. Identifiers

1. Cable Identifiers
   a. A unique identifier shall be assigned to each cable to serve as a link to the cable record. This identifier shall be marked on each cable or its labels.
2. Cable Labeling
   a. Horizontal and backbone subsystem cables shall be labeled at each end. Labels shall be affixed at each end rather than marking the cable. For proper administration. Additional cable labeling may be required on the cable at intermediate locations such as conduit ends, backbone splice points, manholes, and pull boxes. Both end termination positions shall be marked on the cable or its labels.
      1) Note - For hybrid cables, additional cable labels should be used to identify the individual hybrid components.
   b. Cables of differing conductor counts that are spliced together may be administered as separate cables. Encoded cable identifiers may be used to identify the pair/conductor counts of the largest cable. This method is preferable when splicing cables of dissimilar characteristics.
   c. The difference splice segments (branches) may be labeled with a single cable identifier provided that the pair/conductor count of the largest cable is maintained end-to-end and indicated on the cable labels.
   d. In the event that a cable is routed through multiple pathway segments, the pathway record linkage field shall contain references to all pathway segments used.
3. Termination Hardware Identifiers
   a. A unique identifier shall be assigned to each termination hardware unit to serve as a link to its record. For example C4R6

is termination hardware in column 4 row 6 of the backbone termination cross-connects in space B101.

b. An identifier shall be marked on each termination hardware or its label.

1) Note - Duplicate labeling of termination hardware located in the work area is optional. For example, a faceplate or box does not require a separate identifier if the identifier for the connector is used for labeling.

4. Termination Position Identifiers

a. A unique identifier shall be assigned to each termination position to serve as a link to the termination position record.

b. An identifier shall be marked on each termination position label. Each termination position shall be marked with the termination identifier except in cases where high termination densities make labeling impractical. In these cases, identifiers shall be assigned to each termination hardware unit and to the actual termination position identifier determined by the conventions used for that unit. Labeling at the work area end may also include the termination position identifier for the other end of the cable and the cable identifier.

5. Splice Closure Identifiers

a. A unique identifier shall be assigned to each splice closure to serve as a link to the splice record.

b. An identifier shall be marked on each splice closure or its label.

C. Labeling and Color Coding

1. Labels

a. Adhesive Labels

1) Adhesive labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref D-16). Additionally, labels shall meet the general exposure requirements in UL 969 for indoor use. Outside plant labels shall meet the exposure requirements listed in UL 969 for indoor and outdoor use.

2) Cable labels should have a durable substrate, such as vinyl, suitable for wrapping. Vinyl has good conformability, thereby making it desirable for wrapping and also enabling it to

withstand bending. It is recommended to use labels with a white printing area and a clear "tail" that self-laminates the printed area when wrapped around a cable. The clear tail should be of sufficient length to wrap around the cable at least one and one-half times.

3) All characters shall be machine generated using a legible font large enough to read. All ink shall be permanent, non-fading, non-bleeding.

b. Insert Labels

1) Insert labels shall meet the legibility, defacement, and general exposure requirements specified in UL 969. Outside plant labels shall meet the exposure requirements listed in UL 969 for indoor and outdoor use. An insert label shall be securely held in place under the normal operating conditions and usage to which the labeled infrastructure element is subjected.

2) All characters shall be machine generated using a legible font large enough to read. All ink shall be permanent, non-fading, non-bleeding.

c. Pathway ID Tags

1) Each pathway, (conduit, cable tray, etc.), shall be appropriately tagged at both ends at strategic locations where midspans are accessible/visible.

2) Each tag shall be 2/32 inch (.16 cm) thick stainless steel, 2 inch (5.08 cm) to 2-1/2 inch (6.35 cm) in diameter, and include a 5/32 inch (.40 cm) hole for the fastener.

3) Authorized fasteners shall be wire-link chain or beaded chain.

4) Letters shall be stamped or engraved, 4/32 inch (.32 cm) high, and be consistent with the specified labeling scheme.

2. Color Coding of Termination Fields

a. Color coding as specified in this standard is based on the hierarchical star configuration for backbone cabling as specified in ANSI/TIA/EIA-568B. That standard allows a maximum of up to two hierarchical levels in the backbone. The first level in the hierarchy encompasses cabling from the main cross-connect to a telecommunications closet in the same building, or to an intermediate cross-connect in a remote building. The second

level encompasses cabling between two telecommunication rooms within the building containing the main cross-connect or between an intermediate cross-connect and a telecommunications closet in a remote building.

b. Color Coding Rules

1) termination labels identify the two ends of the same cable shall be of the same color;
2) cross-connections are generally made between termination fields (groups of termination labels) of two different colors;
3) the color orange (Pantone 150C) shall be reserved for the identification of the demarcation point (central office termination);
4) the color green (Pantone 353C) shall be used to identify the termination of network connections on the customer side of the demarcation point;
5) the color purple (Pantone 264C) shall be used to identify the termination of cables originating from common equipment (e.g., PBXs, computers, LANs, and multiplexers);
6) the color white shall be used to identify the first-level backbone telecommunications media termination in the building containing the main cross-connect;
7) the color gray (Pantone 422C) shall be used to identify the second-level backbone telecommunications media termination in the building containing the main cross-connect;
8) the color blue (Pantone 291C) shall be used to identify the termination of station telecommunication media and is required only on the TC and ER end of the cable, not at the telecommunications outlet;
9) the color brown (Pantone 465C) shall be used to identify interbuilding backbone cable terminations;
10) the color yellow (Pantone 101C) shall be used to identify the termination of auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits;
11) the color red (Pantone 184C) shall be used to identify the termination of key telephone systems;
12) in buildings not containing the main cross-connect, white may be used to identify second-level backbone terminations.

D. Records

1. General

a. For effective administration, telecommunications records are typically used in conjunction with other records. The data included in the records shall contain specific information about the particular installation as required, such as component manufacturer, transmission rate, etc.

2. Cable Records

a. The cable identifier, cable type, and unterminated, damaged, available pairs/conductors shall be recorded for each cable. Additionally, linkages to termination position records, splice records, pathway records, and grounding records shall be maintained. The cable record shall document every pair/conductor in the cable.

b. The cable type field shall include the manufacturer and manufacturer’s designation. The month and year of installation or acceptance shall also be recorded.

c. The termination position linkage field is used to document the termination positions of every pair/conductor or set of pairs/conductors of the cable. Each pair/conductor or set of pairs/conductors has a linkage to two termination position records.

d. The pathway from each outlet to head-end equipment shall be identified on record plans.

3. Termination Hardware Records

a. The termination hardware identifier and type, and damaged position numbers shall be recorded for each element of termination hardware. Additionally, linkages to termination position records, space records, and grounding records shall be maintained. The termination hardware record shall identify every termination position within the hardware.

b. Termination position linkage fields are used to provide access to information in termination position records. Termination positions may be used individually or in sets.

4. Termination Position Records

a. The termination position identifier type, user code, and cable pair/conductor numbers shall be recorded. Additionally, linkages

to cable records, termination position records, termination hardware records, and space records shall be maintained.

b. Other termination position record 1 linkage is used to document the corresponding termination position at the other end of the pair or sets of pairs. Other termination position record 2 linkage is used to document the cross-connect position.

c. A user code shall be assigned to a termination position record for a telecommunications outlet connector only. This user code may be a telephone number, circuit number, user name, or some other specific term of reference.

5. Splice Records

a. The splice identifier and type shall be recorded. Additionally, linkages to cable records and space records shall be maintained.

b. To administer slices joining cable segments with one cable identifier (singly administered), a linkage is established from the cable record to the splice record through the splice linkage field.

c. To administer splices joining cable segments with separate cable identifiers (separately administered), a pair/conductor-level linkage is established from the cable records to the splice record through the termination position field.

E. Reports

1. Cable Reports

a. A cable summary report shall be available listing all cables and, at a minimum, their type and terminating positions. Additional information from the cable records or other interlinked records may be desirable.

2. End-to-End Circuit Report

a. The end-to-end circuit report traces connectivity from end to end. At a minimum, the report should list a user code, associated termination positions, and cables establishing connectivity from the work area to the other end of each circuit. Additional information from termination position or other interlinked records may be desirable.

3. Cross-Connect Report

a. Each termination space containing cross-connects shall have a report available listing the cross-connections in that space.

Additional information from the termination position records or other interlinked records may be desirable.

3.6 CLEANING

A. On completion of system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.7 WARRANTY

A. The installing contractor shall facilitate a manufacturer's warranty between the manufacturer and the Owner which provides coverage of the installed cabling system for twenty years. An extended component warranty shall be provided which warrants the functionality of all components used in the system for twenty years from the date of registration along with a twenty year performance warranty for the horizontal cable plant.

B. At a minimum, the warranty shall define the following:

1. That all passive components (those exhibiting no gain or energy contribution) comprising the registered solution will be free from manufacturing defects in material and workmanship under normal and proper use.
2. That all cabling components utilized in the registered solution exceed the specifications of the TIA/EIA 568-B and ISO/IEC IS 11801 standards.
3. That the installation will exceed the attenuation, near end crosstalk (NEXT), and power sum requirements of TIA/EIA Bulletin 568-A and ISO/IEC IS 11801 for cabling links and channels.
4. THAT THE INSTALLATION WILL EXCEED THE LOSS AND BANDWIDTH REQUIREMENTS SET FORTH IN OF TIA/EIA BULLETIN 568-B AND ISO/IEC IS 11801 FOR FIBER LINKS AND CHANNELS.
5. That the registered solution will be free from failures which prevent operation of any current or future applications introduced by recognized standards or user forums that use the TIA/EIA 568-B and ISO/IEC IS 11801 component and link/channel performance specifications.

C. The warranty shall include all parts and labor necessary.

D. The warranty shall apply to the "LINK" as defined by TIA/EIA. B "CHANNEL" warranty is not applicable.

- - - E N D - - -

SECTION 27 51 16
PUBLIC ADDRESS SYSTEM

PART1 - GENERAL

1.1 SUMMARY

A. This section includes a system for amplifying a telephone system page signal and reproducing them on speakers throughout the facility.

B. System components included herein, but not limited to, the following:

1. Mixer/Amplifier
2. Tuner/CD Player
3. Speakers
4. Telephone Paging Adapter
5. Wiring
6. Volume Controls

1.2 SYSTEM DESCRIPTION

A. General: The sound system shall be a complete system. The system shall sound to all designated areas within the facility

B. The Systems shall operate in a complete and operating condition. After completion, and prior to acceptance by the Owner, the System shall be demonstrated to the Owner.

1.3 DEFINITIONS

A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.

B. VU: Volume unit.

C. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.4 SUBMITTALS

A. General: Submit all product data and/or shop drawings bound in a single, soft cover binder. The sound system submittal shall comply with the following:

1. Complete schedule of ALL equipment and materials that are to be supplied
2. Specification sheets shall be divided into sections for each group of items, i.e., separate sections for sound equipment, accessories, single-line riser, etc.

3. Clearly identify each item by highlight marker or arrow to define that specific component and all associated component and all associated characteristics.

B. Product data for each type of product specified

C. Shop drawings detailing the following:

1. Mixers
2. If speakers submitted are different than the speakers specified, these calculations shall show how this difference affects the operation and performance
3. A complete list, comparing equipment submitted verses equipment specified, showing any difference between the two
4. A statement that the factory authorized distributor will certify the installation as to meeting the factory standards and that the installation company will maintenance the system under the manufacturer’s warranty

D. Wiring Diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation and maintenance

1.5 INSTALLER QUALIFICATIONS

A. Engage and experienced installer who is an authorized representative of the system manufacturer to perform work of this section

1. The sound systems contractor shall be regularly engaged in the furnishing and installation of high quality sound systems for the last three (3) years and can provide evidence of successfully completing, with its present staff, at least three (3) projects of similar size and scope. The contractor shall meet the above installer qualifications
2. Contractor shall be factory authorized sales and installation contractor for all products used in the sound system
3. Contractor shall demonstrate the following to the owner if requested during the submittal process:
   a. Adequate staff and technical experience to implement the work

B. Manufacturer Qualifications: Engage firms experienced in manufacturing equipment for sound systems and music systems complying with the requirements of these specifications

C. Comply with the following industry standards:
   1. Speakers shall be installed using standard industry standards
   2. Mounting hardware shall be designed and installed with the consideration of the manufactures specifications

1.6 COORDINATION

A. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in factory containers. Store in clean, dry space. Protect products from fumes and construction dirt. Handle carefully to avoid damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: In order to guarantee the owner of all factory warranties, all equipment shall be obtained from a local factory authorized vendor/distributor for the job site geographical location. Vendor shall be prepared to prove this, at the request of the owner.
   1. Alpha Communications.
   2. Altec Lansing Technologies, Inc.
   3. Atlas Sound LP.
   4. Bogen Communications, Inc.
   5. Dukane Communication Systems; part of GE Infrastructure, Security.
   6. Edwards Signaling & Security Systems; part of GE Infrastructure, Security.
   7. Rauland-Borg Corporation.

2.2 EQUIPMENT

A. AM/FM Tuner/CD Player
   1. General description:
      a. Unit shall mount in standard 19" equipment rack. Front panel of unit shall consist of a LCD to display units current state and allow selection of system functions.
      b. Memory buttons shall be available to store signal frequencies. Each memory button shall store a frequency from each band, for a total of 12 memorized frequencies. Frequencies can be manually

stored, or the unit can automatically store the six strongest frequencies in the area.

2. Unit requirements:
   a. Power required: 12VDC.
   b. Current draw: 1A Max.
   c. Power Output: 50W x 4.
   d. Frequency Characteristics: 40Hz - 20kHz.
   e. Signal-to-Noise Ration: 70dB.
   f. Controls: On/Off, Volume, Treble, and Bass adjustment, Bass Enhance, Mute, Digital Signal Processing.
   g. Display: Liquid Crystal Display.
   h. Weight: 4.5 lbs.
   i. Dimensions: 19"L x 3.5"H, 7.5"D.
   j. Color & Finish: Black Textured, semi-gloss enamel.
   k. Mounting Requirements: 19" Equipment Rack.
   l. AM/FM Tuner:
      1) FM Section Frequency Range: 87.5Mhz - 108.0MHz.
      2) Usable Sensitivity: 3uV.
      3) I.F. Frequency: 10.7MHz.
      4) AM Section Frequency Range: 531kHz - 1602kHz.
      5) Output: 1000mV @ FM 10% THD.
      6) Impedance: 600 ohm.
      7) Controls: AM/FM Band Selector, Tuning Control, Six Frequency Store and Recall Buttons, Automatic Storage, Weak Signal Gain.
   m. CD Player
      1) Sampling Frequency: 44.1kHz.
      2) Quantization Bits: 1 bit.
      3) Controls: Play, Pause, Stop, Track, Froward, Track Previous, Fast Forward, Rewind, Repeat, Random Play, Intro Play, Volume, Eject, Open.

B. Preamplifiers
   1. Preamplifier: Separately mounted.
   2. Output Power: Plus 4 dB above 1 mW at matched power-amplifier load.
   3. Total Harmonic Distortion: Less than 1 percent.
   4. Frequency Response: Within plus or minus 2 dB from 20 to 20,000 Hz.

5. Input Jacks: Minimum of two. One matched for low-impedance microphone; the other matchable to cassette deck, CD player, or radio tuner signals without external adapters.
6. Minimum Noise Level: Minus 55 dB below rated output.
7. Controls: On-off, input levels, and master gain.

C. Power Amplifier: The power amplifier shall be capable of operation from a 120 V, 50/60 Hz line. Either direct input or plug-in module connections shall be available on the rear panel. The amplifier shall meet the following performance criteria:

1. Input sensitivity for rated output shall be available at 0.1V or 1.0 V for module input and direct input.
2. Power output shall be 240 W at less than 0.5% THD from 20 to 20k Hz (direct output) or 50 to 20k Hz (transformer output).
3. Frequency response shall be ±1dB from 20 to 20k Hz (direct output) or 20 to 15k Hz (transformer output).
4. Input impedance shall be 10k ohms for module input and direct input.
5. Load impedance shall be 4, 8, 2.6 (25V line) or 21 (70.7 V line) ohms.
6. Load voltage shall be 31.0, 43.8, 25 or 70.7 V.
7. Output noise shall be 90 dB below rated output when all gain controls are off.
8. Plug-in accessory modules designed for use with the power amplifier shall utilize the latest in surface mount component technology and shall include microphone, line and special function models.
9. The power amplifier shall be rack-mounted using an optional rack-mounting bracket.
10. The amplifier’s dimensions shall be 16.5” x 6.0” x 13.2” and its weight shall be 43 lbs.

D. Ceiling Mount Speakers

1. The ceiling speakers shall utilizing line matching transformer and a white CRS baffle.
2. It shall have a 10 oz. Ceramic magnet and a seamless cone.
3. Frequency response range shall be 45 Hz. 19 kHz. (Nominal).
4. Sensitivity shall be 97 dB. 1 W/1M.
5. Voice coil shall be black anodized aluminum to help dissipate heat, have an impedance of 8 ohms and a diameter of 1”.

6. Transformer primary voltage shall be 25V/70.7V with a frequency response range of 45 Hz-19kHz. (Nominal) and multiple taps.
7. Insertion loss shall not exceed 1.5 dB.
8. Unit shall include factory installed CRS baffle.
9. Baffle shall include welded speaker mounting studs and all necessary hardware to match the baffle to associated hardware.
10. Baffle overall diameter shall not exceed 12 ¾”.
11. Baffle shall be finished in white powder coat epoxy.

E. Wall Mounted Speakers:

1. Speakers shall have the same requirements as ceiling mount speakers only wall mounts shall come complete with necessary mounting hardware to install speaker on walls shown on the drawings.

F. Horn-Type Loudspeakers:

1. Type: Single-horn units, double-reentrant design, with minimum full-range power rating of 15 W.
2. Matching Transformer: Full-power rated with four standard taps. Maximum insertion loss of 0.5 dB.
3. Frequency Response: Within plus or minus 3 dB from 250 to 12,000 Hz.
4. Dispersion Angle: 130 by 110 degrees.
5. Mounting: Integral bracket.

2.3 EQUIPMENT CABINET

A. Comply with TIA/EIA-310-D.

B. House amplifiers and auxiliary equipment at each location.

C. Cabinet Housing:

1. Constructed of 0.0478-inch steel, minimum, with front- and rear-locking doors and standard TIA/EIA-310-D-compliant, 19-inch racks.
2. Arranged for wall mounting.
3. Sized to house all equipment indicated, plus spare capacity.
4. Include **20** percent minimum spare capacity for future equipment in addition to space required for future cassette deck and CD player.

D. Ventilation: A low-noise fan for forced-air cabinet ventilation. Fan shall be equipped with a filtered input vent and shall be connected to operate from 105- to 130-V ac, 60 Hz; separately fused and switched; arranged to be powered when main cabinet power switch is on.

2.4 TELEPHONE PAGING ADAPTER

A. Adapters shall accept voice signals from telephone extension dialing access and automatically provide amplifier input and program override for preselected zones.

1. Minimum Frequency Response: Flat, 200 to 2500 Hz.
2. Impedance Matching: Adapter matches telephone line to public address equipment input.
3. Rack mounting.
4. Adapter shall be complete with separate volume control so that paring volume is independent of overall building sound system.

2.5 OUTLETS

A. Volume Attenuator Station: Wall-plate-mounted autotransformer type with paging priority feature.

1. Wattage Rating: 10 W unless otherwise indicated.
2. Attenuation per Step: 3 dB, with positive off position.
3. Insertion Loss: 0.4 dB maximum.
4. Attenuation Bypass Relay: Single pole, double throw. Connected to operate and bypass attenuation when all-call, paging, program signal, or prerecorded message features are used. Relay returns to normal position at end of priority transmission.
5. Label: "Speaker Volume."

B. Microphone Outlet: Three-pole, polarized, locking-type, microphone receptacles in single-gang boxes. Equip wall outlets with brushed stainless-steel device plates. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed outlet covers. Floor outlet boxes shall be listed for installation in slab on-grade concrete floor application.

2.6 CONDUCTORS AND CABLES

A. Jacketed, twisted pair and twisted multipair, untinned solid copper.

1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
2. Plenum Cable: Listed and labeled for plenum installation.

2.7 RACEWAYS

A. Conduit and Boxes: Comply with Division 16 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be not less than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Division 16 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF RACEWAYS

A. Comply with requirements in Division 16 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Cable Installation Requirements:
   1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
   2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
   3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
   5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend speaker cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceiling by cable supports not more than 60 inches (1524 mm)apart.
3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

3.4 INSTALLATION

A. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

B. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.

C. Equipment Racks:

1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.
2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
3. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.

D. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.

E. Speaker-Line Matching Transformer Connections: Make initial connections using taps.

F. Connect wiring according to Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes as specified in Division 16 Section "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Schedule tests with at least seven days' advance notice of test performance.
2. After installing public address and mass notification systems and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
   a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding

connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.

b. Repeat test for each separately controlled zone of loudspeakers.

c. Minimum acceptance ratio is 50 dB.

5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.

6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.

7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.

8. Signal Ground Test: Measure and report ground resistance at pubic address equipment signal ground. Comply with testing requirements specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

F. Public address and mass notification systems will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

1. Include a record of final speaker-line matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
2. Complete installation and startup checks according to manufacturer's written instructions.

B. The gain structure of the System shall be adjusted for the best signal to noise performance. The zero indication of the mixer meters shall correspond to 3dB below amplifier maximum power output with amplifier volume controls at full clockwise. Fixed pads shall only be used.

C. Equalization shall be determined by averaging data taken at four points in the room. Equalization shall be configured for four preset operation.

D. With typical control settings and no audience present there shall be no hum or buzz heard from any loudspeaker at any listener location. With typical control settings and an audience present there shall be no hiss heard from any loudspeaker.

E. With the loudspeakers operating at maximum sound pressure level there shall be no noise caused by mechanical resonance.

3.8 ADJUSTING

A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the public address and mass notification systems and equipment.

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SECTION 312000
EARTH MOVING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:
   1. Site preparation.
   2. Excavation.
   3. Underpinning.
   4. Filling and backfilling.
   5. Grading.
   6. Soil Disposal.
   7. Clean Up.

1.2 DEFINITIONS:

A. Unsuitable Materials:
   1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D 1557.
   2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
   3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to Resident Engineer's approval.

B. Building Earthwork: Earthwork operations required in area enclosed by a line located 1500 mm (5 feet) outside of principal building perimeter.

It also includes earthwork required for auxiliary structures and buildings.

C. Trench Earthwork: Trenchwork required for utility lines.

D. Site Earthwork: Earthwork operations required in area outside of a line located 1500 mm (5 feet) outside of principal building perimeter and within new construction area with exceptions noted above.

E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of field test procedures presented in ASTM D1556, ASTM D2167, and ASTM D2922.

F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term “fill” means fill or backfill as appropriate.

G. Backfill: Soil materials or controlled low strength material used to fill an excavation.

H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the Resident Engineer. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.

I. Authorized additional excavation: Removal of additional material authorized by the Resident Engineer based on the determination by the Government’s soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.

J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.

K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the springline of the pipe.

O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.

P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.

R. Contaminated soils: Soil that contains contaminates as defined and determined by the Resident Engineer or the Government’s testing agency.

1.3 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.

C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.

D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

E. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, and Section 32 90 00, PLANTING.

F. Site preparation: Section 31 23 19, DEWATERING, and Section 02 41 00, DEMOLITION.

G. Paving sub-grade requirements: Section 32 12 16, ASPHALT PAVING.

1.4 CLASSIFICATION OF EXCAVATION:

A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed;

together with any type of materials regardless of character of material and obstructions encountered.

B. Rock Excavation:

1. Trenches and Pits: Removal and disposal of solid, homogenous, interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be excavated with a late-model, track-mounted hydraulic excavator; equipped with a 1050 mm (42 inch) wide, short-tip-radius rock bucket; rated at not less than 103 kW (138 hp) flywheel power with bucket-curling force of not less than 125 kN (28,090 lbf) and stick-crowd force of not less than 84.5 kN (19,000 lbf); measured according to SAE J-1179. Trenches in excess of 3000 mm (10 feet) wide and pits in excess of 9000 mm (30 feet) in either length or width are classified as open excavation.
2. Open Excavation: Removal and disposal of solid, homogenous, interlocking crystalline material firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be dislodged and excavated with a late-model, track-mounted loader; rated at not less than 157 kW (210 hp) flywheel power and developing a minimum of 216 kN (48,510 lbf) breakout force; measured according to SAE J-732.
3. Other types of materials classified as rock are unstratified masses, conglomerated deposits and boulders of rock material exceeding 0.76 m3 (1 cubic yard) for open excavation, or 0.57 m3 (3/4 cubic yard) for footing and trench excavation that cannot be removed by rock excavating equipment equivalent to the above in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted.
4. Blasting: Removal and disposal of solid, homogenous, interlocking crystalline material firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be removed with conventional methods may not be performed by blasting.
5. Definitions of rock and guidelines for equipment are presented for general information purposes only. The Contractor is expected to use the information presented in the Geotechnical Engineering Report to evaluate the extent and competency of the rock and to determine both quantity estimations and removal equipment and efforts.

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Rock Excavation Report:

1. Certification of rock quantities excavated.
2. Excavation method.
3. Labor.
4. Equipment.
5. Land Surveyor's or Civil Engineer's name and official registration stamp.
6. Plot plan showing elevation.

C. Furnish to Resident Engineer:

1. Contactor shall furnish resumes with all personnel involved in the project including Project Manager, Superintendent, and on-site Engineer. Project Manager and Superintendent should have at least 3 years of experience on projects of similar size.
2. Soil samples.
   a. Classification in accordance with ASTM D2487 for each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
   b. Laboratory compaction curve in accordance with ASTM D 1557 for each on site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
   c. Test reports for compliance with ASTM D 2940 requirements for subbase material.
   d. Pre-excavation photographs and videotape in the vicinity of the existing structures to document existing site features, including surfaces finishes, cracks, or other structural blemishes that might be misconstrued as damage caused by earthwork operations.
   e. The Contractor shall submit a scale plan daily that defines the location, limits, and depths of the area excavated.

1.6 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):

T99-01(2004).....Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop

T180-01(2004).....Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop

C. American Society for Testing and Materials (ASTM):

D448-03a.....Standard Classification for Sizes of Aggregate for Road and Bridge Construction

D698-00ae1.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft^3 (600 kN m/m^3))

D1556-00.....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

D1557-02e1.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN m/m^3))

D2167-94 (2001).....Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

D2487-06.....Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System)

D2922-05.....Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D2940-03.....Standard Specifications for Graded Aggregate Material for Bases or Subbases for Highways or Airports

D. Society of Automotive Engineers (SAE):

J732-92.....Specification Definitions - Loaders

J1179-02.....Hydraulic Excavator and Backhoe Digging Forces

PART 2 - PRODUCTS

2.1 MATERIALS:

A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.

B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 75 mm (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 1760 kg/m3 (110 pcf), a maximum Plasticity Index of 15, and a maximum Liquid Limit of 40.

C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the Engineer or material with at least 90 percent passing a 37.5-mm (1 1/2-inch) sieve and not more than 12 percent passing a 75-µm (No. 200) sieve, per ASTM D2940;.

D. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 25 mm (1 inch) sieve and not more than 8 percent passing a 75-µm (No. 200) sieve.

E. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 37.5 mm (1 1/2-inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve.

F. Granular Fill:

1. Under concrete slab, crushed stone or gravel graded from 25 mm (1 inch) to 4.75 mm (No. 4), per ASTM D 2940.
2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No 4), per ASTM D 2940.

PART 3 - EXECUTION

3.1 SITE PREPARATION:

A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions. Remove materials from Property.

B. Grubbing: Remove stumps and roots 75 mm (3 inch) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inch) diameter, and

nonperishable solid objects a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left.

C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 4500 mm (15 feet) of new construction and 2250 mm (7.5 feet) of utility lines when removal is approved in advance by Resident Engineer. Remove materials from Property. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs, that are to remain, than farthest extension of their limbs.

D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by Resident Engineer. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 0.014 m3 (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed.

E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Property.

F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.

1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
2. Locations of existing and proposed elevations indicated on plans are approximate. Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. Contractor is responsible to notify Resident Engineer of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify Resident Engineer of any differences between existing or constructed grades, as compared to those shown on the plans.
3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
4. Finish grading is specified in Section 32 90 00, PLANTING.

G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION:

A. Shoring, Sheeting and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Resident Engineer, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.
   1. Design of the temporary support of excavation system is the responsibility of the Contractor.

2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the Resident Engineer.
3. Extend shoring and bracing to a minimum of 1500 mm (5 feet) below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall underpin the existing foundation, per Section 3.3 under disturbed foundations, as directed by Resident Engineer, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by Resident Engineer.

B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from Resident Engineer. Approval by the Resident Engineer is also required before placement of the permanent work on all subgrades.

C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the Resident Engineer.

D. Proofrolling:
1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.
2. Proofrolling shall consist of at least two complete passes with one pass being in a direction perpendicular to preceding one. Remove any areas that deflect, rut, or pump excessively during proofrolling, or

that fail to consolidate after successive passes to suitable soils and replaced with compacted fill. Maintain subgrade until succeeding operation has been accomplished.

E. Building Earthwork:
   1. Excavation shall be accomplished as required by drawings and specifications.
   2. Excavate foundation excavations to solid undisturbed subgrade.
   3. Remove loose or soft materials to a solid bottom.
   4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete poured separately from the footings.
   5. Do not tamp earth for backfilling in footing bottoms, except as specified.
   6. Slope grades to direct water away from excavations and to prevent ponding.

F. Trench Earthwork:
   1. Utility trenches (except sanitary and storm sewer):
      a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
      b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
      c. Support piping on undisturbed earth unless a mechanical support is shown.
      d. Length of open trench in advance of piping laying shall not be greater than is authorized by Resident Engineer.
   2. Sanitary and storm sewer trenches:
      a. Trench width below a point 150 mm (6 inches) above top of pipe shall be 600 mm (24 inches) maximum for pipe up to and including 300 mm (12 inches) diameter, and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
      b. Bed bottom quadrant of pipe on undisturbed soil or granular fill.
         1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.

2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one sixth of pipe diameter below pipe to 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.

c. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.

d. Use granular fill for bedding where rock or rocky materials are excavated.

G. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm (1 inch). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by Resident Engineer as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the contractor shall obtain samples of the material, under the direction of the Resident Engineer, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is encountered and removed, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on volume in cut section only.

1. Site Grading:

a. Provide a smooth transition between adjacent existing grades and new grades.

b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
   1) Lawn or Unpaved Areas: Plus or minus 25 mm (1 inch).
   2) Walks: Plus or minus 25 mm (1 inch).
   3) Pavements: Plus or minus 13 mm (1 inch).
d. Grading Inside Building Lines: Finish subgrade to a tolerance of 13 mm (1/2 inch) when tested with a 3000 mm (10 foot) straightedge.

3.3 UNDERPINNING:

A. Design of the underpinning system is the responsibility of the Contractor and is subject to review and approval by the Resident Engineer. Underpinning of existing building foundations, as indicated on structural drawings, or where excavation undermines existing foundations, shall be accomplished in the following manner:
   1. Make general excavation for new construction, where new foundations are to be below existing foundations, to elevation of new foundations (or sized stone subbase), maintaining a 45 degree sloped berm.
   2. For underpinning pits, underpin existing wall foundations by excavating 1200 mm (4 feet) wide pits to depth shown on drawings skipping 3 sections at any one time so as to maintain support for wall at all times.
   3. Underpin intervening sections one at a time; no adjacent sections shall be underpinned until concrete in adjacent sections shall have reached 20 MPa (2500 psi) strength and have been dry packed with non-shrink grout to obtain positive bearing. Sheet and brace underpinning pits if soil will not stand on a vertical cut during this operation, or as required for safety of workmen. Repack any voids behind sheeting to prevent sloughing which could cause settlement of existing foundations. Contractor performing this portion of work shall have been prequalified by Resident Engineer as having previously performed successfully this type of work or will demonstrate his capability for successfully performing this work. It shall be sole responsibility of the Contractor to guard against

objectionable movement or settlement and to preserve integrity of existing structures.

4. The tip elevation of the underpinning pits shall be a minimum of 900 mm (3 feet) below the adjacent excavation elevation.
5. Subgrades at the tip of the underpinning pit shall be clean, dry, and free of debris and shall be observed by the Resident Engineer prior to concrete placement.
6. Concrete shall not be free fall greater than 3000 mm (10 feet) into the pit.

3.4 FILLING AND BACKFILLING:

A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied at no additional cost to the Government. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by Resident Engineer.

B. Placing: Place materials in horizontal layers not exceeding 200 mm (8 inches) in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm (4 inches) in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.

C. Compaction: Compact with approved tamping rollers, sheepsfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without prior approval of Resident Engineer. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining

specified compaction with equipment used. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:

1. Fills, Embankments, and Backfill
   a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 300 mm (12 inches) of existing subgrade and each layer of backfill or fill material in accordance with ASTM D1557, D 1556, D 2167, D 2922; 95 percent.
   b. Curbs, curbs and gutters, ASTM D1557, D 1556, D 2167, D 2922; 95 percent.
   c. Under Sidewalks, scarify and recompact top 150 mm (6 inches) below subgrade and compact each layer of backfill or fill material in accordance with ASTM D1557, D 1556, D 2167, D 2922; 95 percent.
   d. Landscaped areas, top 400 mm (16 inches), ASTM D1557, D 1556, D 2167, D 2922; 85 percent.
   e. Landscaped areas, below 400 mm (16 inches) of finished grade, ASTM D1557, D 1556, D 2167, D 2922; 90 percent.
2. Natural Ground (Cut or Existing)
   a. Under building slabs, steps and paved areas, top 150 mm (6 inches), ASTM D1557, D 1556, D 2167, D 2922; 95 percent.
   b. Curbs, curbs and gutters, top 150 mm (6 inches), ASTM D1557, D 1556, D 2167, D 2922; 95 percent.
   c. Under sidewalks, top 150 mm (6 inches), ASTM D1557, D 1556, D 2167, D 2922; 95 percent.

3.5 GRADING:

A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.

B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.

C. Slope backfill outside building away from building walls for a minimum distance of 1800 mm (6 feet).
D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.
E. Finished grade shall be at least 150 mm (6 inches) below bottom line of window or other building wall openings unless greater depth is shown.
F. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 150 mm (6 inches) unless otherwise shown.
G. Finish subgrade in a condition acceptable to Resident Engineer at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.
H. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off // Medical Center // Cemetery // property.
B. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.

3.7 CLEAN UP:

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Property.

----- E N D -----

SECTION 312319
DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

1.2 SUMMARY:

A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
   1. Implementation of the Erosion and Sedimentation Control Plan.
   2. Dewater excavations, including seepage and precipitation.

B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

1.3 REQUIREMENT:

A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 300 mm (1 foot) below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.

B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 300 mm (1 foot) below prevailing excavation surface.

C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.

D. Maintain stability of sides and bottom of excavation.

E. Construction operations are performed in the dry.

F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:
   1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.
   2. Erosion is controlled.
   3. Flooding of excavations or damage to structures does not occur.
   4. Surface water drains away from excavations.
   5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.
G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

1.4 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
F. Excavation, backfilling, site grade and utilities: Section 31 20 00, EARTH MOVING.

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Drawings and Design Data:
   1. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
   2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of

dewatering methods to be employed to convey the water from site to adequate disposal.

3. Include a written report outlining control procedures to be adopted if dewatering problem arises.
4. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.

C. Inspection Reports.

D. All required permits.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.

B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 300 mm (1 foot) below prevailing excavation surface at all times.

3.2 OPERATION:

A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.

B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

3.3 WATER DISPOSAL:

A. Dispose of water removed from the excavations in such a manner as:

1.Will not endanger portions of work under construction or completed.

2. Will cause no inconvenience to Government or to others working near site.
3. Will comply with the stipulations of required permits for disposal of water.
4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.

B. Excavation Dewatering:
1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.

C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

3.4 STANDBY EQUIPMENT:

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain de-watering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

3.5 CORRECTIVE ACTION:

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

3.6 DAMAGES:

Immediately repair damages to adjacent facilities caused by dewatering operations.

3.7 REMOVAL:

Insure compliance with all conditions of regulating permits and provide such information to the Resident Engineer. Obtain written approval from Resident Engineer before discontinuing operation of dewatering system.

----- E N D -----

SECTION 320523
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following:

B. Curb, gutter, wheel stop.

C. Pedestrian Pavement: Walks, wheelchair curb ramps.

D. Equipment Pads: transformers.

1.2 RELATED WORK

A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Subgrade Preparation: Section 31 20 00, EARTH MOVING.

C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 00, CAST-IN-PLACE-CONCRETE.

1.3 DESIGN REQUIREMENTS

Design all elements with the latest published version of applicable codes.

1.4 WEATHER LIMITATIONS

Placement of concrete shall be as specified under Article 3.8, COLD WEATHER and Article 3.7, HOT WEATHER of Section 03 30 00, CAST-IN-PLACE CONCRETE.

1.5 SELECT SUBBASE MATERIAL JOB-MIX

The Contractor shall retain and reimburse a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the Resident Engineer, in writing, for approval. The formula shall include the source of materials, gradation, plasticity index, liquid limit, and laboratory compaction curves indicating maximum density at optimum moisture.

1.6 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.

1. Expansion joint filler
2. Hot poured sealing compound
3. Reinforcement
4. Curing materials

C. Data and Test Reports: Select subbase material.
1. Job-mix formula.
2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes.

B. American Association of State Highway and Transportation Officials (AASHTO):

M031MM031-07-UL.....Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement (ASTM A615/A615M-09)

M055MM055-09-UL.....Steel Welded Wire Reinforcement, Plain, for Concrete (ASTM A185)

M147-65-UL.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)

M148-05-UL.....Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309)

M171-05-UL.....Sheet Materials for Curing Concrete (ASTM C171)

M182-05-UL.....Burlap Cloth Made from Jute or Kenaf and Cotton Mats

M213-01-UL.....Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)

M233-86-UL.....Boiled Linseed Oil Mixer for Treatment of Portland Cement Concrete

T099-09-UL.....Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop

T180-09-UL.....Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

C. American Society for Testing and Materials (ASTM):
C94/C94M-09.....Ready-Mixed Concrete
C143/C143M-09.....Slump of Hydraulic Cement Concrete

PART 2 - PRODUCTS

2.1 GENERAL

Concrete shall be Type C, air-entrained as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, with the following exceptions:

TYPE	MAXIMUM SLUMP*
Curb & Gutter	75 mm (3")
Pedestrian Pavement	75 mm (3")
Vehicular Pavement	50 mm (2") (Machine Finished) 100 mm (4") (Hand Finished)
Equipment Pad	75 to 100 mm (3" to 4")
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

2.2 REINFORCEMENT

A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.
B. Welded wire-fabric shall conform to AASHTO M55.
C. Dowels shall be plain steel bars conforming to AASHTO M31. Tie bars shall be deformed steel bars conforming to AASHTO M31.

2.3 SELECT SUBBASE (WHERE REQUIRED)

A. Subbase material shall consist of select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, Grading E or F.
B. Materials meeting other gradations than that noted will be acceptable whenever the gradations are within a tolerance of three to five percent, plus or minus, of the single gradation established by the job-mix formula.

C. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

2.4 FORMS

A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.

B. Do not use forms if they vary from a straight line more than 3 mm (1/8 inch) in any 3000 mm (ten foot) long section, in either a horizontal or vertical direction.

C. Wood forms should be at least 50 mm (2 inches) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.5 CONCRETE CURING MATERIALS

A. Concrete curing materials shall conform to one of the following:

1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.
2. Impervious Sheeting conforming to AASHTO M171.
3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 1 and shall be free of paraffin or petroleum.

2.6 EXPANSION JOINT FILLERS

Material shall conform to AASHTO M213.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTH MOVING.

B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SELECT SUBBASE (WHERE REQUIRED)

A. Mixing: Proportion the select subbase by weight or by volume in quantities so that the final approved job-mixed formula gradation, liquid limit, and plasticity index requirements will be met after subbase course has been placed and compacted. Add water in approved quantities, measured by weight or volume, in such a manner to produce a uniform blend.

B. Placing:
   1. Place the mixed material on the prepared subgrade in a uniform layer to the required contour and grades, and to a loose depth not to exceed 200 mm (8 inches), and that when compacted, will produce a layer of the designated thickness.
   2. When the designated compacted thickness exceeds 150 mm (6 inches), place the material in layers of equal thickness. Remove unsatisfactory areas and replace with satisfactory mixture, or mix the material in the area.
   3. In no case will the addition of thin layers of material be added to the top layer in order to meet grade.
   4. If the elevation of the top layer is 13 mm (1/2 inch) or more below the grade, excavate the top layer and replace with new material to a depth of at least 75 mm (3 inches) in compacted thickness.

C. Compaction:
   1. Perform compaction with approved equipment (hand or mechanical) well suited to the material being compacted.
   2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
   3. Compact each layer to at least 95 percent or 100 percent of maximum density as determined by AASHTO T180 or AASHTO T99 respectively.

D. Smoothness Test and Thickness Control:
   Test the completed subbase for grade and cross section with a straight edge.
   1. The surface of each layer shall not show any deviations in excess of 10 mm (3/8 inch).
   2. The completed thickness shall be within 13 mm (1/2 inch) of the thickness as shown.

E. Protection:
   1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
   2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new

material meeting the requirements herein specified, at no additional cost to the VA.

3.3 SETTING FORMS

A. Base Support:

1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

B. Form Setting:

1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
3. Forms shall conform to line and grade with an allowable tolerance of 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) at any point.
4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
5. Clean and oil forms each time they are used.

C. The Contractor’s Registered Professional Land Surveyor, specified in Section 00 72 00, GENERAL CONDITIONS, shall establish and control the alignment and the grade elevations of the forms or concrete slipforming machine operations.

1. Make necessary corrections to forms immediately before placing concrete.
2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

3.4 EQUIPMENT

A. The Resident Engineer shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.

B. Maintain equipment and tools in satisfactory working condition at all times.

3.5 PLACING REINFORCEMENT

A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.

B. Before the concrete is placed, the Resident Engineer shall approve the reinforcement, which shall be accurately and securely fastened in place with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown.

3.6 PLACING CONCRETE - GENERAL

A. Obtain approval of the Resident Engineer before placing concrete.

B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the Resident Engineer before placing concrete.

C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.

D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.

E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.

F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.

G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

3.7 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS

A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.

B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
E. Finish the surface to grade with a wood or metal float.
F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.8 CONCRETE FINISHING - GENERAL

A. The sequence of operations, unless otherwise indicated, shall be as follows:
   1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
   2. Maintain finishing equipment and tools in a clean and approved condition.

3.9 CONCRETE FINISHING CURB

A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 6mm (1/4 inch) or as otherwise detailed.
B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.
D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.
E. Except at grade changes or curves, finished surfaces shall not vary more than 3 mm (1/8 inch) for gutter and 6 mm (1/4 inch) for top and face of curb, when tested with a 3000 mm (10 foot) straightedge.
F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
G. Correct any depressions which will not drain.

H. Visible surfaces and edges of finished curb shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.10 CONCRETE FINISHING PEDESTRIAN PAVEMENT

A. Walks, Wheelchair Curb Ramps:

1. Finish the surfaces to grade and cross section with a metal float, trowled smooth and finished with a broom moistened with clear water.
2. Brooming shall be transverse to the line of traffic.
3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 2 mm (1/16 inch) in depth.
5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
6. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

3.11 CONCRETE FINISHING EQUIPMENT PADS

A. After the surface has been struck off and screeded to the proper elevation, give it a smooth dense float finish, free from depressions or irregularities.

B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.

C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 3 mm (1/8 inch) when tested with a 3000 mm (10 foot) straightedge.

D. Correct irregularities exceeding the above.

3.12 JOINTS - GENERAL

A. Place joints, where shown, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.

B. Joints shall be straight and continuous from edge to edge of the pavement.

3.13 CONTRACTION JOINTS

A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.

B. Construct joints in curbs by inserting 3 mm (1/8 inch) steel plates conforming to the cross sections of the curb.

C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.

D. Finish edges of all joints with an edging tool having the radius as shown.

E. Score pedestrian pavement with a standard grooving tool or jointer.

3.14 EXPANSION JOINTS

A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.

B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.

C. Anchor with approved devices to prevent displacing during placing and finishing operations.

D. Round the edges of joints with an edging tool.

E. Form expansion joints as follows:

1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
2. Using joint filler of the type, thickness, and width as shown.
3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.15 FORM REMOVAL

A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.

B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.16 CURING OF CONCRETE

A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the Resident Engineer.

B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).

C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at lease 0.1 mm (4 mils) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 300 mm (12 inches). Securely anchor sheeting.

D. Liquid Membrane Curing:

1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 5 m^2/L (200 square feet per gallon) for both coats.
2. Do not allow the concrete to dry before the application of the membrane.
3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.17 CLEANING

A. After completion of the curing period:
   1. Remove the curing material (other than liquid membrane).
   2. Sweep the concrete clean.
   3. After removal of all foreign matter from the joints, seal joints as herein specified.
   4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.18 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Resident Engineer, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the Resident Engineer.

3.19 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

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SECTION 321216
ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.2 RELATED WORK

A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 00, EARTH MOVING.

C. Pavement Markings: Section 32 17 23, PAVEMENT MARKINGS.

1.3 INSPECTION OF PLANT AND EQUIPMENT

The Resident Engineer shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.4 ALIGNMENT AND GRADE CONTROL

The Contractor’s Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

B. Data and Test Reports:

1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.

2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
3. Job-mix formula.

C. Certifications:
1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
2. Asphalt cement certificate of conformance to State Highway Department requirements.
3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification. Obtain bituminous materials conforming to the State Highway Specification requirements of Bulletin 25 from a producer listed in Bulletin 15.

D. One copy of State Highway Department Specifications.

E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

PART 2 - PRODUCTS

2.1 GENERAL

A. Aggregate base, Asphaltic base, and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the State Highway Material Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA Resident Engineer or VA Contracting Officer.

2.2 AGGREGATES

A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.

B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").

C. Base aggregate maximum size:
1. Base course over 152mm(6") thick: 38mm(1-1/2");
2. Other base courses: 19mm(3/4").

D. Asphaltic base course:
1. Maximum particle size not to exceed 25.4mm(1”).

2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

Sieve Sizes	Percentage Passing
19mm(3/4")	100
9.5mm(3/8")	67 to 85
6.4mm(1/4")	50 to 65
2.4mm(No. 8 mesh)	37 to 50
600µm(No. 30 mesh)	15 to 25
75µm(No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

2.3 ASPHALTS

A. Comply with provisions of Asphalt Institute Specification SS2:
   1. Asphalt cement: Penetration grade 50/60
   2. Prime coat: Cut-back type, grade MC-250
   3. Tack coat: Uniformly emulsified, grade SS-1H

2.4 SEALER

A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.

B. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

PART 3 - EXECUTION

3.1 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate

sections of the State Highway Specifications for the type of material specified.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

A. Provide hot plant-mixed asphaltic concrete paving materials.
   1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.
   2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

3.3 SUBGRADE

A. Shape to line and grade and compact with self-propelled rollers.
B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

A. Subbase (when required)
   1. Spread and compact to the thickness shown on the drawings.
   2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
   3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
B. Base
   1. Spread and compact to the thickness shown on the drawings.
   2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
   3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").

D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).

E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING

A. Remove all loose materials from the compacted base.

B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer’s recommendations as approved by the Architect or Engineer.

C. Receipt of asphaltic concrete materials:

1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).
2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

D. Spreading:

1. Spread material in a manner that requires the least handling.
2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown own the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
   a. No depressions which will retain standing water.
   b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.6 APPLICATION OF SEAL COAT

A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer’s recommendations as approved by the Architect or Engineer.

B. Apply one coat of the specified sealer.

C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.7 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

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SECTION 321723
PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall consist of furnishing and applying paint on pavement surfaces, in the form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings, in accordance with the details as shown or as prescribed by the Resident Engineer. Conform to the Manual on Uniform Traffic Control Devices for Streets and Highways, published by the U.S. Department of Transportation, Federal Highway Administration, for details not shown.

1.2 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the following materials conform to the requirements specified.

B. Paint.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):

TT-P-1952E.....Paint, Traffic Black, and Airfield Marking, Waterborne

C. Master Painters Institute (MPI):

Approved Product List - 2010

PART 2 - PRODUCTS

2.1 PAINT

Paint for marking pavement (parking lot and zone marking) shall conform to MPI No. 97, color as shown. Paint for obliterating existing markings shall conform to Fed. Spec. TT-P-1952E. Paint shall be in containers of at least 18 L (5 gallons). A certificate shall accompany each batch of paint stating compliance with the applicable publication.

2.2 PAINT APPLICATOR

Apply all marking by approved mechanical equipment. The equipment shall provide constant agitation of paint and travel at controlled speeds.

Synchronize one or more paint "guns" to automatically begin and cut off paint flow in the case of skip lines. The equipment shall have manual control to apply continuous lines of varying length and marking widths as shown. Provide pneumatic spray guns for hand application of paint in areas where a mobile paint applicator cannot be used. An experienced technician that is thoroughly familiar with equipment, materials, and marking layouts shall control all painting equipment and operations.

2.3 SANDBLASTING EQUIPMENT

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall furnish not less than 0.08 m^3/s (150 cfm) of air at a pressure of not less than 625 kPa (90 psi) at each nozzle used.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.

B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by the Resident Engineer. The application of paint conforming to Fed. Spec. TT-P-1952E is an option to removal of existing paint markings on asphalt pavement. Apply the black paint in as many coats as necessary to completely obliterate the existing markings. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint. Pavement marking shall follow as closely as practicable after the surface has been cleaned and dried, but do not begin any marking until the Resident Engineer has inspected the surface and gives permission to proceed. The Contractor shall establish

control points for marking and provide templates to control paint application by type and color at necessary intervals. The Contractor is responsible to preserve and apply marking in conformance with the established control points.

3.2 APPLICATION

Apply uniformly painted pavement marking of required color(s), length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with the details as shown and established control points. The length and width of lines shall conform within a tolerance of plus or minus 75 mm (3 inches) and plus or minus 3 mm (1/8 inch), respectively, in the case of skip markings. The length of intervals shall not exceed the line length tolerance. Temperature of the surface to be painted and the atmosphere shall be above 10°C (50°F) and less than 35°C (95°F). Apply the paint at a wet film thickness of 0.4 mm (0.015 inch). Apply paint in one coat. At the direction of the Resident Engineer, markings showing light spots may receive additional coats. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the marking, discontinue paint operations until cause of the slow drying is determined and corrected. Remove and replace marking that is applied at less than minimum material rates; deviates from true alignment; exceeds stipulated length and width tolerances; or shows light spots, smears, or other deficiencies or irregularities. Use carefully controlled sand blasting, approved grinding equipment, or other approved method to remove marking so that the surface to which the marking was applied will not be damaged.

3.3 PROTECTION

Conduct operations in such a manner that necessary traffic can move without hindrance. Protect the newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce

crossing by traffic. Efface and replace damaged portions of markings at no additional cost to the Government.

3.4 DETAIL PAVEMENT MARKING

Use Detail Pavement Markings, exclusive of actual traffic lane marking, at exit and entrance islands and turnouts, on curbs, at crosswalks, at parking bays, and at such other locations as shown. Show the International Handicapped Symbol at indicated parking spaces. Color shall be as shown. Apply paint for the symbol using a suitable template that will provide a pavement marking with true, sharp edges and ends. Place detail pavement markings of the color(s), width(s) and length(s), and design pattern at the locations shown.

3.5 TEMPORARY PAVEMENT MARKING

When shown or directed by the Resident Engineer, apply Temporary Pavement Markings of the color(s), width(s) and length(s) shown or directed. After the temporary marking has served its purpose and when so ordered by the Resident Engineer, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that the surface to which the marking was applied will not be damaged. As an option, an approved preformed pressure sensitive, adhesive tape type of temporary pavement marking of the required color(s), width(s) and length(s) may be furnished and used in lieu of temporary painted marking. The Contractor shall be fully responsible for the continued durability and effectiveness of such marking during the period for which its use is required. Remove any unsatisfactory tape type marking and replace with painted markings at no additional cost to the Government.

3.6 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

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SECTION 329000

PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work in this section consists of furnishing and installing plant, soils, edging turf, grasses and landscape materials required as specified in locations shown.

1.2 RELATED WORK

A. Topsoil Testing: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

C. Stripping Topsoil, Stock Piling and Topsoil Materials: Section 31 20 00, EARTH MOVING.

D. Section 32 84 00, PLANTING IRRIGATION.

1.3 DEFINITIONS

A. Backfill: The earth used to replace earth in an excavation.

B. Balled and Burlapped Stock: ANSI Z60.1. Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than the specified Minimum root ball diameter and depth for field grown trees and shrubs specifically for each type and size of plant, as recommended by ANSI Z60.1; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball.

C. Balled and Potted Stock: ANSI Z60.1. Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than the minimum spread of roots/root ball diameter specified according to the height or spread, as recommended by ANSI Z60.1

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium

removed, and with not less than minimum root spread according to ANSI Z60.1,for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

J. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

K. Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, turf and grasses, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

L. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

M. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

N. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 ABBREVIATIONS

1.5 DELIVERY, STORAGE AND HANDLING

A. Notify the Contracting Officer’s Representative of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant and landscape materials from the job site immediately.

B. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable. Keep seed and other packaged materials in dry storage away from contaminants.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants. Keep bulk materials in dry storage away from contaminants.
2. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

D. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

E. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or

shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

F. Handle planting stock by root ball.

G. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.

H. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than 6 hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

   1. Heel-in bare-root stock: Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
   2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   3. Do not remove container-grown stock from containers before time of planting.
   4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet, condition.

J. Harvest, deliver, store, and handle sod according to requirements in TPI's "Guideline Specifications to Turfgrass Sodding". Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage, seed contamination and drying.

K. Deliver sprigs in air tight bags to keep from drying out. Sprigs delivered unwrapped, shall be kept moist in burlap or other accepted material until planting.

L. Deliver plugs within 24 hours of harvesting, keep moist until planting.

M. All pesticides and herbicides shall be properly labeled and registered with the U.S. Department of Agriculture. Deliver materials in original, unopened containers showing, certified analysis, name and address of manufacturer, product label, manufacturer’s application instructions specific to the project and indication of conformance with state and federal laws, as applicable.

1.6 PROJECT CONDITIONS

A. Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion. Plant during one of the following periods:

1. Spring Planting: March 15 to June 1.
2. Fall Planting: August 15 to October 1.

C. Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

D. Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

E. Plant trees, shrubs, and other plants after finish grades and irrigation system components are established, but not before irrigation system components are installed, tested and approved unless otherwise indicated.

1. When planting trees, shrubs, and other plants, protect irrigation system components and promptly repair damage caused by planting operations.

1.7 QUALITY ASSURANCE:

A. Products Criteria:
   1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
   2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
   1. Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association with 10 years experience in landscape installation.
   2. Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   3. Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network and submit one copy of certificate to the Contracting Officer’s Representative:
      a. Certified Landscape Technician (CLT) - Exterior, with installation irrigation specialty area(s), designated CLT-Exterior.
      b. Certified Ornamental Landscape Professional, designated COLP.
   4. Pesticide Applicator: Licensed in state of project, commercial.

C. A qualified Arborist shall be licensed and required to submit one copy of license to the Contracting Officer’s Representative.

D. Include an independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct

the testing indicated and that specializes in types of tests to be performed.

E. For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
   1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60, “Diagnosis and Improvement of Saline and Alkali Soils”.
   2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Contracting Officer’s Representative. A minimum of 3 representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
   3. Report suitability of tested soil for plant growth.
      a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd (0.76 cu. m) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
      b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

F. Provide quality, size, genus, species, variety and sources of plants indicated, complying with applicable requirements in ANSI Z60.1.

G. Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
   1. Measure trees and shrubs with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure

main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4 inch (100 mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.

2. Measure other plants with stems, petioles, and foliage in their normal position.

H. Contracting Officer’s Representative may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Contracting Officer’s Representative retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Contracting Officer’s Representative of plant material sources 14 days in advance of delivery to site.

I. Include product label and manufacturer's literature and data for pesticides and herbicides.

J. Conduct a pre-installation conference at Project site.

1.8 SUBMITTALS

A. Submit product data for each type of product indicated, including soils:

1. Include quantities, sizes, quality, and sources for plant materials.
2. Include EPA approved product label, MSDS (Material Safety Data Sheet) and manufacturer's application instructions specific to the Project.
3. Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of 3 photographs showing the average plant, the best quality plant, and the worst quality plant to

be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Submit samples and manufacturer’s literature for each of the following for approval before work is started.
   1. Trees and Shrubs: 3 samples of each variety and size delivered to the site for review. Maintain approved samples on-site as a standard for comparison.
   2. Organic and Compost Mulch: 1-pint (0.5-liter) volume of each organic and compost mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
   3. Submit edging materials and accessories in manufacturer's standard size, to verify color selected.
   4. Erosion Control Materials: 12 by 12 inches (300 by 300 mm).
   5. Root Barrier: Width of panel by 12 inches (300 mm).
   6. Landscape Membranes: 12 by 12 inches (300 by 300 mm).

C. Qualification data for qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

D. Prior to delivery, provide notarized certificates attesting that each type of manufactured product, from the manufacturer, meet the requirements specified and shall be submitted to the Contracting Officer’s Representative for approval:
   1. Plant Materials (Department of Agriculture certification by State Nursery Inspector declaring material to be free from insects and disease).
   2. Seed and Turf Materials notarized certificate of product analysis.
   3. Manufacturer's certified analysis of standard products.

4. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

E. Material Test Reports: For standardized ASTM D5268 topsoil, existing native surface topsoil, existing in-place surface soil.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

1.9 PLANT AND TURF ESTABLISHMENT PERIOD

A. The establishment period for plants and turf shall begin immediately after installation, with the approval of the Contracting Officer’s Representative, and continue until the date that the Government accepts the project or phase for beneficial use and occupancy. During the Establishment Period the Contractor shall maintain the plants and turf as required in Part 3.

1.10 PLANT AND TURF MAINTENANCE SERVICE

A. Provide initial maintenance service for trees, shrubs, ground cover and other plants by skilled employees of landscape Installer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 12 months from the date ~~of~~ planting completion when the Contracting Officer’s Representative determines that 100 percent of the plants are alive and healthy.

B. Obtain continuing maintenance proposal from Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.11 APPLICABLE PUBLICATIONS

A. The publications listed below, form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. American National Standards Institute (ANSI):

Z60.1-04.....Nursery Stock

C. Association of Official Seed Analysts (AOSA): Rules for Testing Seed.

D. American Society For Testing And Materials (ASTM):

B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

C33/C33M-11.....Concrete Aggregates

C136-06.....Sieve Analysis of Fine and Coarse Aggregates

C516-08.....Vermiculite Loose Fill Thermal Insulation

C549-06.....Perlite Loose Fill Insulation

C602-07.....Agricultural Liming Materials

D977-05.....Emulsified Asphalt (AASTHO M140)

D5268-07.....Topsoil Used for Landscaping Purposes

E. Hortus Third: A Concise Dictionary of Plants Cultivated in the United States and Canada.

F. Turfgrass Producers International (TPI): Guideline Specifications to Turfgrass Sodding.

G. United States Department of Agriculture (USDA): Handbook No. 60 Diagnosis and Improvement of Saline and Alkali Soils; Federal Seed Act Regulations.

1.12 WARRANTY

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of two years from final acceptance, unless noted

otherwise below. Further, the Contractor will provide all manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

1. Plant and Turf Warranty Periods will begin from the date of Government acceptance of the project or phase for beneficial use and occupancy.
   a. Trees, Shrubs, Vines, and Ornamental Grasses: 24 months.
   b. Ground Covers, Biennials, Perennials, Turf, and Other Plants: 12 months.
   c. Annuals: 3 Insert number months.
2. The Contractor shall have completed, located, and installed all plants and turf according to the plans and specifications. All plants and turf are expected to be living and in a healthy condition at the time of final inspection.
3. The Contractor will replace any dead plant material and any areas void of turf immediately, unless required to plant in the succeeding planting season. Provide extended warranty for period equal to original warranty period for replacement plant materials. Replacement plant and turf warranty will begin on the day the work is completed.
4. Replacement of relocated plants, that the Contractor did not supply, is not required unless plant failure is due to improper handling and cares during transplanting. Loss through Contractor negligence requires replacement in plant type and size.
5. The Government will reinspect all plants and turf at the end of the Warranty Period. The Contractor will replace any dead, missing, or defective plant material and turf immediately. The Warranty Period will end on the date of this inspection provided the Contractor has complied with the warranty work required by this specification. The Contractor shall also comply with the following requirements:
   a. Replace plants that are more than 25 percent dead, missing or defective plant material prior to final inspection.

b. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
c. Mulch and weed plant beds and saucers. Just prior to final inspection, treat these areas to a second application of approved pre-emergent herbicide.
d. Complete remedial measures directed by the Contracting Officer’s Representative to ensure plant and turf survival.
e. Repair damage caused while making plant or turf replacements.

B. Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
b. Structural failures including plantings falling or blowing over.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. Plant and turf materials: ANSI Z60.1 ; will conform to the varieties specified and be true to botanical name as listed in Hortus Third; nursery-grown plants and turf material true to genus, species, variety, cultivar, stem form, shearing, and other features indicated on Drawings; healthy, normal and unbroken root systems developed by transplanting or root pruning; well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf; free of disease, pests, eggs, larvae, and defects such as knots, sun scald, windburn, injuries, abrasions, and disfigurement.

1. Trees-deciduous and evergreen: Single trunked with a single leader, unless otherwise indicated; symmetrically developed deciduous trees and shrubs of uniform habit of growth; straight boles or stems; free from objectionable disfigurements; evergreen trees and shrubs with well developed symmetrical tops, with typical spread of branches for each particular species or variety. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots will be rejected.
2. Ground cover and vine plants: Provide the number and length of runners for the size specified on the Drawings, together with the proper age for the grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. Plants shall have been grown under climatic conditions similar to those in the locality of the project. Spray all plants budding into leaf or having soft growth with an anti desiccant at the nursery before digging.
3. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the Contracting Officer’s Representative, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1 .
4. Provide nursery grown plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting.
5. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1 , consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.

6. Bare root (BR) plants shall have the root system substantially intact, but with the earth carefully removed. Cover roots with a thick coating of mud by "puddling" after the plants are dug.
7. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
8. Make substitutions only when a plant (or alternates as specified) is not obtainable and the Contracting Officer’s Representative authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant with the same essential characteristics and an equitable adjustment of the contract price.
9. Existing plants to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.
10. Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Label at least one plant of each variety, size, and caliper with a securely attached, waterproof and weather-resistant label bearing legible the correct designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as indicated in the Plant Schedule or Plant Legend shown on the Drawings. Labels shall be securely attached and not be removed.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36 mm) sieve and a minimum of 75 percent passing through No. 60 (0.25 mm) sieve.

2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36 mm) sieve and a minimum of 55 percent passing through No. 60 (0.25 mm) sieve.
3. Provide lime in form of ground calcitic limestone.

2.3 ORGANIC SOIL AMENDMENTS

A. Organic matter: Commercially prepared compost. Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1 inch (25 mm) sieve; soluble salt content of not to exceed 4 decisiemens; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
   1. Organic Matter Content: 50 to 60 percent of dry weight.

2.4 PLANT AND TURF FERTILIZERS

A. Soil Test: Evaluate existing soil conditions and requirements prior to fertilizer selection and application to minimize the use of all fertilizers and chemical products. Obtain approval of Contracting Officer’s Representative for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Fertilizers to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer applicable to specific areas as required for Project conditions and application. Provide commercial grade plant and turf fertilizers, free flowing, uniform in composition and conforms to applicable state and federal regulations.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
   1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

C. Slow-Release Fertilizer: Granular or pellet fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.5 PLANTING SOILS

A. Planting Soil: ASTM D5268 topsoil, with pH range of 5.5 to 7, a minimum of 6 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D5268 topsoil with the following soil amendments and fertilizers as recommended by the soils analysis.

B. Existing Planting Soil: Existing, native surface topsoil formed under natural conditions retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
   1. Supplement with planting soil when quantities are insufficient.
   2. Mix existing, native surface topsoil with the following soil amendments and fertilizers as recommended by the soils analysis.

C. Imported Planting Soil: Imported topsoil or manufactured topsoil from off-site sources can be used if sufficient topsoil is not available on site to meet the depth as specified herein. The Contractor shall furnish imported topsoil. At least 10 days prior to topsoil delivery, notify the Contracting Officer’s Representative of the source(s) from which topsoil is to be furnished. Obtain imported topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs, or marshes.

2.6 BIOSTIMULANTS

A. Biostimulants: Contain soil conditioners, VAM fungi, and endomycorrhizal and ectomycorrhizal fungi spores and soil bacteria appropriate for existing soil conditions.

2.7 LANDSCAPE MEMBRANES

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101 g/sq. m) minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally-encountered chemicals, alkalis, and acids.

B. Composite Fabric shall be woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd. (162 g/sq. m).

2.8 MULCH

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Triple hammer milled Shredded hardwood.
2. Size Range shall be 5/8 to 1 ¼ inches.
3. Color shall be natural.

2.9 TACKIFIERS AND ADHESIVES

A. Nonasphalt tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

B. Asphalt emulsion: ASTM D977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.10 EROSION CONTROL

A. Erosion control blankets: Biodegradable wood excelsior, straw, or coconut fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended biodegradable staples, 6 inches (150 mm) long.

B. Erosion control fiber mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended biodegradable staples, 6 inches (150 mm) long.

2.11 WATER

A. Water shall not contain elements toxic to plant life. Water to be obtained from project site at no cost to the Contractor.

2.12 ANTIDESICCANT

A. Antidesiccant: An emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

2.13 TURF SELECTIONS

A. Grasses for Cool Regions shall be:
   1. Bentgrasses: Redtop (Agrostis alba) & Colonial (Agrostis tenuis)
   2. Bluegrasses: Kentucky (Poa pratensis), Rough-stalked (Poa trivialis) & Canada (Poa compressa)
   3. Fescue: Red (Festuca rubra), Meadow (Festuca pratensis) & Tall (Festuca arundinacea)
   4. Ryegrasses: Perennial (Lolium perenne)

2.14 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with "AOSA, Rules for Testing Seed" for purity and germination tolerances. Seed shall be labeled in conformance with U. S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable.

B. Seed Species: Not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed.
   1. Sun and Partial Shade: Proportioned by weight as follows:
      a. 40 percent Falcon III Tall Fescue, or equal.
      b. 40 Shenandoah II Tall Fescue, or equal.
      c. 10 percent Paragon GLR Perennial Ryegrass, or equal.
      d. 10 percent Merit Kentucky Bluegrass, or equal.

2.15 PESTICIDES

A. Consider IPM (Integrated Pest Management) practices to minimize the use of all pesticides and chemical products. Obtain approval of Chief Engineer for allowable products, product alternatives, scheduling and

application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Pesticides to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
5. Special conditions may exist that warrant a variance in the specified planting dates or conditions. Submit a written request to the

Contracting Officer's Representative stating the special conditions and proposal variance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Contracting Officer's Representative and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain approval by the Contracting Officer's Representative of layout before excavating or planting. The Contracting Officer's Representative may approve adjustments to plant material locations to meet field conditions.

D. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 12 inches (300 mm. Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   1. Apply fertilizer directly to subgrade before loosening.
   2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
      a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
      b. Mix lime with dry soil before mixing fertilizer.
   3. Spread planting soil to a depth of 12 inches (300 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
      a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil.
B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
C. Before planting, obtain Contracting Officer’s Representative acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45 degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

1. Excavate approximately 3 times as wide as ball diameter for balled and burlapped and container-grownd stock.
2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
8. Use topsoil to form earth saucers or water basins for watering around plants. Basins to be 2 inches (50 mm) high for shrubs and 4 inches (100 mm) high for trees.

B. Subsoil and topsoil removed from excavations may not be used as planting soil.

C. Notify Contracting Officer’s Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Notify Contracting Officer’s Representative if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow water to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Prior to planting, verify that root flare is visible at top of root ball according to ANSI Z60.1 . If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from

the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches (50 mm) above adjacent finish grades.
   1. Use planting soil for backfill.
   2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
   3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
   4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
   5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Set container-grown stock plumb and in center of planting pit or trench with root flare 2 inches (50 mm) above adjacent finish grades.
   1. Use planting soil for backfill.
   2. Carefully remove root ball from container without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
   3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately

one-half full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Set and support bare-root stock in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grade.

1. Use planting soil for backfill.
2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.
3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
4. Continue backfilling process. Water again after placing and tamping final layer of soil.

F. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 MECHANIZED TREE SPADE PLANTING

A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped

root-ball diameter according to ANSI Z60.1, or larger than the manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.

B. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

C. Cut exposed roots cleanly during transplanting operations.

D. Use the same tree spade to excavate the planting hole as was used to extract and transport the tree.

E. Where possible, orient the tree in the same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Contracting Officer’s Representative, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

C. Do not apply pruning paint to wounds.

3.8 ROOT-BARRIER INSTALLATION

A. Install root barrier where trees are planted within 48 inches (1200 mm) of paving or other hardscape elements, such as walls, curbs, and walkways unless otherwise shown on Drawings.

B. Align root barrier with bottom edge angled at 20 degrees away from the paving or other hardscape element and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.

C. Install root barrier continuously for a distance of 60 inches (1500 mm) in each direction from the tree trunk, for a total distance of 10 feet (3 m) per tree. If trees are spaced closer, use a single continuous piece of root barrier.

1. Position top of root barrier flush with finish grade.
2. Overlap root barrier a minimum of 12 inches (300 mm) at joints.

3. Do not distort or bend root barrier during construction activities.
4. Do not install root barrier surrounding the root ball of tree.

3.9 GROUND COVER AND PLANT INSTALLATION

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Landscape Plan in even rows with triangular spacing.
B. Use planting soil for backfill.
C. Dig holes large enough to allow spreading of roots.
D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.
H. Plant ground cover in areas to receive erosion control materials through the material after erosion control materials are in place.

3.10 MULCH INSTALLATION

A. Mulch backfilled surfaces of planting areas and other areas indicated. Keep mulch out of plant crowns and off buildings, pavements, utility standards/pedestals, and other structures.
   1. Trees and Tree-like Shrubs in Turf Areas: Apply organic mulch ring of 3 inch (75 mm) average thickness, with 36 inch (900 mm) radius around trunks or stems, unless noted otherwise on the Landscape Plan. Do not place mulch within 3 inches (75 mm) of trunks or stems.
   2. Organic Mulch in Planting Areas: Apply 3 inch (75 mm) average thickness of organic mulch extending 12 inches (300 mm) beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches (75 mm) of trunks or stems.

3.11 EDGING INSTALLATION

A. For Natural Cut Edging provide a uniform lazy 'V' cut with one vertical side adjacent to turf areas 5 inches (125 mm) deep and a second side angled 10 inches (250 mm) toward center of plant bed for a clear cut division line between the plant bed and adjacent turf.

3.12 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring plant saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.13 TURF AREA PREPARATION AND GRADING

A. For newly graded subgrades loosen subgrade to a minimum depth of 6 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer, lime, and soil amendments directly to subgrade before loosening, at rates recommended by the soils analysis.
2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
3. Spread planting soil to a depth of 6 inches (150 mm) but not less than required to meet finish grades after light rolling and natural

settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches (50 mm) of subgrade. Spread remainder of planting soil.

b. Reduce elevation of planting soil to allow for soil thickness of sod.

B. Finish grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

3.14 PREPARATION FOR EROSION-CONTROL MATERIALS.

A. Prepare area as specified in "Turf Area Preparation and Grading" Article.

B. For erosion control mats, install planting soil in two lifts, with second lift equal to thickness of erosion control mats. Install erosion control mat and fasten with biodegradable materials as recommended by material manufacturer.

C. Fill cells of erosion control mat with planting soil and compact before planting.

D. For erosion control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten with biodegradable materials as recommended by material manufacturer.

E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.15 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.
2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 5 to 8 lb/1000 sq. ft. (2.3 to 3.6 kg/92.9 sq. m).

C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mesh and fastened with biodegradable materials according to manufacturer's written instructions.

E. Protect seeded areas with erosion control mats where shown on Drawings; install and anchor with biodegradable materials according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 3 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket over seeded areas. Spread by hand, blower, or other suitable equipment.
   1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

G. Protect seeded areas from hot, dry weather or drying winds by applying straw mulch planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch (4.8 mm), and roll surface smooth.

3.16 TURF RENOVATION

A. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
   1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
   2. Install new planting soil as required.

B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
D. Mow, dethatch, core aerate, and rake existing turf.
E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).
H. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches (100 mm) of existing soil. Install new planting soil to fill low spots and meet finish grades.
I. Apply seed and protect with straw mulch as required for new turf.
J. Water newly planted areas and keep moist until new turf is established.

3.17 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
   1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
   2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
   3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).
   1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
   1. Mow 1-1/2 to 2 inches (38 to 50 mm).

3.18 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Contracting Officer’s Representative:
   1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
   2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
   3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
   4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable

plants, and areas between sprigs are free of weeds and other undesirable vegetation.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.19 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Contracting Officer’s Representative before each application is performed.

B. Pre-Emergent Herbicides (Selective and Non-Selective): Applied to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Non-Selective): Applied only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.20 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

D. Erect temporary fencing or barricades and warning signs, as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

E. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

F. Remove nondegradable erosion control measures after grass establishment period.

G. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

--- END ---

SECTION 331000
WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

Underground water distribution system complete, ready for operation, including all appurtenant structures, and connections to both new building service lines and to existing water supply.

1.2 RELATED WORK:

A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.

B. Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing: Section 31 20 00, EARTH MOVING.

C. Concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.

D. Protection of materials and equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

E. Fire protection system connection and supervisory switch for post indicator valve: Section 21 12 00, FIRE-SUPPRESSION STANDPIPES.

1.3 DEFINITIONS:

A. Water Distribution: Pipelines and appurtenances which are part of the distribution system. The distribution system comprises the network of piping located throughout building areas and other areas of water use, including hydrants, valves, and other appurtenances used to supply water for domestic and fire-fighting/fire protection purposes.

B. Water Service Line: Pipe line connecting building piping to water distribution lines.

1.4 QUALITY ASSURANCE:

A. Products Criteria:

1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be product of one manufacturer.
2. Nameplate: Nameplate bearing manufacturer's name or identifiable trademark securely affixed in a conspicuous place on equipment or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Water lines and the extension, and/or modifications to Public Utility systems.

C. Comply with all rules and regulations of Federal, State, and Local Water Purveyor, Health Department, and Department of Environmental Resources having jurisdiction over the design, construction, and operation of potable water systems.

D. All material surfaces in contact with potable water shall comply with NSF 61.

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturers' Literature and Data (Submit all items as one package): (Ductile Iron Pipe shall be in accordance with AWWA C600 and shall be provided to Resident Engineer for approval.)

1. Piping.
2. Gaskets.
3. Valves.
4. Fire hydrants.
5. Street washer.
6. Meter.
7. Vaults, frames and covers.
8. Steps.
9. Post indicator.
10. Valve boxes.
11. Corporation and curb stops.
12. Curb stop boxes.
13. Joint restraint.
14. Disinfection products.
15. Link/sleeve seals.

C. Testing Certifications:

1. Certification of Backflow Devices.
2. Hydrostatic Testing.
3. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.

1.6 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI/ASME):

B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
B16.18.....Cast Bronze Solder Joint Pressure Fittings
B16.26-88.....Cast Copper Alloy Fittings for Flared Copper Tubes
B40.100-98.....Pressure Gauges and Gauge Attachments

C. American Society for Testing and Materials (ASTM):

A123-97.....Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A148M-03.....Standard Specifications for Steel Castings
A242-00.....Standard Specifications for High Strength Low Alloy Structural Steel AASHTO No. M161
A307-02.....Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A536-04.....Standard Specifications for Ductile Iron Castings
B61-02.....Steam or Valve Bronze Castings
B62-02.....Composition Bronze or Ounce Metal Castings B88-02.....Seamless Copper Water Tube
B828.....Standard Practice: Soldering and Brazing Copper Tube and fittings
C32-04.....Sewer and Manhole Brick (Made from Clay or Shale)
C139-03.....Concrete Masonry Units for Construction of Catch Basins and Manholes
D1784-03.....Standard Specifications for Rigid PVC Compounds and CPVC Compounds
D1869-00.....Standard Specifications for Rubber Rings for Asbestos Cement Pipe
D2464-99.....Standard Specifications for Threaded PVC Pipe Fittings, Schedule 80

D2467-02.....Standard Specifications for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D3139-98.....Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe

C32-04.....Standard Specifications for Sewer Manhole Brick

D. American Water Works Association (AWWA):

B300-04.....Hypochlorites

B301-04.....Liquid Chlorine

C104-04.....Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water

C105-99.....Polyethylene Encasement for Gray and Ductile C.I. Piping for Water and Other Liquids

C110-03.....Ductile-Iron and Gray-Iron Fittings, 80 mm (3 Inches) Through 1200 mm (48 Inches) for Water and Other Liquids

C111-01.....Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

C115-99.....Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges

C150-02.....American National Standard for Thickness Design of Ductile Iron Pipe

C151-96.....Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

C153-00.....Ductile-Iron Compact Fittings, 80 mm (3 inches) Through 300 mm (12 Inches) for Water and Other Liquids

C500-02.....Gate Valves for Water and Sewerage Systems

C502a-95.....Dry-Barrel Fire Hydrants

C503-97.....Wet-Barrel Fire Hydrants

C508-01.....Swing Check Valves for Waterworks Service, 2 Inches (50 mm) Through 24 Inches (600mm) NPS

C509-01.....Resilient Seated Gate Valve for Water and Sewage System
C510-97.....Double Check Valve Back-Flow Prevention Assembly
C511-97.....Reduced Pressure Principle Back-Flow Prevention Assembly
C550-01.....Protective Epoxy Interior Coatings for Valves and Hydrants
C600-01.....Installation for Ductile-Iron Water Mains and Their Appurtenances
C605-94.....Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
C651-92.....Disinfecting Water Mains
C800-01.....Underground Service Line Valves and Fittings
C900-97.....Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Thru 12 Inches, for Water
C905-97.....Polyvinyl Chloride (PVC) Pressure Pipe 14 Inches Thru 36 Inches

E. National Fire Protection Association (NFPA):
24-95.....Installation of Private Fire Service Mains and Their Appurtenances
291-01.....Fire Flow Testing and Marking of Hydrants
1141-98.....Fire Protection in Planned Building Groups

F. NSF International:
14-03.....Plastics Piping Components and Related Materials
61-02.....Drinking Water System Components-Health Effects (Sections 1-9)

G. American Welding Society (AWS):
A5.8-04.....Brazing Filler Metal

H. Foundation for Cross-Connection Control and Hydraulic Research-2005

I. Copper Development Association’s Copper Tube Handbook-2005

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS:

A. Ductile iron pipe, direct buried:

1. Provide ductile iron pipe conforming to the requirements of AWWA C151, Pipe Thickness Class 54 for Pipe 100 mm through 200 mm (4

inches through 8 inches) in diameter and Pipe Thickness Class 53 for Pipe 250 mm through 300 mm (10 inches through 12 inches) in diameter, with standard thickness cement mortar lining interior, and interior asphaltic seal coat and exterior asphaltic coating, in accordance with AWWA and ANSI Standards.

2. Below Grade: Supply pipe in lengths not in excess of a nominal 6 m (20 feet) with rubber ring type push-on joints, mechanical joint or approved restrained joint. Provide flange joint pipe where shown on the drawings. Provide mechanical and restrained joint pipe with sufficient quantities of accessories as required for each joint.
3. When a polyethylene encasement over pipe, fittings, and valves is a requirement as indicated on the drawings, the material, installation and workmanship shall conform to applicable sections of AWWA C105. Make provisions to keep the polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.

B. Ductile Iron Pipe Above Grade or in Below Ground Concrete Pits:

1. Flanged ductile iron pipe, AWWA C115, with factory applied screwed long hub flanges except as otherwise specified hereinafter. Face and drill flanges after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and flush with end of pipe, ANSI B16.1, 850 kPa (125 psi) or 1725 kPa (250 psi) standard, for the purpose intended.
2. Wall Sleeve Castings: Size and types shown on the drawings and be hot dipped galvanized. Seal strips, where required shall be Link Seal as manufactured by Thunderline Corp., Wayne, Michigan or equal.
3. Pipe Thickness Class: Minimum of Class 53 as defined in AWWA C150 for all sizes of flanged pipe.
4. Rubber Ring Gaskets: Full face type, AWWA C111, 2 mm (1/16 inch) rubber ring gaskets and of approved composition suitable for the required service.
5. Pipe and fittings exposed to view in the finished work are to be painted in accordance with Section 09 91 00, PAINTING. Pipe shall not receive the standard tar or asphalt coat on the outside surfaces but shall be shop primed on the outside with one coat of Kop-Coat No. 621

Rust Inhibitive Primer or equal. Paint color shall match the wall color.

6. Bolts and Nuts on Flanged Fittings: Grade B, ASTM A307. Low alloy, high strength steel in accordance with AWWA C111. Assemble stainless steel bolts and nuts using anti-seize compound to prevent galling.

C. All Pipe Fittings: Ductile iron with a minimum pressure rating of 2400 kPa (350 psi). Fittings shall meet the requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 850 kPa (125 psi) or 1725 kPa (250 psi) template in accordance with ANSI B16.1 with full faced gaskets.

D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior.

E. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for all pipe in accordance with AWWA C151.

F. Provide non-detectable adhesive backed identification tape on top and sides of all buried ductile iron pipe, extended from joint to joint along the length of the pipe and have black lettering identifying the pipe service at no more than 300 mm (12 inch) intervals. According to service, the tape background color shall be as follows: potable water-blue.

2.2 COPPER PIPE AND TUBING:

Copper Piping: ASTM B88, Type K, with flared fittings in accordance with AWWA C800, with sweat cast brass fittings per ANSI B16.18. Use brazing alloy, AWS A5.8, Classification BCuP.

2.3 VALVES:

A. Asbestos packing is not allowed.

B. Gate:

1. 75 mm (3 inches) and Larger: Resilient seated, ductile iron body, bronze mounted, inclined seats, non-rising stem type turning counter-clockwise to open, 1375 kPa (200 pound) WOG. AWWA C509. The resilient seat shall be fastened to the gate with stainless steel fasteners or

vulcanizing methods. The interior and exterior shall be coated with thermo-setting or fusion epoxy coating in accordance with AWWA C550.

2. Operator:
   a. Underground: Except for use with post indicators, furnish valves with 50 mm (2 inch) nut for socket wrench operation. Post indicator shall comply with the requirements of NFPA 24 and shall be fully compatible with the valve provided.
   b. Above Ground and in Pits: Hand wheels.
3. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.

C. Check: Swing.
1. Smaller than 100 mm (4 inches): Bronze body and bonnet, ASTM B61 or B62, 1375 kPa (200 pound) WOG.
2. 100 mm (4 inches) and Larger: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 1375 kPa (200 pound) WOG. Check valves for fire lines shall conform to AWWA C508 and shall be epoxy coated and lined per AWWA C550.

D. Corporation stops and saddles shall conform to AWWA C800.

E. Curb Stop: Smaller than 75 mm (3 inches). Waterworks standard for Type "K" copper, single piece cast bronze body with tee top operated plug sealed with O-ring gaskets, 1375 kPa (200 pound) WOG per AWWA C800.

2.4 CURB STOP BOX:

Cast iron extension box with screw or slide type adjustment and flared base. Box shall be adapted, without full extension, to depth of cover required over pipe at stop location. Cast the word "WATER" in cover and set cover flush with finished grade. Curb stop shut-off rod shall extend 600 mm (2 feet) above top of deepest stop box.

2.5 VALVE BOX:

Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness of metal shall be 5 mm (3/16 inch). Box shall be adapted, without full extension, to depth of cover required over pipe at valve location. Cast the word "WATER" in cover. Provide [ ] "T" handle socket wrenches of 16 mm (5/8 inch) round stock long enough to extend 600 mm (2 feet) above top of deepest valve box.

2.6 POST INDICATOR VALVE:

A. Valve: Valve shall conform to the specifications listed in Section 2.4 for gate valves. The Post Indicator shall conform to NFPA 24, and shall be fully compatible with the valve and all the supervisory switches.

2.7 FIRE HYDRANTS:

A. Size of main valve opening of each hydrant shall be 125 mm (5 inches), minimum. Hose thread, size of fire apparatus connection, and shape, size and direction of rotation of operating head of hydrant shall be identical with present local fire department and/or water department standards.

B. Hydrant shall be type AWWA C502, heavy construction, of proper length to connect pipe without extra fittings, and shall be the traffic type with safety flange on barrel and safety couplings on the valve stem with the following features:

1. Interior removable without digging up hydrant; can be packed under pressure; 150 mm (6 inch) bell connection; one steamer nozzle and two hose nozzles with nozzle caps securely chained to barrel; suitable drainage device; single rubber or leather-faced valve in base; nozzles, stuffing boxes, wedge nuts, seat rings, clamp plates, etc. Threaded joints or spindles shall be bronze. Upper and lower barrels shall be of equal diameters. Upper barrel shall be of sufficient length to permit setting hydrant with barrel flange not more than 50 mm (2 inches) above finished grade. All fire hydrants shall have 150 mm (6 inch) bottom connection.
2. Provide fire hydrants with a finish paint identical to the existing fire hydrants.

C. Provide two wrenches with handles not less than 350 mm (14 inches) long.

2.8 PIPE SLEEVES:

Ductile iron or zinc coated steel.

2.9 BACKFLOW PREVENTER:

A. Potable Water and Irrigation Water Service: Reduced Pressure Principle Type AWWA C511, except pressure drop at rated flow shall not exceed 100 kPa (15 psi). Gate valves installed on the assembly shall be resilient seated valve conforming to AWWA C509.

B. Fire Service: Double detector check valve. AWWA C510 and NFPA 14.

C. In cold climate areas, backflow assemblies and devices shall be protected from freezing by a method acceptable to local jurisdiction.
D. Backflow preventers shall be approved by the Foundation for Cross-Connection Control and Hydraulic Research per current edition of the Manual of Cross-Connection Control.
E. Backflow preventer shall not be located in any area containing fumes that are toxic, poisonous or corrosive.
F. Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow protection.
G. Backflow preventer shall be accessed and have clearance for the required testing, maintenance and repair. Access and clearance shall require a minimum of one (1) foot (305 mm) between the lowest portion of the assembly and grade, floor or platform. Installations elevated more than five (5) feet (1524 mm) above the floor or grade shall be provided with a permanent platform capable of supporting a tester or maintenance person.

2.10 WATER METER:

Furnished and set by Water Service Utility.

2.11 VAULTS (BACKFLOW PREVENTER OR METER):

A. Top and base shall be reinforced concrete.
B. Walls shall be reinforced concrete, precast concrete, or segmental block (ASTM C139).

2.12 CAST IRON FRAME AND COVER, STEPS, ETC.:

Cast iron frame and cover, steps, etc. shall comply with State Department of Transportation standard details. Identify cover as “WATER”.

2.13 FLEXIBLE EXPANSION JOINTS: (PROVIDE FOR DOMESTIC AND FIRE SERVICE)

Ductile iron with ball joints rated for 1725 kPa (250 PSI) working pressure conforming to ANSI/AWWA A21.53/C153, capable of deflecting a minimum of 30 degrees and expanding simultaneously to the amount shown on the drawings. Flexible expansion joint shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure containing parts shall be lined with a minimum of 375 µm (15 mils) of fusion bonded epoxy conforming to the applicable

requirements of ANSI/AWWA C213 and shall be factory holiday tested with a 1500 volt spark test. Flexible expansion joint shall have flanged connections conforming to ANSI/AWWA A21.11/C110. Bolts and nuts high strength steel with synthetic gaskets that comply with AWWA C110.

2.14 POTABLE WATER:

Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.15 DISINFECTION CHLORINE:

A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
B. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5.g tablets, and shall contain 65 percent chlorine by weight.

2.16 WARNING TAPE

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, non-detectable type, blue with black letters, and imprinted with “CAUTION BURIED WATER LINE BELOW”.

PART 3 - EXECUTION

3.1 BUILDING SERVICE LINES:

Install water service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed provide temporary caps.

3.2 REGRADING:

Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

3.3 PIPE LAYING, GENERAL:

A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the Resident Engineer.
B. All pipe and fittings shall be subjected to a careful inspection just prior to being laid or installed. If any defective piping is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional expense to the Government. All pipe and fittings shall be thoroughly cleaned before

laying, shall be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.

C. All buried piping shall be installed to the lines and grades as shown on the drawings. All underground piping shall slope uniformly between joints where elevations are shown.

D. Contractor shall exercise extreme care when installing piping to shore up and protect from damage all existing underground water line and power lines, and all existing structures.

E. Do not lay pipe on unstable material, in wet trench, or when trench or weather conditions are unsuitable.

F. Do not lay pipe in same trench with other pipes or utilities unless shown otherwise on drawings.

G. Hold pipe securely in place while joint is being made.

H. Do not walk on pipes in trenches until covered by layers of earth well tamped in place to a depth of 300 mm (12 inches) over pipe.

I. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.

J. Tees, plugs, caps, bends and hydrants on pipe installed underground shall be anchored. See section 3.7 “PIPE SUPPORTS”.

K. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water and chemical, or mechanical injury. At completion of all work, thoroughly clean exposed materials and equipment.

L. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the manufacturer.

M. Warning tape shall be continuously placed 300 mm (12 inches) above buried water pipes.

3.4 DUCTILE IRON PIPE:

A. Installing Pipe: Lay pipe in accordance with AWWA C600 with polyethylene encasement if required in accordance with AWWA C105. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.

B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.

C. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Cement lining shall be undamaged.

D. Jointing Ductile-Iron Pipe:

1. Push-on joints shall be made in strict accordance with the manufacturer’s instruction. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home with approved means.
2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening the bolts. Bolts shall be tightened to the specified torque.
3. Ball Joints: Install in strict accordance with the manufacturer’s instructions. Where ball joint assemblies occur at the face of structures, the socket end shall be at the structure and ball end assembled to the socket.
4. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

3.5 COPPER PIPE:

Copper piping shall be installed in accordance with the Copper Development Association’s Copper Tube Handbook and manufacturer’s recommendations. Copper piping shall be bedded in 150 mm (6 inches) of sand and then back filled as specified in Section 31 20 00, EARTH MOVING.

3.6 PIPE SUPPORTS:

A. Supports:

1. All piping shall be properly and adequately supported. Hangers, supports, base elbows and tees, and concrete piers and pads shall be provided as indicated on the drawings. If the method of support is not indicated on the drawings, exposed piping shall be supported by hangers wherever the structure is suitable and adequate to carry the superimposed load. Supports shall be placed approximately 2.4 m (8 feet) on centers and at each fitting.
2. Hangers shall be heavy malleable iron of the adjustable swivel type, split ring type, or the adjustable-swivel, pipe-roll type for horizontal piping and adjustable, wrought iron, clamp type for vertical piping. Flat steel strap or chain hangers are not acceptable unless indicated on the drawings.
3. Hangers shall be attached to the structure, where possible, by beam clamps and approved concrete inserts set in the forms before concrete is poured. Where this method is impractical, anchor bolts with expanding lead shields, rawl drives, or malleable iron expansion shields will be permitted.
4. Where hangers cannot be used, the Contractor shall provide pipe saddle supports with pipe column and floor flange.

3.7 RESTRAINED JOINTS:

A. Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained “locked-type” joints and the joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure but not less than 1375 kPa (200 psi). The pipe and fittings shall be restrained push-on joints or restrained mechanical joints.

B. The minimum number of restrained joints required for resisting force at fittings and changes in direction of pipe shall be determined from the length of retained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Restrained pipe length shall be as shown on the drawings.

C. Restrained joint assemblies with ductile iron mechanical joint pipe shall be “Flex-Ring”, “Lok-Ring”, or mechanical joint coupled as manufactured by American Cast Iron Pipe Company, “Mega-Lug” or approved equal.

D. Ductile iron pipe bell and spigot joints shall be restrained with EBBA Iron Sales, Inc. Series 800 Coverall or approved equal.

E. Ductile iron mechanical joint fittings shall be restrained with EBBA Iron Sales, Inc. Series 1200 Restrainer. The restraining device shall be designed to fit standard mechanical joint bells with standard T head bolts conforming to AWWA C111 and AWWA C153. Glands shall be manufactured of ductile iron conforming to ASTM A536. Set screws shall be hardened ductile iron and require the same torque in all sizes. Steel set screws not permitted. These devices shall have the stated pressure rating with a minimum safety factor of 2:1. Glands shall be listed with Underwriters Laboratories and/or approved by Factory Mutual.

F. Thrust blocks shall not be permitted.

G. Where ductile iron pipe manufactured with restrained joints is utilized, all restrained joints shall be fully extended and engaged prior to back filling the trench and pressurizing the pipe.

H. PVC pipe bell and spigot joints shall be restrained with the Uni-Flange Corp. Series 1350 Restrainer or approved equal. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.

I. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained with UNI-Flange Corp. Series 1300 Restrainer, EBBA Iron, Inc, Series 2000PV Mechanical Joint Restrainer Gland, or approved equal. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A-536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.

3.8 PIPE SEPARATION:

A. Horizontal Separation-Water Mains and Sewers:

1. Water mains shall be located at least 3 m (10 feet) horizontally from any proposed drain, storm sewer, sanitary or sewer service connection.
2. Water mains may be located closer than 3 m (10 feet) to a sewer line when:

a. Local conditions prevent a lateral separation of 3 m (10 feet); and
b. The water main invert is at least 450 mm (18 inches) above the crown of the sewer; and
c. The water main is either in a separate trench or in the same trench on an undisturbed earth shelf located one side of the sewer.

3. When it is impossible to meet (1) or (2) above, both the water main and drain or sewer shall be constructed of mechanical joint ductile iron pipe. Ductile iron pipe shall comply with the requirements listed in this specification section. The drain or sewer shall be pressure tested to the maximum expected surcharge head before back filling.

B. Vertical Separation-Water Mains and Sewers:

1. A water main shall be separated from a sewer so that its invert is a minimum of 450 mm (18 inches) above the crown of the drain or sewer whenever water mains cross storm sewers, sanitary sewers or sewer service connections. The vertical separation shall be maintained for that portion of the wear main located within 10 feet horizontally of any sewer or drain crossed. A length of water main pipe shall be centered over the sewer to be crossed with joints equidistant from the sewer or drain.
2. Both the water main and sewer shall be constructed of slip-on or mechanical joint ductile iron pipe when:
   a. It is impossible to obtain the proper vertical separations described in (1) above; or
   b. The water main passes under a sewer or drain.
3. A vertical separation of 450 mm (18 inches) between the invert of the sewer or drain and the crown of the water main shall be maintained where a water main crosses under a sewer. Support the sewer or drain lines to prevent settling and breaking the water main.
4. Construction shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer or drain line is at least 3 m (10 feet). Sewer line shall be encased in concrete for a minimum of 3 m (10 feet) on each side of the crossing.

3.9 SETTING OF VALVES AND BOXES:

A. Provide a surface concrete pad 450 by 450 by 150 mm (18 by 18 by 6 inches) to protect valve box when valve is not located below pavement.
B. Clean valve and curb stops interior before installation.
C. Set valve and curb stop box cover flush with finished grade.
D. Valves shall be installed plumb and level and in accordance with manufacturer’s recommendations.

3.10 SETTING OF FIRE HYDRANTS:

A. Set center of each hydrant not less than 600 mm (2 feet) nor more than 1800 mm (6 feet) back of edge of road or face of curb. Fire apparatus connection shall face road with center of nozzle 450 mm (18 inches) above finished grade. Set barrel flange not more than 50 mm (2 inches) above finished grade.
B. Set each hydrant on a slab of stone or concrete not less than 100 mm (4 inches) thick and 375 mm (15 inches) square. The service line to the hydrant, between the tee and the shoe of the hydrant, shall be fully restrained.
C. Set bases in not less than 0.4 cubic meter (1/2 cubic yard) of crushed rock or gravel placed entirely below hydrant drainage device.
D. Clean interiors of hydrants of all foreign matter before installation.

3.11 PIPE SLEEVES:

Install where water lines pass through retaining walls, building foundations and floors. Seal with modular mechanical type link seal. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

3.12 FLUSHING AND DISINFECTING:

A. Flush and disinfect new water lines in accordance with AWWA C651.
B. Initial flushing shall obtain a minimum velocity in the main of 0.75 m/sec (2.5 feet per second) at 40 PSI residual pressure in water main. The duration of the flushing shall be adequate to remove all particles from the line.

Pipe Diameter		Flow Required to Produce 2.5 ft/sec(approx.) Velocity in Main		Number of Hydrant Outlets			
				Size of Tap. in. (mm)			
				1(25)	1 ½(38)	2(51)	2 1/2-in (64 mm)
In	(mm)	gpm	(L/sec)	Number of taps on pipe			

4	(100)	100	(6.3)	1	--	--	1
6	(150)	200	(12.6)	--	1	--	1
8	(200)	400	(25.2)	--	2	1	1
10	(250)	600	(37.9)	--	3	2	1
12	(300)	900	(56.8)	--	--	3	2
16	(400)	1,600	(100.9)	--	--	4	2

The backflow preventers shall not be in place during the flushing.

C. The Contractor shall be responsible to provide the water source for filling, flushing, and disinfecting the lines. Only potable water shall be used, and the Contractor shall provide all required temporary pumps, storage facilities required to complete the specified flushing, and disinfection operations.

D. The Contractor shall be responsible for the disposal of all water used to flush and disinfect the system in accordance with all governing rules and regulations. The discharge water shall not be allowed to create a nuisance for activities occurring on or adjacent to the site.

E. The bacteriological test specified in AWWA C651 shall be performed by a laboratory approved by the Water Purveyor. The cost of sampling, transportation, and testing shall be the responsibility of the Contractor.

F. Re-disinfection and bacteriological testing of failed sections of the system shall be the sole responsibility of the Contractor.

G. Before backflow preventers are installed, all upstream piping shall be thoroughly flushed.

3.13 HYDROSTATIC TESTING:

A. Hydrostatic testing of the system shall occur prior to disinfecting the system.

B. After new system is installed, except for connections to existing system and building, backfill at least 300 mm (12 inches) above pipe barrel, leaving joints exposed. The depth of the backfill shall be adequate to prevent the horizontal and vertical movement of the pipe during testing.

C. Prior to pressurizing the line, all joint restraints shall be completely installed and inspected.

D. If the system is tested in sections, and at the temporary caps at connections to the existing system and buildings, the Contractor shall provide and install all required temporary thrust restraints required to safely conduct the test.

E. The Contractor shall install corporation stops in the line as required to purge the air out of the system. At the completion of the test, all corporation stops shall be capped.

F. The Contractor shall perform pressure and leakage tests for the new system for 2 hours to 1375 kPa (200 psi). Leakage shall not exceed the following requirements.

1. Copper Tubing: No leaks.
2. Ductile Iron Pipe: AWWA C600.Provide to Resident Engineer office.

3.14 BACKFLOW PREVENTOR TESTING:

A. All backflow preventers shall be tested and certified for proper operation prior to being placed in operation.

B. Original copies of the certification shall be submitted to the Resident Engineer.

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SECTION 333000
SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

Outside, underground sanitary sewer system, complete, ready for operation, including all gravity flow lines manholes, cleanouts, frames, covers, structures, appurtenances, and connections to new building and structure, service lines, existing sanitary sewer lines, and existing sanitary structures, and all other incidentals.

1.2 RELATED WORK:

A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.

B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING. Dewatering: Section 31 23 19, DEWATERING.

C. Concrete Work Reinforcing, Placement and Finishing; Section 03 30 00, CAST-IN-PLACE CONCRETE Section 03 30 53, MISCELLANEOUS CAST-IN-PLACE CONCRETE.

D. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 QUALITY ASSURANCE:

A. Products Criteria:

1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, including model number, securely affixed in a conspicuous place on equipment, or name or trademark, including model number cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturers' Literature and Data: Submit the following as one package:

1. Pipe, Fittings, and, Appurtenances.
2. Jointing Material.
3. Manhole and Structure Material.
4. Frames and Covers.
5. Steps.

1.5 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A48/A48M-03.....Gray Iron Castings
A536-84(2004).....Ductile Iron Castings
A615/A615M-06.....Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
C150-05.....Portland Cement
C478-06a/C478M-06a.....Precast Reinforced Concrete Manhole Sections
C857-95(2001).....Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
D698-00ae1.....Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
D2321-05.....Underground Installation of Thermoplastic Pipes for Sewers and Other Gravity-Flow Applications
D2412-02.....Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
D3034-04a.....Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3212-96a (2003) e1.....Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

D4101-05a.....Polypropylene Injection and Extrusion Materials
F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F679-06.....Poly (vinyl chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

C. American Association of State Highway and Transportation Officials AASHTO):
M198-05.....Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants

D. Uni-Bell PVC Pipe Association:
Uni-B-6-98.....Recommended Practice Low Pressure Air Testing of Installed Sewer Pipe

PART 2 - PRODUCTS

2.1 PIPING:

A. Gravity Flow Lines (Pipe and Fittings):

1. Polyvinyl Chloride (PVC):

a. Pipe and Fittings, 100 to 375 mm (4 to 15 inches) in diameter, shall conform to ASTM D3034, Type PSM, SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D3212. Gaskets shall conform to ASTM F477. Solvent welded joints shall not be permitted.

2.2 JOINTING MATERIAL:

A. Gravity Flow Lines:

1. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.

2.3 MANHOLES AND VAULTS:

A. Manholes and vaults shall be constructed of precast reinforced concrete rings or precast reinforced sections. The manholes and vaults shall be in accordance with State Department of Transportation or State Roads Commission standard details, and the following:

1. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to

requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.

2. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
3. Flat top manhole tops shall be reinforced concrete rated for AASHTO HS20-44 loading.
4. Mortar:
   a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, l/4 part lime hydrate, and 3 parts sand.
   b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21 L (5-l/2 gallons) per sack of cement.
5. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M198.
6. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words “sanitary sewer”. The studs and the lettering shall be raised 8 mm (5/16 inch). The cover shall be a minimum of 600 mm (24 inches) in diameter and shall have four 19 mm (3/4 inch) vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
7. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 406 mm (16 inches) wide and project a minimum of 178 mm (7 inches) away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.

2.4 CONCRETE:

Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

2.5 REINFORCING STEEL:

Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.6 CLEANOUT FRAMES AND COVERS:

Frames and covers shall be gray iron casting conforming to ASTM C48. The frame and cover shall be rated for HS20-44 wheel loading, have a studded pattern on its cover, vent holes, and lifting slots. The cover shall fit firmly on the frame without movement when subject to vehicular traffic. The word “SEWER” shall be cast on the cover.

2.7 WARNING TAPE:

Standard, .1mm (4Mil) polyethylene 76 mm (3 inch) wide tape detectable non-detectable type, green with black letters and imprinted with “CAUTION BURIED SEWER LINE BELOW”.”

PART 3 - EXECUTION

3.1 BUILDING SERVICE LINES:

A. Install sanitary sewer service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.

B. Connections of service line to building piping shall be made after the new sanitary sewer system has been constructed, tested, and accepted for operation by the Resident Engineer. The Contractor shall install all temporary caps or plugs required for testing.

C. When building services have not been installed at the time when the sanitary sewer system is complete, provide temporary plugs or caps at the ends of all service lines. Mark the location and depth of the service lines with continuous warning tape placed 300 mm (12 inches) above service lines.

3.2 ABANDONED MANHOLES STRUCTURES AND PIPING:

A. Piping under and within 1500 mm (5 feet) of building areas shall be completely removed.
B. Piping outside of building areas shall have all ends of the piping at the limit of the abandonment and within structures and manholes, plugged with concrete, and abandoned in-place.
C. The Contractor shall comply with all OSHA confined space requirements while working within existing manholes and structures.
D. When the limit of the abandonment terminates in an existing manhole to remain, the flow line in the bench of the manhole to the abandoned line shall be filled with concrete and shaped to maintain the flowline of the lines to remain.

3.3 REGRADING:

A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.4 CONNECTIONS TO EXISTING VA OWNED MANHOLES:

A. During construction of new connections to existing manholes, it shall be the sole responsibility of the Contractor to maintain continued sanitary sewer service to all buildings and users upstream. The contractor shall provide, install, and maintain all pumping, conveyance system, dams, weirs, etc. required to maintain the continuous flow of sewage. All temporary measures required to meet this requirement shall be subject to the review of the Resident Engineer.

B. Core existing structure, install pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.
C. The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all pipes connected to the manhole.
D. Connections and alterations to existing manholes shall be constructed so that finished work conforms as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting and shaping.

3.5 CONNECTIONS TO EXISTING PUBLIC UTILITY COMPANY MANHOLES:

A. Comply with all rules and regulations of the public utility.
B. The connection to the existing utility shall comply with the standard details and specifications of the public utility company, except as specifically modified on the plans and specifications.

3.6 PIPE SEPARATION:

A. Horizontal Separation - Water Mains and Sewers:
1. Existing and proposed water mains shall be at least 3 meters (10 feet) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
2. Gravity flow mains and pressure (force) mains may be located closer than 3 meters (10 feet) but not closer than 1.8 m (6 feet) to a water main when:
a. Local conditions prevent a lateral separation of ten feet; and
b. The water main invert is at least 450 mm (18 inches) above the crown of the gravity sewer or 600 mm (24 inches) above the crown of the pressure (force) main; and
c. The water main is in a separate trench separated by undisturbed earth.
3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe. The pipe for the sanitary sewer main shall comply with the specifications for pressure (force) mains, and the water main material shall comply with Section 33 10 00, WATER UTILITIES. The sewer shall be pressure tested as specified for pressure (force) mains before backfilling.

B. Vertical Separation - Water Mains and Sewers at Crossings:
   1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 600 mm (24 inches) above the crown of gravity flow sewer or 1200 mm (48 inches) above the crown of pressure (force) mains. The vertical separation shall be maintained within 3 meters (10 feet) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
   2. In no case shall pressure (force) sanitary main cross above, or within 600 mm (24 inches) of water lines.
   3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 450 mm (18 inches) above or 300 mm (12 inches) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 600 mm (24 inches) below the water line provided both the water line and sewer line are constructed of ductile iron pipe. The pipe for the sewer shall conform to the requirements for pressure sewers specified herein. Piping for the water main shall conform to Section 33 10 00, WATER UTILITIES.
   4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 3 meters (10 feet).

3.7 GENERAL PIPING INSTALLATION:

A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade. Pressure (force) mains shall have the bells facing the direction of flow.
B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.

E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
G. Do not lay sewer pipe in same trench with another pipe or other utility. Sanitary sewers shall cross at least 600 mm (2 feet) below water lines.
H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 300 mm (12 inches) over the crown of the pipe.
I. Warning tape shall be continuously placed 300 mm (12 inches) above sewer pipe
J. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
   1. Polyvinyl Chloride (PVC) Piping: ASTM D2321.

3.8 MANHOLES AND VAULTS:

A. General:
   1. Circular Structures:
      a. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top, shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
      b. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.
   2. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
   3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:

a. Forming directly in concrete base of structure.
b. Building up with brick and mortar.

4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (1-inch per foot) nor more than 1:6 (2 inches per foot). Bottom slab and benches shall be concrete.
5. The wall that support access rungs shall be 90 degrees vertical from the floor of structure to manhole cover.
6. Install steps per the manufacturer’s recommendations. Steps shall not move or flex when used. All loose steps shall be replaced by the Contractor.
7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.9 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES:

Reinforced concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

3.10 CLEANOUTS:

A. 150 millimeters (6 inches) in diameter and consisting of a ductile iron 45 degree fitting on end of run, or combination Y fitting and l/8 bend in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Center-set cleanouts, located in unpaved areas, in a 300 by 300 by 150 mm (12 by 12 by 6 inches) thick concrete slab set flush with adjacent finished grade. Where cleanout is in force main, provide a blind flange top connection. The center of the flange shall be equipped with a 50 mm (2 inches) base valve to allow the pressure in the line to be relieved prior to removal of the blind flange. Frames and covers for pressure (force) mains shall be 600 mm (24 inches) in diameter.

B. The top of the cleanout assembly shall be 50 mm (2 inches) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.11 INSPECTION OF SEWERS:

Inspect and obtain the Resident Engineer's approval. Thoroughly flush out before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lip at joints on the inside of gravity sewer lines are not acceptable.

3.12 TESTING OF SANITARY SEWERS:

A. Gravity Sewers and Manholes (Select one of the following):

1. Air Test: Vitrified Clay Pipe ASTM C828. PVC Pipe, Uni-Bell Uni-B-6. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 28 kPa (4 psi) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 24 kPa (3.5 psi) greater than the average back-pressure of any groundwater above the sewer. The minimum test time shall be as specified in Uni-Bell Uni-B-6.
2. Exfiltration Test:
   a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During one hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11 L (3.0 gallons) per hour per 30 m (100 feet).
   b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.
3. Infiltration Test: If ground water level is greater than 900 mm (3 feet) above invert of the upper manhole, infiltration tests are

acceptable. Allowable leakage for this test will be the same as for the exfiltration test.

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SECTION 334000

STORM SEWER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.2 RELATED WORK

A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.

B. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 00, CAST-IN-PLACE CONCRETE.

C. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

D. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.

E. Materials and Testing Report Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

F. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 ABBREVIATIONS

A. HDPE: High-density polyethylene

B. PE: Polyethylene

C. RCP: Reinforced Concrete Pipe

D. PVC: Polyvinyl Chloride

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Handle manholes, catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.5 COORDINATION

A. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.

B. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

1.6 QUALITY ASSURANCE:

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.7 SUBMITTALS

A. Manufacturers' Literature and Data shall be submitted, as one package, for pipes, fittings and appurtenances, including jointing materials, hydrants, valves and other miscellaneous items.

1.8 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A185/A185M-07.....Steel Welded Wire Reinforcement, Plain, for Concrete

A242/A242M-04(2009).....High-Strength Low-Alloy Structural Steel

A536-84(2009).....Ductile Iron Castings

A615/A615M-09b.....Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

A760/A760M-10.....Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

A798/A798M-07.....Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications

A849-10.....Post-Applied Coatings, Paving, and Linings for Corrugated Steel Sewer and Drainage Pipe

A929/A929M-01(2007).....Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe

B745/B745M-97(2005).....Corrugated Aluminum Pipe for Sewers and Drains

B788/B788M-09.....Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe

C14-07.....Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe

C33/C33M-08.....Concrete Aggregates

C76-11.....Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

C139-10.....Concrete Masonry Units for Construction of Catch Basins and Manholes

C150/C150M-11.....Portland Cement

C443-10.....Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

C478-09.....Precast Reinforced Concrete Manhole Sections

C506-10b.....Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe

C507-10b.....Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe

C655-09.....Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe

C857-07.....Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

C891-09.....Installation of Underground Precast Concrete Utility Structures

C913-08.....Precast Concrete Water and Wastewater Structures

C923-08.....Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

C924-02(2009).....Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method

C990-09.....Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

C1103-03(2009).....Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

C1173-08.....Flexible Transition Couplings for Underground Piping Systems

C1433-10.....Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers

C1479-10.....Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations

D448-08.....Sizes of Aggregate for Road and Bridge Construction

D698-07e1.....Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))

D1056-07.....Flexible Cellular Materials—Sponge or Expanded Rubber

D1785-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D2321-11.....Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D2751-05.....Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings

D2774-08.....Underground Installation of Thermoplastic Pressure Piping

D3034-08.....Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

D3350-10.....Polyethylene Plastics Pipe and Fittings Materials

D3753-05e1.....Glass-Fiber-Reinforced Polyester Manholes and Wetwells

D4101-11.....Polypropylene Injection and Extrusion Materials

D5926-09.....Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems

F477-10.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F679-08.....Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

F714-10.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

F794-03(2009).....Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

F891-10.....Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core

F894-07.....Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

F949-10.....Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

F1417-11.....Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

F1668-08.....Construction Procedures for Buried Plastic Pipe

C. American Association of State Highway and Transportation Officials (AASHTO):

M190-04.....Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches

M198-10.....Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

M252-09.....Corrugated Polyethylene Drainage Pipe

M294-10.....Corrugated Polyethylene Pipe, 12 to 60 In. (300 to 1500 mm) Diameter

D. American Water Works Association(AWWA):

C105/A21.5-10.....Polyethylene Encasement for Ductile iron Pipe Systems

C110-08.....Ductile-Iron and Gray-Iron Fittings

C219-11.....Bolted, Sleeve-Type Couplings for Plain-End Pipe

C600-10.....Installation of Ductile iron Mains and Their Appurtenances

C900-07.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

M23-2nd ed.....PVC Pipe ”Design And Installation”

E. American Society of Mechanical Engineers (ASME):

A112.6.3-2001.....Floor and Trench Drains

A112.14.1-2003.....Backwater Valves

A112.36.2M-1991.....Cleanouts

F. American Concrete Institute (ACI):

318-05.....Structural Commentary and Commentary

350/350M-06.....Environmental Engineering Concrete Structures and Commentary

G. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for Erosion and Sediment Control

1.9 WARRANTY

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of two years from final acceptance. Further, the Contractor will furnish all manufacturers’ and suppliers’ written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements. The Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 PE PIPE AND FITTINGS

A. Profile Wall PE Pipe: Pipe shall comply with ASTM F894, Class 160.
   1. Profile Wall PE Plastic Pipe Joints: Joints shall be as per ASTM F894, gasket or thermal weld type with integral bell.

B. PVC Type PSM Sewer Piping
   1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends.
   2. Fittings: ASTM D3034, PVC with bell ends.
   3. Gaskets: ASTM F477, elastomeric seals.

2.3 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete sewer pipe and fittings shall be ASTM C76 or ASTM C655.
   1. Bell-and-spigot ends and gasketed joints with ASTM C443, rubber gaskets.
   2. Class III: Wall B
   3. Class V: Wall B

2.4 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials
   1. For concrete pipes: ASTM C443, rubber.
   2. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
   3. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, flexible couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.5 CLEANOUTS

A. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

2.6 MANHOLES AND CATCH BASINS

A. Standard Precast Concrete Manholes:

1. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6 inch (150 mm) minimum thickness for floor slab and 4-inch (102 mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4 inch (102 mm) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.

9. Steps: If total depth from floor of manhole to finished grade is greater than 60 inches (1500 mm). ASTM A615, deformed, 1/2 inch (13 mm) steel reinforcing rods encased in ASTM D4101, PP //, width of 16 inches (400 mm) minimum, spaced at 12 to 16 inch (300 to 400 mm) intervals.
10. Adjusting Rings: Reinforced-concrete rings, 6 to 9 inch (150 to 225 mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:
1. Description: Ferrous; 24 inch (610 mm) ID by 7 to 9 inch (175 to 225 mm) riser with 4 inch (102 mm) minimum width flange and 26-inch (600 mm) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A536, Grade 60-40-18 ductile, ASTM A48/A48M, Class 35 gray iron unless otherwise indicated.

2.7 CONCRETE FOR MANHOLES AND CATCH BASINS

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:
1. Cement: ASTM C150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C33, crushed gravel.
4. Water: Potable.

B. Concrete Design Mix: 4000 psi (27.6 MPa) minimum, compressive strength in 28 days.
1. Reinforcing Fabric: ASTM A185, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.
1. Channels: Main line pipe material or concrete invert. Height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same

slope as the main line pipe. Bench to be concrete, sloped to drain into channel. Minimum of 6 inch slope from main line pipe to wall sides.

2.8 PIPE OUTLETS

A. Head walls: Precast reinforced concrete, with apron and tapered sides.

B. Riprap basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size: NSSGA No. R-5, screen opening 5 inches (127 mm).

C. Filter Stone: NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size graded stone.

D. Energy Dissipaters: To be as per NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton (2721-kg) average weight armor stone, unless otherwise indicated.

2.9 HEADWALLS

A. Headwalls: Precast concrete with a minimum compressive strength of 3000 psi (20 MPa) at 28 days.

2.10 FLARED END SECTIONS

A. Flared End Sections: Precast concrete with a minimum compressive strength of 3000 psi (20 MPa) at 28 days.

2.11 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS FOR BUILDING ROOF DRAINS

A. Resilient connectors and downspout boots: Flexible, watertight connectors used for connecting pipe to manholes and inlets, and shall conform to ASTM C923.

2.12 WARNING TAPE

A. Standard, 4-Mil polyethylene 3 inch (76 mm) wide tape non-detectable type, purple with black letters, and imprinted with “CAUTION BURIED STORM SEWER BELOW”.

PART 3 - EXECUTION

3.1 PIPE BEDDING

A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe

requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

3.2 PIPING INSTALLATION

A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping with 12 inch (300 mm).

C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.

5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
6. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches (300 mm) over the crown of the pipe.
7. Warning tape shall be continuously placed 12 inches (300 mm) above storm sewer piping.

D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

F. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

G. Install gravity-flow, nonpressure drainage piping according to the following:
1. Install piping pitched down in direction of flow.
2. Install PE corrugated sewer piping according to ASTM D2321 with gasketed joints.
3. Install PVC cellular-core piping, PVC sewer piping, and PVC profile gravity sewer piping, according to ASTM D2321 and ASTM F1668.
4. Install reinforced concrete sewer piping according to ASTM C1479.

3.3 REGRADING

A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.

B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

3.4 CONNECTIONS TO EXISTING VA-OWNED MANHOLES

A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.5 CONNECTIONS TO EXISTING PUBLIC UTILITY MANHOLES

A. Comply with all rules and regulations of the public utility.

B. Cleanout Installation

1. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast iron soil pipe fittings in sewer pipes at branches for cleanouts and cast iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
   a. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
   b. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
   c. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
   d. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
2. Set cleanout frames and covers in earth in cast in-place concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 DRAIN INSTALLATION

A. Install type of drains in locations indicated.
   1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
   2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
   3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
   4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Embed drains in 4 inch (102 mm) minimum concrete around bottom and sides.

C. Set drain frames and covers with tops flush with pavement surface.

3.7 MANHOLE INSTALLATION

A. Install manholes, complete with appurtenances and accessories indicated. Install precast concrete manhole sections with sealants according to ASTM C891.

B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops flush with finished surface elsewhere unless otherwise indicated.

C. Circular Structures:
   1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 1/2 inch (15 mm) or cement mortar applied with a trowel and finished to an even glazed surface.
   2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.

3. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

D. Rectangular Structures:

1. Precast concrete structures shall be placed on a 8 inch (200 mm) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on an 8 inch (200 mm) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
2. Do not build structures when air temperature is 32 deg F (0 deg C), or below.
3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
   a. Forming directly in concrete base of structure.
   b. Building up with brick and mortar.
4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1 to 12 or more than 1 to 6. Bottom slab and benches shall be concrete.
5. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.
6. Install steps and ladders per the manufacturer’s recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be flush with the adjacent

finish grade. Install an 8 inch (203 mm) thick, by 12 inch (300 mm) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.8 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.9 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete.

B. Construct riprap of broken stone.

C. Install outlets that spill onto grade, anchored with concrete.

D. Install outlets that spill onto grade, with flared end sections that match pipe.

E. Construct energy dissipaters at outlets.

3.10 CONNECTIONS

A. Connect nonpressure, gravity-flow and drainage piping in building's storm building drains specified in Division 22 Section FACILITY STORM DRAINAGE PIPING.

B. Encase entire connection fitting, plus 6 inch (150 mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping.

3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to

conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Shielded flexible couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
2. Use pressure-type pipe couplings for force-main joints.

3.11 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8 inch (203 mm) thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.

2. Remove top of manhole or structure down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with stone, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section EARTH MOVING.

3.12 IDENTIFICATION

A. Install green warning tape directly over piping and at outside edge of underground structures.

3.13 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

3.14 TESTING OF STORM SEWERS:

A. Submit separate report for each test.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
4. Submit separate report for each test.
5. Air test gravity sewers. Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.

C. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.15 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

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