DEPARTMENT OF VETERANS AFFAIRS
Carl Vinson VA Medical Center

1826 Veterans Boulevard
Dublin, Georgia 31021

New Hospice Care Unit
VA Project No. 557-CSI-375
Seed Project: Location 2 - Georgia

Solicitation # RFP VA-247-11-RP-0205
Issue Date: February 16, 2012
RFP Due Date: March 20, 2012; 9:00 a.m. Eastern Time

A pre-bid conference and site investigation will be conducted by the Resident Engineer and Contracting. Note: Please confirm attendance at this conference / site visit, Refer to Instructions, Conditions, and Notices to Offerors or Quoters, Far Clause **52.236-27 SITE VISIT (CONSTRUCTION) (FEB 1995)-ALTERNATE 1 (FEB 1995)**

DEPARTMENT OF VETERANS AFFAIRS
VHA MASTER SPECIFICATIONS

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SECTION 01 00 00

GENERAL REQUIREMENTS

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SECTION 01 00 00

GENERAL REQUIREMENTS

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 construction of a New 12-Bed Inpatient Hospice Care Unit at the Carl Vinson VA Medical Center as required by drawings and specifications.

B. Visits to the site by Bidders may be made only by appointment with the COTR.

C. Offices of JM Smith Engineering, LLC and Matrix Architects Incorporated, 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 COTR 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 COTR.

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. Safety:

1. 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. OSHA certified "competent person" cannot be the job site superintendent.
2. Contractor shall provide proof that a safety representative will maintain a presence at the work site whenever the general or subcontractors are present. The safety representative may be the OSHA certified "competent person," if workplace hazards do not warrant additional safety oversight.

3. Contractor shall document daily safety meetings on the daily logs turned into the COTR. Safety meetings shall highlight any safety issues that will be encountered during the work day and shall list all hazardous conditions and the associated competent person that will be inspecting the preventative measures and overseeing the hazardous condition. The OSHA Required Competent Person inspections that must be documented on daily safety reports include, but are not limited to, asbestos work, assured equipment grounding, concrete slab lift operations, cranes and derricks, demolition, material chutes, fall protection, hot work, ladders, lead work, lockout, means of egress, penetrations, personnel hoists, power transmission lines, rigging equipment, scaffolding, and trenching/excavations. The required Competent Person inspections are the contractor's responsibility with VA providing oversight.
4. Contractor must comply with VA Lockout/Tagout policy. Written permits must be approved for confined space entry, excavations deeper than 15", hot work, live electrical work, and creating any hole or penetration in floors, walls, or ceilings. Except for hot work operations or actual emergencies, these tasks require a 24-hour advanced notice to allow for proper planning and adequate task review. Work will not commence for any of these tasks until Fire Department approval is received.
5. Contractors are expected to independently provide properly trained personnel and all safety equipment necessary for the contracted work including, but not limited to, personal protective equipment (i.e., safety glasses, face shields, ear plugs, hard hats, steel-toed footwear, flame-retardant clothing, gloves, etc.), atmospheric testing devices (such as "four-gas" monitors), confined space retrieval or extraction gear (harnesses, tripods, etc.), fall prevention/protection devices, lockout locks/tags/devices, excavation shoring or "trench boxes," etc. Please note that lockout locks and tags used by the contractor must comply with Dublin VAMC requirements; COTR can provide specific details. Contractor is also responsible for having all MSDS's on their job site location.
6. Dublin VAMC reserves the right to temporarily terminate contractor operations, without financial penalty or other negative contract

implications, if instances of non-compliance with safety regulations or generally accepted safe work practices are observed. Operations will not resume until all safety issues have been resolved to the satisfaction of Dublin VAMC management.

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. In addition, the on-site superintendent, OSHA certified "competent person," and safety manager shall have the 30-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, GENERAL CONSTRUCTION: Work includes general construction, alterations, roads, walks, grading, drainage, mechanical and electrical work, utility systems, and necessary removal of existing structures and construction and certain other items.

B. BASE BID: All work specified or shown in the bid documents. Completion within 360 days. Contractor shall provide a cumulative bid for all of Base Bid.

C. DEDUCT ALTERNATE A: Furnish all Work associated with Base Bid less labor and material for the following. Completion within 360 days.

1. Delete Family Lounge 122-86 and Screened Porch 123-86. Add Porch 301-86. (Alternate No. G-3)

D. DEDUCT ALTERNATE B: Furnish all Work associated with Base Bid less labor and material for the following. Completion within 360 days.

1. Delete Family Lounge 122-86 and Screened Porch 123-86. Add Porch 301-86. (Alternate No. G-3)
   Delete Family Lounge 163-86 and Screened Porch 162-86. Add Porch 302-86. (Alternate No. G-4)

E. DEDUCT ALTERNATE C: Furnish all Work associated with Base Bid less labor and material for the following. Completion within 360 days.

1. Delete Family Lounge 122-86 and Screened Porch 123-86. Add Porch 301-86. (Alternate No. G-3)

Delete Family Lounge 163-86 and Screened Porch 162-86. Add Porch 302-86. (Alternate No. G-4)

Delete overhead patient lift in all patient rooms. Patient lift material and installation will be by Owner. (Alternate No. G-15)

F. DEDUCT ALTERNATE D: Furnish all Work associated with Base Bid less labor and material for the following. Completion within 360 days.

1. Delete Family Lounge 122-86 and Screened Porch 123-86. Add Porch 301-86. (Alternate No. G-3)

   Delete Family Lounge 163-86 and Screened Porch 162-86. Add Porch 302-86. (Alternate No. G-4)

   Delete overhead patient lift in all patient rooms. Patient lift material and installation will be by Owner. (Alternate No. G-15)

   Provide VCT flooring in lieu of VP flooring in all areas. VCT shall be selected from manufacturer’s full range of colors. (Alternate No. G-10)

G. Contractor is advised to ignore all references to Alternate No. G-1, G-2, G-5, G-6, G-7, G-8, G-9, G-11, G-12, G-13, G-14, G-16. These bid deducts have been removed from the solicitation. Bid Deducts are cumulative as written

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

A. AFTER AWARD OF CONTRACT, 10 sets of drawings and 2 sets of specifications will be furnished.

B. Additional sets of drawings may be made by the Contractor, at Contractor's expense, from computer files furnished by Issuing Office.

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 COTR 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. Key Control:
1. The General Contractor shall provide duplicate keys and lock combinations to the COTR 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.

D. Document Control:
1. Before starting any work, the General Contractor/Sub Contractors 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.
4. 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.
5. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
6. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.

7. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
8. 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.

E. 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):
   E84-2008.....Surface Burning Characteristics of Building Materials
2. National Fire Protection Association (NFPA):
   10-2006.....Standard for Portable Fire Extinguishers
   30-2007.....Flammable and Combustible Liquids Code
   51B-2003.....Standard for Fire Prevention During Welding, Cutting and Other Hot Work
   70-2007.....National Electrical Code
   241-2004.....Standard for Safeguarding Construction, Alteration, and Demolition Operations
3. Occupational Safety and Health Administration (OSHA):
   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 COTR 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 COTR 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 Construction Partitions:

1. Install and maintain temporary construction partitions to provide smoke-tight separations between construction areas and adjoining areas. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of fire retardant treated wood or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
2. Install fire-rated temporary construction partitions to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.
3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.

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

G. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with COTR.

H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COTR.

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

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

K. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.

L. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with COTR. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the COTR.

M. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with COTR.

N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COTR. Obtain permits from facility Safety Officer at least 8 hours in advance. Hot work permits are repuired for each day that hot work will be performed.

O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COTR.

P. 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.

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

R. 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 shown on the drawings.

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

F. 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. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly

by patients or medical personnel, and Contractor's personnel, except as permitted by COTR where required by limited working space.

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

G. Building(s) No.(s) 14, 16, and the New Wellness Center will be occupied during performance of work.

1. 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.

H. 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 COTR.

I. 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 COTR.

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 COTR. 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 COTR, in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption. No interruption of services should be planned to last more than 4 hours, unless absolutely unavoidable and approved by the COTR. Multiple crews may need to be positioned by the contractor during an outage to shorten the duration. This applies to all utilities, including electricity, domestic water, steam, chilled water, natural gas, and all medical gases.
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 COTR.
5. In case of a contract construction emergency, service will be interrupted on approval of COTR. 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.

J. 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.

K. 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 COTR.

L. Coordinate the work for this contract with other construction operations as directed by COTR. 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 COTR of areas of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report to the COTR. This report shall list by rooms and spaces:
1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of buildings.
2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by drawings to be either reused or relocated, or both.
3. Shall note any discrepancies between drawings and existing conditions at site.
4. 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 COTR.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COTR to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).

C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COTR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient 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.

D. 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.
3. Protection of interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

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. Prior to start of work, prepare a plan detailing project-specific dust protection measures, including periodic status reports, and submit to COTR 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.
   1. 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. In general, following preventive measures shall be adopted during construction to keep down dust and prevent mold.
   1. Dampen debris to keep down dust and provide temporary construction partitions in existing structures where directed by COTR. Blank off ducts and diffusers to prevent circulation of dust into occupied areas during construction.
   2. Do not perform dust producing tasks within occupied areas without the approval of the COTR. For construction in any areas that will remain jointly occupied by the medical Center and Contractor's workers, the Contractor shall:
      a. Provide dust proof fire-rated temporary drywall construction barriers to completely separate construction from the operational areas of the hospital in order to contain dirt debris and dust. Barriers shall be sealed and made presentable on hospital occupied side. Install a self-closing rated door in a metal frame, commensurate with the partition, to allow worker access. Maintain negative air at all times. A fire retardant polystyrene, 6-mil thick or greater plastic barrier meeting local fire codes may be used where dust control is the only hazard, and an agreement is reached with the COTR and Medical Center.
      b. HEPA filtration is required where the exhaust dust may reenter the breathing zone. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. Install HEPA (High Efficiency Particulate Accumulator) filter vacuum system rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. Insure continuous negative air pressures occurring within the work area. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Exhaust hoses shall be

heavy duty, flexible steel reinforced and exhausted so that dust is not reintroduced to the medical center.

c. Adhesive Walk-off/Carpet Walk-off Mats, minimum 600mm x 900mm (24” x 36”), shall be used at all interior transitions from the construction area to occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.

d. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as they are created. Transport these outside the construction area in containers with tightly fitting lids.

e. The contractor shall not haul debris through patient-care areas without prior approval of the COTR and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.

f. Using a HEPA vacuum, clean inside the barrier and vacuum ceiling tile prior to replacement. Any ceiling access panels opened for investigation beyond sealed areas shall be sealed immediately when unattended.

g. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.

h. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.

E. 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 COTR.
   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.

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 Contracting Officer.

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 COTR 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:

- Designating areas for equipment maintenance and repair;
- Providing waste receptacles at convenient locations and provide regular collection of wastes;
- Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
- Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
- 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 COTR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COTR 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.

1. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by ECS Southeast, LLC, 1281 Kennestone Circle, Suite 100, Marietta, Georgia 30066.

(FAR 52.236-4)

B. Subsurface conditions have been developed by core borings and test pits.

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

D. 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 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 Contracting Officer. 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 Contracting Officer 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, and 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 COTR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.

D. Contractor shall furnish to the COTR 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 COTR.

F. 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. An as-built review will be accomplished by the COTR prior to each construction payment request.

C. 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 COTR's review, as often as requested.

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

E. 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 COTR, 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 COTR. If the equipment is not installed and maintained in accordance with the following provisions, the COTR 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 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 COTR, 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.

1.19 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 COTR, 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 COTR'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 COTR's discretion), of use of steam from the Medical Center's system.

1.20 NEW TELEPHONE EQUIPMENT

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.

1.21 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 COTR. 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.

1.22 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 COTR 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 COTR and shall be considered concluded only when the COTR 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 COTR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.23 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. Notify COTR 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.

E. 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.

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

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

1.24 CONSTRUCTION SIGN

A. Provide a Construction Sign where directed by the COTR. 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 COTR.

D. Detail Drawing of construction sign showing required legend and other characteristics of sign is shown on the drawings.

1.25 SAFETY SIGN

A. Provide a Safety Sign where directed by COTR. 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 COTR.

D. Detail Drawing Number 45 of safety sign showing required legend and other characteristics of sign is shown on the drawings.

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

1.26 CONSTRUCTION DIGITAL IMAGES

A. During the construction period through completion, furnish Department of Veterans Affairs with 100 views of digital images, including one color print of each view and one Compact Disc (CD) per visit containing those views taken on that visit. Digital views shall be taken of exterior and/or interior as selected and directed by COTR. Each view shall be taken with a professional grade camera with minimum size of 6

megapixels (MP) and the images will be a minimum of 2272 x 1704 pixels for the 200x250mm (8x 10 inch) prints and 2592 x 1944 pixels for the 400x500 mm (16 x 20 inch) prints, as per these specifications:

1. Normally such images will be taken at monthly intervals. However, the COTR may also direct the taking of special digital images at any time prior to completion and acceptance of contract. If the number of trips to the site exceeds an average of one per month of the contract performance period then an adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) of Section 00 72 00, GENERAL CONDITIONS.
2. In event a greater or lesser number of images than specified above are required by the COTR, adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).

B. Images on CD-ROM shall be recorded in JPEG format with a minimum of 24 bit color and no reduction in actual picture size. Compressed size of the file shall be no less than 80% or the original with no loss of information. File names shall contain the date the image was taken, the Project number and a unique sequential identifier. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.

C. Interior Final Photos: After completion of all work in an area final interior photos will be taken. The camera must allow the colors to be as close as possible to the actual colors. For number and location of views, see Section 09 06 00, SCHEDULE FOR FINISHES. View shall be taken after final completion of work. The images shall also be provided on a CD to the COTR Office.

1.27 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 COTR to select the image to be printed. All images are provided to the COTR 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 COTR from the images taken above). Photographs shall be artistically composed showing full front elevations. All images shall become property of the Government. Photographs shall be delivered to the COTR in boxes suitable for shipping.

1.28 HISTORIC PRESERVATION

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 COTR verbally, and then with a written follow up.

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SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) 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), test reports, certificates, and manufacturers' literature and data shall also be subject to 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 COTR, 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 (including any laboratory samples to be tested) will not serve as a basis for extending 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 COTR 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 therefore by COTR, 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. 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 COTR and Architect- Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.

1-9. 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. Submittals shall be hole-punched and bound in three-ring binders by discipline (all HVAC in one book, all Plumbing in another book, etc.) Submittals in binders shall be separated by specification section in numerical order, with separator tabs, also provided by the Contractor, for each section. To expedite this process, the Contractor may submit the complete binder with tabs with the first submittals the Contractor prepare, and then the contractor may submit other sections, hole-punched, as the Contractor gets them prepared. <u>However, submit all items required in specification section in one submittal</u>. <u>Do not separate specification section requirements into multiple submittal packages.</u> Controls shall be in a separate submittal binder. All submittals are due no later than 30 days after Notice to Proceed. Re-submittals are due fourteen calendar days after Contractor receives comments. <u>Submittals received without a binder and out of order will not be reviewed.</u>

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 first class 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 COTR.

1. Laboratory shall furnish COTR 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 COTR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
5. Laboratory test reports shall be sent directly to COTR for appropriate action.

6. 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.
7. 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 COTR 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.

1-10. Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

Matrix Architects Incorporated
249 Wayne Avenue
Dayton, Ohio 45402

1-11. At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the COTR.

1-12. As part of the contractor’s final closeout documents, contractor must submit all approved submittals on items used in the project in .pdf format, on a CD (two copies). The CD shall contain a folder for each division, with sub-folders for each specification section. All approved submittals, RFIs, laboratory test, etc. must be in each specification section folder and included electronically on this CD.

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SECTION 01 42 19

REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

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)

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

DEPARMENT OF VETERANS AFFAIRS
Office of Construction & Facilities Management
Facilities Quality Service (00CFM1A)
811 Vermont Avenue, NW - Room 462
Washington, DC 20420
Telephone Numbers: (202) 461-8217 or (202) 461-8292
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)

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:

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor.

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 Association of State Highway and Transportation Officials (AASHTO):

T27-06.....Sieve Analysis of Fine and Coarse Aggregates

T96-02 (R2006).....Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

T99-01 (R2004).....The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop

T104-99 (R2003).....Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

T180-01 (R2004).....Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

T191-02(R2006).....Density of Soil In-Place by the Sand-Cone Method

C. American Concrete Institute (ACI):

506.4R-94 (R2004).....Guide for the Evaluation of Shotcrete

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

A325-06.....Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A370-07.....Definitions for Mechanical Testing of Steel Products

A416/A416M-06.....Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

A490-06.....Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength

C31/C31M-06.....Making and Curing Concrete Test Specimens in the Field

C33-03.....Concrete Aggregates

C39/C39M-05.....Compressive Strength of Cylindrical Concrete Specimens

C109/C109M-05.....Compressive Strength of Hydraulic Cement Mortars

C138-07.....Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

C140-07.....Sampling and Testing Concrete Masonry Units and Related Units

C143/C143M-05.....Slump of Hydraulic Cement Concrete

C172-07.....Sampling Freshly Mixed Concrete

C173-07.....Air Content of freshly Mixed Concrete by the Volumetric Method

C330-05.....Lightweight Aggregates for Structural Concrete

C567-05.....Density Structural Lightweight Concrete

C780-07.....Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

C1019-08.....Sampling and Testing Grout

C1064/C1064M-05.....Freshly Mixed Portland Cement Concrete

C1077-06.....Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

C1314-07.....Compressive Strength of Masonry Prisms

D698-07.....Laboratory Compaction Characteristics of Soil Using Standard Effort

D1143-07.....Piles Under Static Axial Compressive Load

D1188-07.....Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens

D1556-07.....Density and Unit Weight of Soil in Place by the Sand-Cone Method

D1557-07.....Laboratory Compaction Characteristics of Soil Using Modified Effort

D2166-06.....Unconfined Compressive Strength of Cohesive Soil

D2167-94(R2001).....Density and Unit Weight of Soil in Place by the Rubber Balloon Method

D2216-05.....Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2922-05.....Density of soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D2974-07.....Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

D3666-(2002).....Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials

D3740-07.....Minimum Requirements for Agencies Engaged in the Testing and Inspecting Road and Paving Material

E94-04.....Radiographic Testing

E164-03.....Ultrasonic Contact Examination of Weldments

E329-07.....Agencies Engaged in Construction Inspection and/or Testing

E543-06.....Agencies Performing Non-Destructive Testing

E605-93(R2006).....Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members

E709-(2001).....Guide for Magnetic Particle Examination

E1155-96(R2008).....Determining FF Floor Flatness and FL Floor Levelness Numbers

E. American Welding Society (AWS):

D1.1-07.....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 COTR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of COTR to such failure.

C. Written Reports: Testing laboratory shall submit test reports to COTR, Contractor, unless other arrangements are agreed to in writing by the COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper.

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

E. All testing reports must also be submitted electronically as part of the final closeout documentation on a CD with the submittals.

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 COTR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COTR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide observation of fill placement and compaction and field density testing in building areas and provide observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.

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 ASTM D698 and/or ASTM D1557.
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 COTR before the tests are conducted.
   a. Building Slab Subgrade: At least one test of subgrade for every 185 m^2 (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 m^2 (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
   b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
   c. Pavement Subgrade: One test for each 335 m^2 (400 square yards), but in no case fewer than two tests.
   d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
   e. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
   f. 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 COTR. 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 COTR.

3.2 ASPHALT CONCRETE PAVING:

A. Aggregate Base Course:

1. Determine maximum density and optimum moisture content for aggregate base material 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.

3.3 SITE WORK CONCRETE:

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

3.4 CONCRETE:

A. Batch Plant Inspection and Materials Testing:

1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of COTR and perform periodic inspections thereafter as determined by COTR.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to COTR.
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 m^3 (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 COTR make three cylinders for each 80 m^3 (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. COTR 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 m^3 (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m^3 (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 F_F and F_L 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 COTR with the results of all profile tests, including a running tabulation of the overall F_F and F_L 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 COTR. 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 COTR. 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/m^3 (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.

3.5 REINFORCEMENT:

A. Review mill test reports furnished by Contractor.

3.6 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 D1.1 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 AWS D1.1.

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.

i. Verify that correction of rejected welds are made in accordance with AWS D1.1.

j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the 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. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.

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

e. 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 COTR.

3.7 SPRAYED-ON FIREPROOFING:

A. Provide field inspection and testing services to certify sprayed-on fireproofing has been applied in accordance with contract documents.

B. Obtain a copy of approved submittals from COTR.

C. Use approved installation in test areas as criteria for inspection of work.

D. Test sprayed-on fireproofing for thickness and density in accordance with ASTM E605.

1. Thickness gauge specified in ASTM E605 may be modified for pole extension so that overhead sprayed material can be reached from floor.

E. Location of test areas for field tests as follows:

1. Thickness: Take thickness determinations from each of following locations: Beam and column.

2. Density: Take density determinations from each of the following areas: Beam flanges and beam web.

F. Submit inspection reports, certification, and instances of noncompliance to COTR.

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SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

EP-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.

EP-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.

EP-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. U.S. National Archives and Records Administration (NARA):
33 CFR 328.....Definitions

EP-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 COTR 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 COTR and the Contracting Officer 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, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil 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.

EP-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 COTR. 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 2 (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 COTR. 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 Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.

7. Manage and control spoil areas on Government property to limit spoil to areas shown 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 COTR.

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 insert Name of State and title of State Air Pollution Statue, Rule, or Regulation 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 COTR. 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 6:00 p.m unless otherwise permitted by local ordinance or the COTR. 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		MATERIALS HANDLING	
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS,	80	PNEUMATIC TOOLS	80
STATIONARY			
PUMPS	75	BLASTING	--
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	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 COTR 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 COTR. 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.

1.2 RELATED WORK

A. Section 02 41 00, DEMOLITION.

B. Section 01 00 00, GENERAL REQUIREMENTS.

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 contains information on companies that haul. Collect, and process recyclable debris from 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 COTR 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.

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

C. 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

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.

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

1.7 RECORDS

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.

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.

- - - E N D - - -

DOOR SCHEDULE

DOOR	DOOR DATA					FRAME DATA					LABEL	HARDWARE		NOTES
NO.	DOOR SIZE	MATERIAL	TYPE	GLASS	FINISH	MATERIAL	TYPE	JAMB	HEAD	FINISH		SET NO.	KEY SIDE	
101A	3'-8" x 7'-10" x 1 3/4"	ALUM	-	SAFETY	PTD	ALUM	-	J1	H1	PTD	-	1	EXT	1
102A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	2	106-86	2
104A	3'-0" x 7'-0" x 1 3/4"	CUSTOM WD	FG	SAFETY	STAIN	HM	F1	J8	H8	PTD	-	2	106-86	2
105A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	2	106-86	2
107A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	C-1HR	2	110-86	2
108A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	C-1HR	2	110-86	2
109A	1'-0"/4'-0"x 7'-0" x 1 3/4"	SCWD	HG	SAFETY	STAIN	HM	F1	J7	H7	PTD	-	3	-	-
111A	1'-0"/4'-0"x 7'-0" x 1 3/4"	SCWD	HG	SAFETY	STAIN	HM	F1	J7	H7	PTD	-	3	-	-
112A	1'-0"/4'-0"x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	4	-	-
113A	PR 3'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	5	-	-
114A	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	6	-	-
115A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	7	-	-
116A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
117A	PR 2'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	5	-	-
118A	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	6	-	-
119A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	7	-	-
121A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
122A	4'-0" x 7'-0" x 1 3/4"	CUSTOM WD	FG	SAFETY	STAIN	HM	F1	J7	H7	PTD	-	9	134-86	-
123A	4'-0" x 7'-0" x 1 3/4"	ALUM	-	SAFETY	PTD	ALUM	-	J1	H1	PTD	-	1	123-86	1, 7
123B	4'-0" x 7'-10" x 1 3/4"	CUSTOM WD	SD	-	STAIN	CUSTOM WD	-	J11	H11	STAIN	-	10	EXT	-
124A	PR 2'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	5	-	-
125A	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	6	-	-
126A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	7	-	-
127A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
128A	PR 2'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	5	-	-
129A	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	6	-	-

PROJECT	PROJECT NO.	ISSUE DATE		SHEET NO.
CARL VINSON VA MEDICAL CENTER	09104	September 9, 2010	Matrix Architects	DRSCH1.1
VA HOSPICE CARE UNIT 1826 Veterans Boulevard Dublin, Georgia 31021	REVISION DATES		249 Wayne Avenue, Dayton, Ohio 45402 937-224-7700 Fax: 937-224-7125	

DOOR SCHEDULE

DOOR	DOOR DATA					FRAME DATA					LABEL	HARDWARE		NOTES
NO.	DOOR SIZE	MATERIAL	TYPE	GLASS	FINISH	MATERIAL	TYPE	JAMB	HEAD	FINISH		SET NO.	KEY SIDE	
131A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	7	-	-
132A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
133A	PR 2'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	5	-	-
134A	PR 4'-2" x 7'-10" X 1 3/4"	SCWD	FNV	SAFETY/WIRED	STAIN	HM	F1	J9	H9	PTD	C-20MIN	11	-	3, 5
135A	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	6	-	-
136A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	7	-	-
137A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
138A	Not Used	-	-	-	-	-	-	-	-	-	-	-	-	-
139A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	12	-	-
141A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	C-1HR	13	110-86	-
142A	PR 3'-0" x 7'-0" X 1 3/4"	CUSTOM WD	F	-	STAIN	HM	F1	J8	H8	PTD	C-1HR	14	110-86	-
143A	PR 3'-0" x 7'-10" X 1 3/4"	ALUM	-	SAFETY	PTD	ALUM	-	J1	H1	PTD	-	15	EXT	1, 7
144A	PR 2'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	C-1HR	16	181-86	-
145A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	C-1HR	34	173-86	-
146A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	C-1HR	34	173-86	-
147A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	17	173-86	-
148A	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	6	-	-
149A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	7	-	-
151A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
152A	PR 2'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	5	-	-
153A	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	6	-	-
154A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	7	-	-
155A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
156A	PR 2'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	5	-	-
157A	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	6	-	-
158A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	7	-	-

PROJECT	PROJECT NO.	ISSUE DATE		SHEET NO.
CARL VINSON VA MEDICAL CENTER	09104	September 9, 2010	Matrix Architects	DRSCH1.2
VA HOSPICE CARE UNIT 1826 Veterans Boulevard Dublin, Georgia 31021	REVISION DATES		249 Wayne Avenue, Dayton, Ohio 45402 937-224-7700 Fax: 937-224-7125	

DOOR SCHEDULE

DOOR	DOOR DATA					FRAME DATA					LABEL	HARDWARE		NOTES
NO.	DOOR SIZE	MATERIAL	TYPE	GLASS	FINISH	MATERIAL	TYPE	JAMB	HEAD	FINISH		SET NO.	KEY SIDE	
159A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
161A	PR 2'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	5	-	-
162A	4'-0" x 7'-0" x 1 3/4"	ALUM	-	SAFETY	PTD	ALUM	-	J1	H1	PTD	-	1	162-86	1, 7
162B	4'-0" x 7'-10" x 1 3/4"	CUSTOM WD	SD	-	STAIN	CUSTOM WD	-	J11	H11	STAIN	-	10	EXT	-
163A	4'-0" x 7'-0" x 1 3/4"	CUSTOM WD	FG	SAFETY	STAIN	HM	F1	J7	H7	PTD	-	9	173-86	-
164A	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	6	-	-
165A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	7	-	-
166A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
167A	PR 2'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	5	-	-
168A	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	6	-	-
169A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	7	-	-
171A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
172A	PR 3'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	5	-	-
173A	PR 4'-2" x 7'-10" X 1 3/4"	SCWD	FNV	SAFETY/WIRED	STAIN	HM	F1	J9	H9	PTD	C-20M IN	11	-	3, 5
174A	4'-0" x 7'-0" x 1 3/4"	SCWD	HG	SAFETY	STAIN	HM	F1	J7	H7	PTD	-	18	-	-
175A	4'-0" x 7'-0" x 1 3/4"	SCWD	HG	SAFETY	STAIN	HM	F1	J7	H7	PTD	-	18	-	-
176A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	8	-	-
177A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	C-1HR	34	181-86	-
178A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	C-1HR	35	181-86	-
179A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	C-1HR	9	181-86	-
184A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	2	185-86	-
186A	3'-0" x 7'-0" x 1 3/4"	CUSTOM WD	FG	SAFETY	STAIN	HM	F1	J7	H7	PTD	-	2	106-86	2, 6
188A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	19	187-86	-
189A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	20	-	-
190A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	2	181-86	-
191A	3'-0" x 7'-0" x 1 3/4"	SCWD	FNV	SAFETY/WIRED	STAIN	HM	F1	J7	H7	PTD	C-1HR	21	187-86	-

PROJECT	PROJECT NO.	ISSUE DATE		SHEET NO.
CARL VINSON VA MEDICAL CENTER	09104	September 9, 2010	Matrix Architects	DRSCH1.3
VA HOSPICE CARE UNIT 1826 Veterans Boulevard Dublin, Georgia 31021	REVISION DATES		249 Wayne Avenue, Dayton, Ohio 45402 937-224-7700 Fax: 937-224-7125	

DOOR SCHEDULE

DOOR	DOOR DATA					FRAME DATA					LABEL	HARDWARE		NOTES
NO.	DOOR SIZE	MATERIAL	TYPE	GLASS	FINISH	MATERIAL	TYPE	JAMB	HEAD	FINISH		SET NO.	KEY SIDE	
192A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	C-1HR	22	181-86	-
193A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	C-1HR	22	192-86	-
194A	3'-0" x 7'-0" x 1 3/4"	CUSTOM WD	FG	SAFETY	STAIN	HM	F1	J7	H7	PTD	-	2	206-86	6
195A	4'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	23	181-86	-
196A	3'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	24	198-86	-
197A	4'-0" x 7'-0" x 1 3/4"	SCWD	NV	SAFETY	STAIN	HM	F1	J8	H8	PTD	-	25	208-86	-
197B	4'-0" x 7'-0" x 1 3/4"	SCWD	NV	SAFETY	STAIN	HM	F1	J7	H7	PTD	-	26	197-86	-
201A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	27	198-86	-
202A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J7	H7	PTD	-	27	198-86	-
203A	3'-0" x 7'-0" x 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	-	2	206-86	2
204A	4'-0" x 7'-0" x 1 3/4"	CUSTOM WD	FG	SAFETY	STAIN	HM	F1	J8	H8	PTD	-	28	206-86	6
204B	2'-0" x 7'-0" x 1 3/4"	SCWD	F	-	PTD	HM	F1	J7	H7	PTD	-	2	204-86	-
205A	PR 3'-0" x 7'-0" X 1 3/4"	SCWD	F	-	STAIN	HM	F1	J8	H8	PTD	C-1HR	16	197-86	-
205B	3'-0" x 7'-0" x 1 3/4"	GALV HM	F	-	PTD	GALV HM	F2	J3	H3	PTD	C-1HR	29	EXT	8
205C	3'-0" x 7'-0" x 1 3/4"	GALV HM	F	-	PTD	GALV HM	F2	J5	H5	PTD	-	30	EXT	-
207A	PR 3'-0" x 7'-10" X 1 3/4"	ALUM	-	SAFETY	PTD	ALUM	-	J1	H1	PTD	-	15	EXT	1, 7
208A	4'-0" x 7'-0" x 1 3/4"	HM	FNV	SAFETY/WIRED	PTD	HM	F2	J10	H10	PTD	C-3HR	31	208-86	-
208B	3'-0" x 7'-0" x 1 3/4"	GALV HM	-	-	PTD	GALV HM	F1	J4	H4	PTD	-	32	EXT	-

PROJECT	PROJECT NO.	ISSUE DATE		SHEET NO.
CARL VINSON VA MEDICAL CENTER	09104	September 9, 2010	Matrix Architects	DRSCH1.4
VA HOSPICE CARE UNIT 1826 Veterans Boulevard Dublin, Georgia 31021	REVISION DATES		249 Wayne Avenue, Dayton, Ohio 45402 937-224-7700 Fax: 937-224-7125	

DOOR SCHEDULE

DOOR	DOOR DATA					FRAME DATA					LABEL	HARDWARE		NOTES
NO.	DOOR SIZE	MATERIAL	TYPE	GLASS	FINISH	MATERIAL	TYPE	JAMB	HEAD	FINISH		SET NO.	KEY SIDE	
301A	4'-0" x 7'-0" x 1 3/4"	ALUM	-	SAFETY	PTD	ALUM	-	J1	H1	PTD	-	33	301-86	1, 7, 9
302A	4'-0" x 7'-0" x 1 3/4"	ALUM	-	SAFETY	PTD	ALUM	-	J1	H1	PTD	-	33	302-86	1, 7, 10
304A	4'-0" x 7'-0" x 1 3/4"	ALUM	-	SAFETY	PTD	ALUM	-	J1	H1	PTD	-	33	208-86	1, 7, 11
304B	4'-0" x 7'-0" x 1 3/4"	GALV HM	NV	SAFETY	PTD	GALV HM	F2	J10	H10	PTD	-	33	208-86	-

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DOOR SCHEDULE NOTES

1	Refer to electrical drawings and specifications for all electrical requirements, audio interface, and card access.
2	Door mounted hat and coat hook (mounted on pull side of door); double hook-nylon (ultramid), color: black
3	Doors to have rabbeted edges.
4	Not used.
5	Double egress door and frame. Prep the door and frame to receive concealed overhead door closer.
6	Door with patterned glass.
7	Use Jamb/Head details J2/H2 if Alternate No. G-5 is accepted.
8	Use Jamb/Head details J4/H4 if Alternate No. G-5 is accepted.
9	Use Jamb/Head details J1/H1 if Alternate No. G-3 is accepted.
10	Use Jamb/Head details J1/H1 if Alternate No. G-4 is accepted.
11	Use Jamb/Head details J1/H1 if Alternate No. G-2 is accepted.
	GENERAL NOTES:
A	PREPARE A SEPARATE KEYING SCHEDULE BASED ON INSTRUCTIONS FROM ARCHITECT AND/OR OWNER. FINAL APPROVAL BY OWNER.
B	DOOR CLOSERS: ALL CLOSERS TO BE MOUNTED ON LEAST CONSPICUOUS SIDE OF DOORS. ADVISE ARCHITECT IF THIS WILL CONFLICT OR BE IMPRACTICAL.
C	DOOR STOPS: PROVIDE DOOR STOPS WHEREVER TO PREVENT DOOR OR HARDWARE FROM STRIKING AND ADJACENT PARTITION OR OBSTRUCTION. PROVIDE WALL TYPE WHEREVER POSSIBLE. WHERE THERE IS A CONFLICT REGARDING USE OF FLOOR OR WALL STOPS AT CERTAIN LOCATIONS AND CHANGES ARE NECESSARY DUE TO JOB SITE CONDITIONS SUCH AS INTERFERENCE WITH CABINETS, FURNITURE, ETC. - CHANGES SHALL BE WORKED OUT WITH THE POLICY OF KEEPING STOPS OFF THE FLOOR - AT NO EXTRA COST TO THE CONTRACT PRICE.
D	PROVIDE DOOR SILENCERS PER DOOR HARDWARE SPECIFICATIONS.
E	GLASS: REFER TO DOOR TYPES, UNLESS OTHERWISE NOTED IN SPECIFICATIONS.
F	SUBMIT SAMPLES FOR DOOR MOUNTED HAT AND COAT HOOK WITH DOOR HARDWARE SHOP DRAWING SUBMITTALS.

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HARDWARE SCHEDULE

Hardware Set No. 1

1.5	PR	Hinges-NRP	A5112	4.5 x 4.5	630
1	EA	Low-Enegry Auto Door Operator			Alum.
		Automatic door operators and controls by			
		Section 08 71 13, Automatic Door Operators			
1	EA	Panic Device	E- QEL99L (06)		626
1	EA	Cylinder			626
1	EA	EPT10			
1	EA	Power Supply	PS873-2Q-AO (24 VDC)		
1	EA	Door Sweeps		R3A534	Alum.
1	EA	Threshold (7" wide)		J32180	Alum.
Note: Provide 14 GA. MIN. wire within 100'-0".					
See elec. dwgs. for elec. requirements and card access.					
Weather stripping by door manufacturer.					

Hardware Set No. 2

1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Lockset	93K-7-AB-14K-S3		626
1	EA	Wall Stop	L02251		626
Note: For door 107A and 108A - provide the following closer					
1	EA	Closer	C02011	Reg. Arm	
		No wall stop for door 204B.			

Hardware Set No. 3

1.5	PR	Hinges	A5111	5 x 4.5	630
1.5	PR	Hinges	A5112	4.5 x 4.5	626
1	EA	Passage Set	93K-0-N-14K-S3		626
1	EA	Dummy Trim	93K-0-2DT-14K-S3		626
1	EA	Concealed OVHD. Holder		C11531	626
		(Set to maximum opening)			
1	SET	T/B Flush Bolts		L04251	626
		(12-inch)			
1	SET	Weatherstripping		ROY155	Brown
1	EA	Dust Proof Strike		L04021	626
1	SET	Smoke-Rated Astragal		R3J734	626
1	EA	Wall Stop		L02251	626
1	EA	Dust Proof Strike		L04021	626

Hardware Set No. 4

1.5	PR	Hinges	A5111	5 x 4.5	630
1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Privacy Set	93K-0-L-14K-S3		626
1	EA	Dummy Trim	93K-0-2DT-14K-S3		626
1	SET	T/B Flush Bolts		L04251	626
		(12-inch)			
1	EA	High Dome Floor Stop		L02161	626
1	EA	Dust Proof Strike		L04021	626

Hardware Set No. 5

3	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Passage Set	93K-0-N-14K-S3		626
1	EA	Dummy Trim	93K-0-1DT-14K-S3		626
1	SET	T/B Flush Bolts		L04251	626
		(12-inch)			
1	EA	Dust Proof Strike		L04021	626

Hardware Set No. 6

1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Passage Set	93K-0-N-14K-S3		626

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HARDWARE SCHEDULE

Hardware Set No. 7

1.5	PR	Hinges	A5111	5 x 4.5	630
1	EA	Passage Set	93K-0-N-14K-S3		626
1	EA	Concealed OVHD. Holder	C51531		
		(Set to maximum opening)			
1	EA	Wall Stop		L02251	626

Hardware Set No. 8

1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Privacy Set	93K-0-L-14K-S3		626
1	EA	Concealed OVHD. Stop	C51541		
		(w/adjustable jamb bracket)			

Hardware Set No. 9

1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Lockset	93K-7-R-14K-S3		626
1	EA	Wall Stop	L02251		626

Note: For door 179A - provide the following closer

1	EA	Closer	C02011	Reg. Arm

Hardware Set No. 10

1.5	PR	Hinges-NRP	A5112	4.5 x 4.5	630
1	EA	Panic Device	99L (06)		626
1	EA	Cylinder			626
1	EA	Closer C02061 Hinge Side Hold Open			
1	SET	Weatherstripping		ROY155	Brown
1	EA	Door Sweeps		R3A534	Alum.
1	EA	Threshold (7" wide)		J32180	Alum.

Hardware Set No. 11

4	PR	Hinges	A5111	5 x 4.5	630
2	EA	Concealed Overhead		C05031	
		Closer w/Fire Shield (22 guage steel liner			
		mounted in the track mortise of the door's top rail)			
2	EA	Push Plate	J301	4" x 16"	626
		(w/rounded corners)			
2	EA	Recessed Pulls	J403 2-3/16" x 3-1/4"		626
		(Grip Opening 7/8" x 2-7/16")			
2	EA	Electronic Hold Open	C00011 x 24VDC		626
		(wall mount, low profile, concealed wiring)			

Note: Contractor shall install and connect complete to fire alarm system.

Hardware Set No. 12

1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Privacy Set	93K-0-L-14K-S3		626
1	EA	High Dome Floor Stop		L02161	626

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HARDWARE SCHEDULE

Hardware Set No. 13

1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Lockset	93K-7-D-14K-S3		626
1	EA	Closer	C02011	Reg. Arm	
2	EA	H.D. metal kick plate		J103	626
		(12-inch height and beveled 4 edges)			
1	EA	Wall Stop	L02251		626
Note: For door 141A - provide the following closer					
1	EA	Closer	C02021	Parallel Arm	652

Hardware Set No. 14

3	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Lockset	93K-7-R-14K-S3		626
1	EA	Dummy Trim	93K-0-2DT-14K-S3		626
2	EA	Single point electronic-hold		C02051	
		open closer			
		(heavy-duty closer/holder designed to provide			
		single point hold-open for fire-rated door)			
1	EA	Coordinator		Type 21	Black
1	SET	T/B Flush Bolts		L04251	626
		(12-inch)			
1	SET	Smoke-Rated Astragal		R3J734	626
1	EA	Dust Proof Strike		L04021	626
2	EA	Wall Stop	L02251		626

Hardware Set No. 15

3	PR	Hinges-NRP	A5112	4.5 x 4.5	630
2	EA	Low-Enegry Auto Door Operator			Alum.
		Automatic door operators and controls by			
		Section 08 71 13, Automatic Door Operators			
2	EA	Panic Device	E-QEL9947L-LBR (06)		626
		(concealed vertical rod)			
2	EA	Cylinder			626
2	EA	EPT10			
1	EA	Power Supply	PS873-2Q-AO (24 VDC)		
2	EA	Door Sweeps		R3A534	Alum.
1	EA	Threshold (7" wide)		J32180	Alum.
Note: Provide 14 GA. MIN. wire within 100'-0".					
See elec. dwgs. for elec. requirements and card access.					
Weather stripping and astragals by door manufacturer.					

Hardware Set No. 16

3	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Lockset	93K-7-D-14K-S3		626
1	EA	Dummy Trim	93K-0-1DT-14K-S3		626
2	EA	Closer	C02011	Reg. Arm	
1	EA	Coordinator		Type 21	Black
1	SET	T/B Flush Bolts		L04251	626
		(12-inch)			
1	SET	Smoke-Rated Astragal		R3J734	626
1	EA	Dust Proof Strike		L04021	626

Hardware Set No. 17

1.5	PR	Hinges	A5111	5 x 4.5	630
1	EA	Lockset	93K-7-AB-14K-S3		626
2	EA	H.D. metal kick plate		J103	626
		(12-inch height and beveled 4 edges)			
1	EA	Wall Stop	L02251		626

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HARDWARE SCHEDULE

Hardware Set No. 18

1.5	PR	Hinges	A5111	5 x 4.5	630
1	EA	Passage Set	93K-0-N-14K-S3		626
1	EA	Concealed OVHD. Holder	C11531		
		(Set to maximum opening)			
1	EA	Wall Stop		L02251	626
1	SET	Weatherstripping		ROY155	Brown
1	EA	Heavy Duty Auto. Mortise	R3C324		
		Door Bottom (neoprene)			
1	EA	Wall Stop		L02251	626

Hardware Set No. 19

2	EA	Hinges	A5111	5 x 4.5	630
1	EA	Hinges - 6 wire	A5111	5 x 4.5	630
		(electrified w/concealed circuit)			
1	EA	Lockset	93KW-7-DEU-14K-S3		626
		(Fail Secure - 24 VDC)			
1	EA	Wall Stop	L02251		626

Hardware Set No. 20

1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Privacy Set	93K-0-L-14K-S3		626
1	EA	Wall Stop	L02251		626

Hardware Set No. 21

2	EA	Hinges	A5112	4.5 x 4.5	630
1	EA	Hinges - 6 wire	A5112	4.5 x 4.5	630
		(electrified w/concealed circuit)			
1	EA	Lockset	93KW-7-DEU-14K-S3		626
		(Fail Secure - 24 VDC)			
1	EA	Single point electronic-hold	C02051		
		open closer			
		(heavy-duty closer/holder designed to provide			
		single point hold-open for fire-rated door)			
1	EA	Wall Stop		L02251	626

Note: Electrical Contractor to complete all final connection to building fire alarm system.

Hardware Set No. 22

1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Panic Device	99L-F (06)		626
1	EA	Cylinder			626
1	EA	H.D. Closer	C02021	Parellel Arm	
		Note: For door 193A			
1	EA	Wall Stop		L02251	626

Hardware Set No. 23

1.5	PR	Hinges	A5111	5 x 4.5	630
1	EA	Lockset	93K-7-D-14K-S3		626
2	EA	H.D. metal kick plate		J103	626
		(12-inch height and beveled 4 edges)			
1	EA	Wall Stop	L02251		626

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HARDWARE SCHEDULE

Hardware Set No. 24

2	EA	Hinges	A5112	4.5 x 4.5	630
1	EA	Hinges - 6 wire	A5112	4.5 x 4.5	630
		(electrified w/concealed circuit)			
1	EA	Lockset	93KW-7-DEU-14K-S3		626
		(Fail Secure - 24 VDC)			
1	EA	Closer	C02011	Reg. Arm	

Hardware Set No. 25

1.5	PR	Hinges	A5111	5 x 4.5	630
1	EA	Low-Energy Auto Door Operator			Alum.
		Automatic door operators and controls by			
		Section 08 71 13, Automatic Door Operators			
1	EA	Panic Device	E- QEL99L (06)		626
1	EA	Cylinder			626
1	EA	EPT10			
1	EA	Power Supply	PS873-2Q-AO (24 VDC)		

Note: Provide 14 GA. MIN. wire within 100'-0".

See elec. dwgs. for elec. requirements and card access.

Hardware Set No. 26

1.5	PR	Hinges	A5111	5 x 4.5	630
1	EA	Panic Device	99L (06)		626
1	EA	Cylinder			626
1	EA	Closer	C02011	Reg. Arm	
1	EA	Wall Stop		L02251	626

Hardware Set No. 27

1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Deadbolt	Thumbturn		626
1	EA	Dummy Trim	93K-0-1DT-14K-S3		626
1	EA	H.D. Closer		C02051	
		(hinge side hold open)			
1	EA	Push Plate	J301	4" x 16"	626
		(w/rounded corners)			

Hardware Set No. 28

1.5	PR	Hinges	A5111	5 x 4.5	630
1	EA	Lockset	93K-7-AB-14K-S3		626
1	EA	Wall Stop	L02251		626

Hardware Set No. 29

1.5	PR	Hinges-NRP	A5112	4.5 x 4.5	630
1	EA	Lockset	93K-7-D-14K-S3		626
1	EA	Closer	C02011	Reg. Arm	
1	SET	Weatherstripping		ROY155	Brown
1	EA	Door Sweeps		R3A534	Alum.
1	EA	Threshold (7" wide)		J32180	Alum.

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HARDWARE SCHEDULE

Hardware Set No. 30

1.5	PR	Hinges-NRP	A5112	4.5 x 4.5	630
1	EA	Lockset	93K-7-R-14K-S3		626
1	EA	Wall Stop	L02251		626

Hardware Set No. 31

1.5	PR	Hinges	A5112	4.5 x 4.5	630
1	EA	Low-Enegry Auto Door Operator			Alum.
		Automatic door operators and controls by			
		Section 08 71 13, Automatic Door Operators			
1	EA	Panic Device	E- QEL99L (06)		626
1	EA	Cylinder			626
1	EA	EPT10			
1	EA	Power Supply	PS873-2Q-AO (24 VDC)		
1	EA	Wall Stop	L02251		626

Note: Provide 14 GA. MIN. wire within 100'-0".

See elec. dwgs. for elec. requirements and card access.

Hardware Set No. 32

1.5	PR	Hinges-NRP	A5112	4.5 x 4.5	630
1	EA	Panic Device	99L (06)		626
1	EA	Cylinder			626
1	EA	H.D. Closer	C02061		
		(parallel hold open arm)			
1	SET	Weatherstripping		ROY155	Brown
1	EA	Door Sweeps		R3A534	Alum.
1	EA	Threshold (7" wide)		J32180	Alum.

Hardware Set No. 33

1.5	PR	Hinges-NRP	A5111	5 x 4.5	630
1	EA	Low-Enegry Auto Door Operator			Alum.
		Automatic door operators and controls by			
		Section 08 71 13, Automatic Door Operators			
1	EA	Panic Device	E- QEL99L-NL (06)		626
1	EA	Cylinder			626
1	EA	EPT10			
1	EA	Power Supply	PS873-2Q-AO (24 VDC)		
1	SET	Weatherstripping		ROY155	Brown
1	EA	Door Sweeps		R3A534	Alum.
1	EA	Threshold (7" wide)		J32180	Alum.

Note: Provide 14 GA. MIN. wire within 100'-0".

See elec. dwgs. for elec. requirements and card access.

Hardware Set No. 34

2	EA	Hinges	A5112	4.5 x 4.5	630
1	EA	Hinges - 6 wire	A5112	4.5 x 4.5	630
		(electrified w/concealed circuit)			
1	EA	Lockset	93KW-7-DEU-14K-S3		626
		(Fail Secure - 24 VDC)			
1	EA	Closer	C02011	Reg. Arm	
2	EA	H.D. metal kick plate		J103	626
		(12-inch height and beveled 4 edges)			
1	EA	Wall Stop	L02251		626

Note: No H.D. metal kick plate for door 177A.

Hardware Set No. 35

2	EA	Hinges	A5112	4.5 x 4.5	630
1	EA	Hinges - 6 wire	A5112	4.5 x 4.5	630
		(electrified w/concealed circuit)			
1	EA	Lockset	93KW-7-DEU-14K-S3		626
		(Fail Secure - 24 VDC)			
1	EA	Closer	C02011	Reg. Arm	
1	EA	Wall Stop	L02251		626

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HARDWARE SCHEDULE NOTES

1. See electrical drawings and specifications for electrical requirements and card access on doors. Provide a complete fully code compliant system at each door indicated as specified.
2. Low-Energy Auto Door Operator and Controls by Section 08 71 13 Automatic Door Operators.

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ROOM FINISH SCHEDULE

ROOM NO.	ROOM NAME	FLOOR CODE	BASE CODE	N WALL CODE	E WALL CODE	S WALL CODE	W WALL CODE	CEILING CODE	CEILING HEIGHT	NOTES
101-86	Porch	SC	-	-	-	-	-	BB	SEE PLANS	5
102-86	Lobby	VP-1,2,3	RB-1	WC-2	PT-2	PT-2	PT-2	GWB	SEE PLANS	
103-86	Hospice Coordinator	VP-1	RB-1	PT-1	PT-1	PT-1	PT-1	AC-2	SEE PLANS	
104-86	Team Report / Conference	VP-1,2	RB-1	PT-4	WC-4	PT-4	WC-4	AC-1	SEE PLANS	
105-86	Nurse Manager	VP-1	RB-1	PT-1	PT-1	PT-1	PT-1	AC-2	SEE PLANS	
106-86	Corridor	VP-1,2	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1/GWB	SEE PLANS	
107-86	Team Breakroom	VCT-2,3,4	RB-3	PT-4	PT-4	PT-3	PT-4	AC-2	SEE PLANS	
108-86	Swing Office	VP-1	RB-1	PT-1	PT-1	PT-1	PT-1	AC-2	SEE PLANS	
109-86	Ante Room	VP-1	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1	SEE PLANS	
110-86	Corridor	VP-1,2	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1/GWB	SEE PLANS	
111-86	Bariatric Isolation Room	VP-1,2	RB-1	PT-1	PT-1	PT-1	WC-6	AC-1	SEE PLANS	6
112-86	Toilet	CT-7,15	CT-20,22	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	GWB	SEE PLANS	2,3
113-86	Closet	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
114-86	Patient Server	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
115-86	Patient Room	VP-1,2	RB-1	PT-1	WC-6	PT-1	PT-1	AC-1	SEE PLANS	6
116-86	Toilet	CT-7,15	CT-20,22	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	GWB	SEE PLANS	2,3
117-86	Closet	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
118-86	Patient Server	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
119-86	Patient Room	VP-1,2	RB-1	PT-1	WC-6	PT-1	PT-1	AC-1	SEE PLANS	6
120-86	Not Used									
121-86	Toilet	CT-7,15	CT-20,22	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	GWB	SEE PLANS	2,3
122-86	Family Lounge	VP-1,2	RB-1	PT-4	PT-4	PT-4	PT-4	AC-1	SEE PLANS	7
123-86	Screened Porch	SC	-	-	-	-	-	BB	SEE PLANS	5
124-86	Closet	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
125-86	Patient Server	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
126-86	Patient Room	VP-1,2	RB-1	PT-1	PT-1	PT-1	WC-6	AC-1	SEE PLANS	6

PROJECT

CARL VINSON VA MEDICAL CENTER

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SHEET NO.

FNCLRSCH1.1

ROOM FINISH SCHEDULE

ROOM NO.	ROOM NAME	FLOOR CODE	BASE CODE	N WALL CODE	E WALL CODE	S WALL CODE	W WALL CODE	CEILING CODE	CEILING HEIGHT	NOTES
127-86	Toilet	CT-7,15	CT-20,22	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	GWB	SEE PLANS	2,3
128-86	Closet	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
129-86	Patient Server	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
130-86	Not Used									
131-86	Patient Room	VP-1,2	RB-1	PT-1	PT-1	PT-1	WC-6	AC-1	SEE PLANS	6
132-86	Toilet	CT-7,15	CT-20,22	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	GWB	SEE PLANS	2,3
133-86	Closet	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
134-86	Corridor	VP-1,2	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1/GWB	SEE PLANS	
135-86	Patient Server	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
136-86	Patient Room	VP-1,2	RB-1	PT-1	PT-1	PT-1	WC-6	AC-1	SEE PLANS	6
137-86	Toilet	CT-7,15	CT-20,22	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	CT-7/PT-2	GWB	SEE PLANS	2,3
138-86	Vending / Kitchenette	VCT 2,3	RB-3	PT-1	PT-1	PT-1	WC-5	AC-1	SEE PLANS	
139-86	Family Show er	CT-15	CT-22	CT-15/PT-2	CT-15/PT-2	CT-15/PT-2	CT-15/PT-2	GWB	SEE PLANS	2,3
140-86	Not Used									
141-86	Housekeeping	VCT-1	RB-2	PT-1	PT-1	PT-1	PT-1	AC-3	SEE PLANS	
142-86	Family Lounge	VP-1,2	RB-1	PT-4	PT-5	PT-5	PT-4	GWB	SEE PLANS	8
143-86	Porch	SC	-	-	-	-	-	BB	SEE PLANS	5
144-86	Oxygen Storage	VCT-1	RB-2	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
145-86	Soiled Utility	VCT-1	RB-2	PT-1	PT-1	PT-1	PT-1	AC-3	SEE PLANS	
146-86	Clean Linen	VCT-1	RB-2	PT-1	PT-1	PT-1	PT-1	AC-3	SEE PLANS	
147-86	Patient Gurney Show er	CT-15	CT-22	CT-15/PT-2	CT-15/PT-2	CT-15/PT-2	CT-15/PT-2	GWB	SEE PLANS	
148-86	Patient Server	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
149-86	Patient Room	VP-1,2	RB-1	WC-7	PT-1	PT-1	PT-1	AC-1	SEE PLANS	6
150-86	Not Used									
151-86	Toilet	CT-8,15	CT-20,22	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	GWB	SEE PLANS	2,3
152-86	Closet	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	-	SEE PLANS	

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ROOM FINISH SCHEDULE

ROOM NO.	ROOM NAME	FLOOR CODE	BASE CODE	N WALL CODE	E WALL CODE	S WALL CODE	W WALL CODE	CEILING CODE	CEILING HEIGHT	NOTES
153-86	Patient Server	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
154-86	Patient Room	VP-1,2	RB-1	WC-7	PT-1	PT-1	PT-1	AC-1	SEE PLANS	6
155-86	Toilet	CT-8,15	CT-20,22	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	GWB	SEE PLANS	2,3
156-86	Closet	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
157-86	Patient Server	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
158-86	Patient Room	VP-1,2	RB-1	WC-7	PT-1	PT-1	PT-1	AC-1	SEE PLANS	6
159-86	Toilet	CT-8,15	CT-20,22	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	GWB	SEE PLANS	2,3
160-86	Not Used									
161-86	Closet	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
162-86	Screened Porch	SC	-	-	-	-	-	BB	SEE PLANS	5
163-86	Family Lounge	VP-1,2	RB-1	PT-4	PT-4	PT-4	PT-4	AC-1	SEE PLANS	7
164-86	Patient Server	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
165-86	Patient Room	VP-1,2	RB-1	PT-1	PT-1	WC-7	PT-1	AC-1	SEE PLANS	6
166-86	Toilet	CT-8,15	CT-20,22	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	GWB	SEE PLANS	2,3
167-86	Closet	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
168-86	Patient Server	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
169-86	Patient Room	VP-1,2	RB-1	PT-1	PT-1	WC-7	PT-1	AC-1	SEE PLANS	6
170-86	Not Used									
171-86	Toilet	CT-8,15	CT-20,22	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	GWB	SEE PLANS	2,3
172-86	Closet	VP-2	RB-4	PT-1	PT-1	PT-1	PT-1	GWB	SEE PLANS	
173-86	Corridor	VP-1,2	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1/GWB	SEE PLANS	
174-86	Ante Room	VP-1	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1	SEE PLANS	
175-86	Isolation Room	VP-1,2	RB-1	WC-7	PT-1	PT-1	PT-1	AC-1	SEE PLANS	6
176-86	Toilet	CT-8,15	CT-20,22	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	GWB	SEE PLANS	2,3
177-86	Inpatient Equipment Storage	VCT-1	RB-2	PT-1	PT-1	PT-1	PT-1	AC-3	SEE PLANS	
178-86	IT Room	VCT-1	RB-2	PT-1	PT-1	PT-1	PT-1	AC-3	SEE PLANS	

PROJECT

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ROOM FINISH SCHEDULE

ROOM		FLOOR	BASE	N WALL	E WALL	S WALL	W WALL	CEILING		NOTES
NO.	NAME	CODE	CODE	CODE	CODE	CODE	CODE	CODE	HEIGHT	
179-86	Family Laundry	VP-1	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1	SEE PLANS	
180-86	Not Used									
181-86	Corridor	VP-1,2	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1/GWB	SEE PLANS	
182-86	Team Station	VP-1	RB-1	PT-1	PT-6	PT-6	PT-1	AC-1	SEE PLANS	
183-86	Dictation	VP-1	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1	SEE PLANS	
184-86	Office Supply Storage	VCT-1	RB-4	PT-1	PT-1	PT-1	PT-1	AC-3	SEE PLANS	
185-86	Team Copy / Work Room	VP-1	RB-1	PT-1	PT-1	PT-1	PT-1	AC-2	SEE PLANS	
186-86	Conference / Counseling	VP-1	RB-1	PT-3	PT-3	PT-3	PT-3	AC-1	SEE PLANS	
187-86	Nourishment	VP-1	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1	SEE PLANS	
188-86	Med Prep	VS-1	VS-1	PT-1	PT-1	PT-1	PT-1	AC-1	SEE PLANS	1
189-86	Toilet	CT-8	CT-20	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	CT-8/PT-2	GWB	SEE PLANS	2
190-86	Office / Storage	VP-1	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1	SEE PLANS	
191-86	Central Supply	VCT-1	RB-2	PT-1	PT-1	PT-1	PT-1	AC-3	SEE PLANS	
192-86	Electrical Room	SC	-	PT-1	PT-1	PT-1	PT-1	-	SEE PLANS	4
193-86	Electrical Room	SC	-	PT-1	PT-1	PT-1	PT-1	-	SEE PLANS	4
194-86	Children's Counseling	VP-1	RB-1	PT-1	PT-1	PT-1	WC-1	AC-1	SEE PLANS	
195-86	Equipment Clean-Up	CT-15	CT-19	CT-15/PT-1	CT-15/PT-1	CT-15/PT-1	CT-15/PT-1	AC-4	SEE PLANS	9
196-86	Biohazard Storage	VS-1	VS-1	PT-1	PT-1	PT-1	PT-1	AC-3	SEE PLANS	1
197-86	Corridor	VP-1,2	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1/GWB	SEE PLANS	
198-86	Corridor	VP-1,2	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1/GWB	SEE PLANS	
199-86	Not Used									
200-86	Not Used									
201-86	Men's Toilet	CT-1,3,4	CT-24	CT-10/PT-2	CT-10/PT-2	CT-10/PT-2	CT-10/PT-2	AC-1	SEE PLANS	2
202-86	Women's Toilet	CT-2,5,6	CT-22	CT-9/PT-2	CT-9/PT-2	CT-9/PT-2	CT-9/PT-2	AC-1	SEE PLANS	2
203-86	Medical Director	VP-1	RB-1	PT-3	PT-3	PT-3	PT-3	AC-2	SEE PLANS	
204-86	Chapel	VP-1,2,4	RB-1	PT-2	PT-2	PT-2	PT-2	GWB	SEE PLANS	

PROJECT

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ROOM FINISH SCHEDULE

ROOM		FLOOR	BASE	N WALL	E WALL	S WALL	W WALL	CEILING		NOTES
NO.	NAME	CODE	CODE	CODE	CODE	CODE	CODE	CODE	HEIGHT	
205-86	Mechanical Room	SC	-	PT-1	PT-1	PT-1	PT-1	-	SEE PLANS	4
206-86	Corridor	VP-1,2	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1/GWB	SEE PLANS	
207-86	Patient Drop-Off / Pick-Up	SC	-	-	-	-	-	F.C. BD.	SEE PLANS	
208-86	Connector	SC	RB-1	PT-1	PT-1	PT-1	PT-1	AC-1/GWB	SEE PLANS	4
301-86	Porch	SC	-	-	-	-	-	BB	SEE PLANS	5
302-86	Porch	SC	-	-	-	-	-	BB	SEE PLANS	5
303-86	Patient Drop-Off / Pick-Up	SC	-	-	-	-	-	ALUM	SEE PLANS	
304-86	Connector	SC	-	-	-	-	-	ALUM	SEE PLANS	

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ROOM FINISH SCHEDULE

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	CODED NOTES
1	FLASH COVE BASE PER DETAIL F1/A251
2	SEE INTERIOR ELEVATIONS FOR WALL TILE PATTERN DETAILS
3	CT-15 TILE ON WALLS IN SHOWER ALCOVE, SEE INTERIOR ELEVATIONS
4	SEALED CONCRETE FLOOR SURFACE WITH SMOOTH TROWEL CONCRETE FINISH
5	STAINED OAK BEAD BOARD (BB) CEILING - SEE DRAWINGS AND SPECIFICATIONS - EXTERIOR CEILINGS SHALL HAVE EXTERIOR MARINE GRADE SPAR VARNISH FINISH
6	WALLCOVERING ACCENT WALL AT BED HEADWALL ONLY, SEE INTERIOR ELEVATIONS
7	PT-5 ACCENT WALL ON TV WALL
8	PT-5 ACCENT WALL CONTINUOUS THROUGH DOOR ALCOVE AREA IN SOUTHEAST CORNER OF FAMILY LOUNGE 142-86
9	EXTEND CT-15 ON WALLS TO MINIMUM 5'-0" A.F.F.
	GENERAL NOTES
A	SEE CONSTRUCTION DOCUMENTS FOR ADDITIONAL FINISH AND MATERIAL INFORMATION
B	REFER TO DRAWINGS FOR FLOOR AND WALL TILE PATTERN DESIGN INTENT
C	BEFORE EXECUTION OF DIVISION 9 ITEMS IS TO BEGIN, THE FOLLOWING CONDITIONS MUST BE MET, ALONG WITH THOSE
	SPECIFIED IN THE INDIVIDUAL SPECIFICATIONS:
	A. BUILDING SHALL BE ENCLOSED WITH ALL WINDOWS AND DOORS IN PLACE AND GLAZED, AND THE ROOF WATERTIGHT
	B. WET WORK SHALL BE IN PLACE, COMPLETED, AND NOMINALLY DRY WITH HVAC SYSTEM IN CONTINUOUS OPERATION
	C. MAINTAIN CLIMATE CONDITIONS TO RANGE FROM 60-85 DEGREES AND RELATIVE HUMIDITY OF NOT MORE THAN 70%
	D. DUCTWORK ABOVE THE CEILING SHALL BE COMPLETE, AND PERMANENT HEATING AND COOLING SYSTEMS OPERATING
	E. INSTALLATION OF CONDUIT ABOVE CEILING SHALL BE COMPLETE
	F. A PERMANENT LEVEL OF LIGHTING SHALL BE OBTAINED
D	PAINT COLORS SPECIFIED FOR WALLS CONTINUE ON ALL SIDES OF SOFFITS, U.O.N.
E	INTERIOR HOLLOW METAL DOOR AND WINDOW FRAMES PAINT COLOR TO BE DETERMINED
F	NOT USED
G	REFER TO GYPSUM WALL BOARD SPECIFICATION SECTION FOR GYPSUM BOARD FINISH LEVELS

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SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

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 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. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

F. 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. 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.

E. 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. OMITTED
   3. 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.
   4. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.

F. 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 any damaged items shall be repaired or replaced as approved by the COTR. 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 COTR’s approval.

G. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

H. 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 to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COTR. 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. 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 1500mm (5feet) 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.

D. 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 COTR. When Utility lines are encountered that are not indicated on the drawings, the COTR shall be notified prior to further work in that area.

3.2 CLEAN-UP:

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COTR. Clean-up shall include off the Medical Center 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.

- - - E N D - - -

SECTION 03 30 53

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

Perform work of this Section according to ACI 301-05, "Specifications for Structural Concrete," except as specifically modified herein. Numbers in parentheses (0.00) indicate a related paragraph of ACI 301. This section specifies cast-in-place structural concrete and material and mixes for other concrete. Provide concrete pads, piers, curbs, and bases required for equipment of all trades. Coordinate dimensions and details with requirements of equipment being supplied, prior to placing 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 TOLERANCES:

A. ACI 117.

B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

1.4 REGULATORY REQUIREMENTS:

A. ACI SP-66 ACI Detailing Manual

B. ACI 318 - Building Code Requirements for Reinforced Concrete.

C. CRSI "Placing Reinforcing Bars," 2006, 8th edition.

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submit a concrete mix design for each class of concrete required. Submittals to comply with appropriate methods listed in ACI 301-05.

C. Shop Drawings: Reinforcing steel: Complete shop drawings.

D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

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 Concrete Institute (ACI):

117R-06.....Tolerances for Concrete Construction and Materials

211.1-91(R2002).....Proportions for Normal, Heavyweight, and Mass Concrete

301-05.....Specification for Structural Concrete

305R-06.....Hot Weather Concreting

306R-2002.....Cold Weather Concreting

SP-66-04 .....ACI Detailing Manual

318/318R-05.....Building Code Requirements for Reinforced Concrete

347R-04.....Guide to Formwork for Concrete

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

A185-07.....Steel Welded Wire, Fabric, Plain for Concrete Reinforcement

A615/A615M-08.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

A996/A996M-06.....Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

C31/C31M-08.....Making and Curing Concrete Test Specimens in the Field

C33-07.....Concrete Aggregates

C39/C39M-05.....Compressive Strength of Cylindrical Concrete Specimens

C94/C94M-07.....Ready-Mixed Concrete

C143/C143M-05.....Standard Test Method for Slump of Hydraulic Cement Concrete

C150-07.....Portland Cement

C171-07.....Sheet Material for Curing Concrete

C172-07.....Sampling Freshly Mixed Concrete

C173-07.Air Content of Freshly Mixed Concrete by the Volumetric Method

C192/C192M-07.....Making and Curing Concrete Test Specimens in the Laboratory

C231-08.....Air Content of Freshly Mixed Concrete by the Pressure Method

C260-06.....Air-Entraining Admixtures for Concrete

C494/C494M-08.....Chemical Admixtures for Concrete

C618-08.....Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

D1751-04.Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

D4397-02.....Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

E1155-96(2008).....Determining F_F Floor Flatness and F_L Floor Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS:

Wood, plywood, metal, or other materials, approved by COTR, of grade or type suitable to obtain type of finish specified.

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 alkalis, and loss on ignition (LOI) not to exceed 5 percent.

C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick.

D. Fine Aggregate: ASTM C33.

E. Mixing Water: Fresh, clean, and potable.

F. Air-Entraining Admixture: ASTM C260.

G. Chemical Admixtures: ASTM C494.

H. Vapor Barrier: 15 mil clear polyethylene conforming to ASTM E 1745, Class A with permeance rating of 0.01 US or less, after mandatory conditioning.

I. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. Minimum yield strength to be 60 ksi.

J. Welded Wire Fabric: ASTM A185.

K. Expansion Joint Filler: ASTM D1751.

L. Sheet Materials for Curing Concrete: ASTM C171.

M. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Conform to Corps of Engineers Specification CRD-C621-83 and ASTM C1107/C1107M-08. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a compressive strength of at least 18mpa (2500 psi) at 3 days and 35mpa (5000 psi) at 28 days.

N. Curing Compound: Comply with ASTM C309-07, Type 1, Class B (clear). Compound shall comply with EPA's VOC requirements. Must be compatible with adhesive specified for floor finishes.

O. Curing and Sealing Compound: Comply with ASTM C1315-08. Type I Class A (clear) compound shall comply with EPA's VOC requirements. Apply at the manufacturer's written recommended application rate. Must be compatible with adhesive specified for floor finishes.

P. Joint Sealant: Use 1-component polyurethane, conforming to ASTM C920-08, Type S, Grade NS, Class 25. Use with backer rod as required.

Q. Sealer: Clear membrane-forming compound which will not yellow. Must be formulated for the intended application, either interior or exterior and applied per the manufacturer's written recommendations. Must comply with EPA VOC requirements and be compatible with the curing compound used.

R. Keyed Floor Slab Joints: Mill galvanized steel, 20 gauge minimum, with minimum key dimensions of 3/4 inch deep by 1 1/2 inches at its widest point.

S. Synthetic Fiber Reinforcement: ASTM C1116/C1116M-08a.

2.3 CONCRETE MIXES:

A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.

B. Compressive strength at 28 days shall be not less than 3000 psi for footings and piers, 3500 psi for interior slabs on grade and all interior concrete not otherwise identified, 4000 psi for exterior slabs on grade and all exterior concrete not otherwise identified, and 1500 psi for backfill below footings.

C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.

D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.

E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete: Strength	Non-Air-Entrained		Air-Entrained	
Min. 28 Day Comp. Str.	Min. Cement kg/m^3 (lbs/c.	Max. Water Cement Ratio	Min. Cement kg/m^3	Max. Water Cement Ratio

MPa (psi)	yd)		(lbs/c. yd)	
30 (4000)[1]	NA	NA	340 (570)	0.45
27.5 (3500)[1]	310 (517)	0.45	NA	NA
25 (3000)[1]	280 (470)	-0.65	NA	NA
12.5 (1500)	-	-	-	-

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.

F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content shall conform with the following table:

TABLE I - TOTAL AIR CONTENT

FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
10 mm (3/8 in)	6 to 10
13 mm (1/2 in)	5 to 9
19 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

G. Pozzolans are permitted in all Classes.

H. Concrete used for interior slabs on grade is to have a minimum three (3) day compressive strength of 1800 psi.

I. Synthetic fiber reinforcement shall be used in strict accordance with the manufacturer's recommendations. Dosage rate shall be as recommended by the manufacturer, but not less than 1 lb. per cubic yard.

J. Concrete mixes shall not contain any deleterious or other reactive aggregates or materials that can initiate and promote alkali silica reaction (ASR).

2.4 BATCHING & MIXING:

A. Store, batch, and mix materials as specified in ASTM C94.

1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.

2. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.
3. Backfill concrete may be site mixed; all other concrete is to be ready-mixed. All admixtures are to be added at the batch plant, except that superplasticizer, where used, is to be added at the site. Superplasticizer retarder can be added at the batch plant.

PART 3 – EXECUTION

3.1 ERECTION:

A. This structure is designed to be self-supporting and stable after the building is fully completed. It is solely the Contractor's responsibility to determine erection procedures and sequence, and to ensure the stability of the building and its component parts, and the adequacy of temporary or incomplete connections, during erection. This includes the addition of any shoring, sheeting, temporary guys, bracing or tie-downs that might be necessary. Such material is not shown on the Drawings. If applied, they shall be removed as conditions permit, and shall remain the Contractor's property.

3.2 FORMWORK:

A. Installation conform to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.
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. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, sleeves, boxes for floor hinges 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.

D. Construction Tolerances:

1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. 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.

3.3 REINFORCEMENT:

A. Details of concrete reinforcement, unless otherwise shown, in accordance with ACI 318 and ACI SP-66. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

B. Prior to application of sealer, remove any synthetic fiber reinforcement projecting above the top surface of slabs which remain exposed.

3.4 **EMBEDDED ITEMS:**

A. Install embedded conduit, pipes, sleeves and anchor bolts subject to the following limitations:

1. Do not embed aluminum without prior approval of coating material.
2. Do not displace reinforcing steel.
3. In slabs, limit outside dimension of conduits and pipes to 1/3 member thickness. Where conduits cross, maintain same minimum concrete cover as required for reinforcing bars.
4. Maintain a center-to-center spacing of at least 3 diameters of conduit, pipe or sleeve.
5. Install anchor bolts for base plates of steel elements according to tolerances of AISC Code of Standard Practice for Steel Buildings and Bridges, March 18, 2005, Paragraph 7.5.

3.5 VAPOR BARRIER:

Except where membrane waterproofing is required, place interior concrete slabs on a continuous vapor barrier.

A. Place 100 mm (4 inches) of compacted granular fill, then the vapor barrier, then 25 mm (1 inch) of sand to act as a blotter for concrete slab.

B. Lap joints 150 mm (6 inches) and seal with a compatible pressure-sensitive tape; seal edges to all walls, column bases, etc.; fold and cement corners or otherwise make vaporproof.

C. Patch punctures and tears. Provide sealed contact with piping and all penetrating items.

3.6 PLACING CONCRETE:

A. Verify that excavations are free of water and ice, are of the required dimensions, and have been approved by the testing agency responsible for soils inspection before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of COTR before placing concrete. Provide screeds at required elevations for concrete slabs.

B. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.

C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow concrete to drop freely more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.

D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.

E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from COTR.

3.7 **JOINTING:**

A. Interior Slabs on Grade:

1. Locate control and construction joints as shown on the Drawings. In the absence of information on Drawings, locate at openings, walls, columns, inside corners and at 15 feet on center generally. Schedule slab placements and sawcutting operations such that sawing is completed prior to onset of shrinkage cracking (5.3.5). Complete saw cutting within 12 hours after placement.
2. Provide isolation joints at columns (1/2 inch thick) and at walls (1/4 inch thick). Where isolation joint will be exposed to view, set top of joint filler below top of slab a distance equal to the filler thickness, to receive sealant. Where not exposed to view, set top of filler flush with top of slab.
3. Where joints are exposed to view in the finished building, provide joint sealant.

B. Exterior Slabs on Grade: Locate joints as shown on the Drawings. In the absence of information on the Drawings, provide the following:

1. Expansion Joints: Full depth, with 1/2 inch joint filler, where slabs abut vertical surfaces, at intersections of sidewalks, at abrupt changes in width, and at a spacing not exceeding 30 feet.
2. Control Joints: Tooled, 7/8 inch deep, 4 feet to 6 feet on center between expansion joints.

3.8 PROTECTION AND CURING:

Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by COTR:

1. Interior slab areas which will receive finish in cementitious setting bed or to receive adhesive applied finishes are to be cured using paper curing membranes, without the use of a curing compound (5.3.6.4.a through 5.3.6.4.d).
2. All other slab areas may be either moist-cured or receive an application of curing compound or cured using paper curing membranes (5.3.6.4.e).
3. Whichever curing method is used, it is to commence immediately after disappearance of water sheen, and continue for at least seven (7) days. Do not allow curing to be delayed overnight.
4. Prevent excessive moisture loss from formed surfaces (5.3.6.3). If forms are removed before seven (7) days have elapsed, cure the

formed surfaces by moist-curing or application of curing compound for the remainder of the curing period.

5. All exterior slabs are to receive an application of sealer prior to completion of construction.
6. Interior slabs which remain exposed are to receive an application of sealer prior to the completion of construction.

3.9 FORM REMOVAL:

Forms remain in place until concrete has a sufficient strength to carry its own weight and loads supported. Removal of forms at any time is the Contractor's sole responsibility.

3.10 SURFACE PREPARATION:

Immediately after forms have been removed and work has been examined and approved by COTR, remove loose materials, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part portland cement and 2 to 3 parts sand.

3.11 FINISHES:

A. Slab Finishes:

1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application shall all be thoroughly raked or wire broomed after partial setting (within 2 hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.
2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
3. Float Finish: Ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive non-cementitious materials, except as specified, shall be screened and floated to a smooth dense finish. After first floating, while surface is still soft, surfaces shall be checked for alignment using a straightedge or template. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.
4. Steel Trowel Finish: Applied toppings, concrete surfaces to receive resilient floor covering or carpet, and all monolithic concrete floor slabs exposed in finished work and for which no other finish

is shown or specified shall be steel troweled. Final steel troweling to secure a smooth, dense surface shall be delayed as long as possible, generally when the surface can no longer be dented with finger. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface shall be free of trowel marks, uniform in texture and appearance.

5. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.
6. Finishing Tolerances:
   a. Conform to F-number requirements noted below and as described in ACI 117, Section 4.5.6, F-number method in accordance with ASTM E1155 for all interior slabs on grade:
      F_F-25/F_L-20 minimum overall for composite of all measured values;
      F_F-17/F_L-15 minimum for any individual floor section.

Slab on grade & Shored suspended slabs		Unshored suspended slabs	
Specified overall value	F_F 25/F_L 20	Specified overall value	F_F 25
Minimum local value	F_F 17/F_L 15	Minimum local value	F_F 17

   b. Take remedial measures if flatness and levelness testing indicates either of the following conditions exists:
      1. The entire floor composite value, when installation is complete, measures less than either of the specified overall F-numbers.
      2. Any individual floor section measures less than either of the specified minimum section F-numbers.
   c. Individual floor sections for floor tolerance testing purposes shall be bound by the following that provide the smallest sections: construction joints and control joints.
   d. Obtain written approval of the Architect and COTR for remedial measures proposed before implementing measures.
   e. All exterior slabs shall be finished to a 1/2 inch in 10 foot tolerance.

3.12 **FIELD QUALITY CONTROL:**

A. Obtain concrete for required tests at point of placement (1.6.4.2).

B. For each concrete class, perform one strength test for each 50 yards, or fraction thereof, placed in any one day (1.6.4.2.d and 1.6.4.2.e).

C. Determine slump for each strength test (1.6.4.2.f).

D. Determine air content for each strength test of air-entrained concrete (1.6.4.2.h).

E. Determine concrete temperature for each strength test when air temperature is less than 40 degrees F or will be within 24 hours (1.6.4.2.g).

F. Do not place concrete when slump, air content or temperature vary from allowable.

G. Test interior floor slab finished surfaces for flatness and levelness in accordance with ASTM **E1155**. (5.3.4.3.c).

H. Each individual floor cast in a single day shall meet the composite flatness requirements.

I. Floor tolerance tests shall typically be performed (and all defective areas identified) within 24 hours after slab placement and reported to all parties as soon as possible, but not later than 72 hours after installation. At areas cured with a paper curing membrane, floor tolerance tests shall be performed immediately following its removal.

J. Visual inspections:

1. Periodically inspect reinforcing steel for size, location and placement.
2. Continuously inspect anchor bolts cast into concrete.
3. Periodically verify the use of the required design mix.
4. Continuously inspect the placement of the concrete for proper techniques. Periodically inspect for maintenance of specified curing temperature and techniques.
5. Periodically inspect concrete formwork for shape, location and dimensions of members.

K. Maintain records of all tests, indicating exact location of the structure represented by each test.

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SECTION 04 05 13

MASONRY MORTARING

PART 1 - GENERAL

1.1 DESCRIPTION:

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 COTR to perform tests specified below.

B. Submit information regarding testing laboratory's facilities and qualifications of technical personnel to COTR.

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 COTR.

E. After tests have been made and materials approved, do not change without additional test and approval of COTR.

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:
      Type S: Minimum 12400 kPa (1800 psi) at 28 days.
      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.

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. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. 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).

g. Color admixture.

C. Laboratory Test Reports:

1. Mortar, each type.

2. Admixtures.

D. Manufacturer's Literature and Data:

1. Cement, each kind.

2. Hydrated lime.

3. Admixtures.

4. Liquid acrylic resin.

1.6 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.

1.7 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):

C40-04.....Organic Impurities in Fine Aggregates for Concrete
C91-05.....Masonry Cement
C109-07.....Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-MM Cube Specimens)
C144-04.....Aggregate for Masonry Mortar
C150-05.....Portland Cement
C207-06.....Hydrated Lime for Masonry Purposes
C270-07.....Mortar for Unit Masonry
C307-03.....Tensile Strength of Chemical - Resistant Mortar, Grouts, and Monolithic Surfacing
C321-00/R05.....Bond Strength of Chemical-Resistant Mortars
C348-02.....Flexural Strength of Hydraulic Cement Mortars
C595-08.....Blended Hydraulic Cement
C780-07.....Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C979-05.....Pigments for Integrally Colored Concrete
C1329-05.....Mortar Cement

PART 2 - PRODUCTS

2.1 HYDRATED LIME

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY MORTAR

A. ASTM C144 and as follows:
   1. Light colored sand for mortar for laying face brick.
   2. White plastering sand meeting sieve analysis for mortar joints for pointing.
   3. White- Mortar Aggregates: Natural white sand or crushed white stone.
   4. Colored- Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

B. Test sand for color value in accordance with ASTM C40. Sand producing color darker than specified standard is unacceptable.

C. Mortar pigments: natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. use only pigments with a record of satisfactory performance in masonry mortar.2.3 blended hydraulic cement

ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT

A. ASTM C91. Type N or S.

2.5 MORTAR CEMEMT

ASTM C1329, Type N or S.

2.6 PORTLAND CEMENT

A. ASTM C150, Type I.

B. Provide natural color or white cement as required to produce mortar color indicated.

2.7 LIQUID ACRYLIC RESIN

A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.8 WATER

Potable, free of substances that are detrimental to mortar, masonry, and metal.

2.9 POINTING MORTAR

A. For Cast Stone or Precast Concrete: Proportion by volume; One part white Portland cement, two parts white sand, and 1/5 part hydrated lime.

2.10 MASONRY MORTAR

A. Conform to ASTM C270.

B. Admixtures:

1. Do not use mortar admixtures, unless approved by COTR.
2. Submit laboratory test report showing effect of proposed admixture on strength, water retention, and water repellency of mortar.
3. Do not use antifreeze compounds.

C. Colored Mortar:

1. Maintain uniform mortar color for exposed work throughout.
2. Color of mortar for exposed work in alteration work to match color of existing mortar unless specified otherwise in section 09 06 00, SCHEDULE FOR FINISHES. The existing mortar color is believed to be white and not standard gray. Match other buildings on campus, VA COTR to approve color selection.

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.

3.2 MORTAR USE LOCATION

A. Use Type S mortar for masonry containing vertical reinforcing bars (non-engineered), masonry below grade and setting cast stone.

B. For brick veneer over frame back up walls, use Type N portland cement-lime mortar or Type S masonry cement or mortar cement mortar.

C. Use Type N mortar for other masonry work, except as otherwise specified.

3.3 MORTAR JOINTS INSTALLATION

A. Mortar joints to be 4 head and 4 bed joints, unless otherwise specified elsewhere.

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SECTION 04 05 16

MASONRY GROUTING

PART 1 - GENERAL

1.1 DESCRIPTION:

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 COTR.

E. After tests have been made and materials approved, do not change without additional test and approval of COTR.

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. 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.

4. Liquid acrylic resin.

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):

C40-04.....Organic Impurities in Fine Aggregates for Concrete

C91-05.....Masonry Cement

C150-05.....Portland Cement

C207-06.....Hydrated Lime for Masonry Purposes

C404-07.....Aggregate for Masonry Grout

C476-07.....Grout for Masonry

C979-05.....Pigments for Integrally Colored Concrete

C1019-05.....Sampling and Testing Grout

PART 2 - PRODUCTS

2.1 HYDRATED LIME:

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY GROUT:

ASTM C404, Size 8.

2.3 MASONRY CEMENT:

A. ASTM C91. Type N, S, or M.

2.4 PORTLAND CEMENT:

A. ASTM C150, Type I.

2.5 LIQUID ACRYLIC RESIN:

A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.6 WATER:

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 three 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 three times sum of volumes of cement and lime used.
   d. Coarse aggregate: one to two times sum of volumes of cement and lime used.
3. Sum of volumes of fine and coarse aggregates: Do not exceed four 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.

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.

- - - E N D - - -

SECTION 04 20 00

UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

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. Flashing: Section 07 60 00, FLASHING AND SHEET METAL.

C. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.

D. Color and texture of masonry units: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Samples:

1. Face brick, sample panel, 200 mm by 400 mm (8 inches by 16 inches,) showing full color range and texture of bricks, bond, and proposed mortar joints.
2. Concrete masonry units, when exposed in finish work.
3. Anchors, and ties, one each and joint reinforcing 1200 mm (48 inches) long.

C. 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. Concrete masonry units for typical window and door openings, and, for special conditions as affected by structural conditions.

D. 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. Face brick.

b. Solid and load-bearing concrete masonry units, including fire-resistant rated units.

3. Testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.
4. Certificates signed by manufacturer, indicating joint reinforcement material as specified.

E. Laboratory Test Reports:
1. Brick.

F. Manufacturer's Literature and Data:
1. Anchors, ties, and reinforcement.
2. Shear keys.
3. Reinforcing bars.

1.4 QUALITY ASSURANCE

A. Engage experienced stone veneer assembly installer, or firm, who has performed projects of similar size and complexity within the past 5 years of date of bid.
1. This contractor shall submit evidence of such experience with his proposal to the General Contractor, the General Contractor shall attach same to his/her bid submitted to the Owner. The experience listing requires the following; each data for a minimum of 3 similar projects.
a. Project Name.
b. Project Address.
c. Architect, including address, phone number and contact.

B. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

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. Sample Panels: Before starting masonry, lay up a sample panel in accordance with Masonry Standards Joint Committee (MSJC) and Brick Industry Association (BIA).
1. Use masonry units from random cubes of units delivered on site.

2. Include reinforcing, ties, sealant-filled joint at least 16 inches, and anchors.
3. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. See drawings for sample or mock-up panel location.
6. Use sample panels approved by COTR for standard of workmanship of new masonry work.7. Use sample panel to test cleaning methods.

1.5 WARRANTY

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.

1.6 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):

A951-06.....Steel Wire for Masonry Joint Reinforcement.

A615/A615M-07.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

A675/A675M-03.....Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical PropertiesC34-03 Structural Clay Load-Bearing Wall Tile

C67-07.....Sampling and Testing Brick and Structural Clay Tile

C90-06.....Load-Bearing Concrete Masonry Units

C216-07.....Facing Brick (Solid Masonry Units Made From Clay or Shale)

C476-02.....Standard Specification for Grout for Masonry

C612-04.....Mineral Fiber Block and Board Thermal Insulation

C1093-09.....Standard Practice for Accreditation of Testing Agencies for MasonryD1056-07 Flexible Cellular Materials - Sponge or Expanded Rubber

D2240-05.....Rubber Property - Durometer Hardness

D3574-05.....Flexible Cellular Materials-Slab, Bonded, and Molded Urethane Foams

F1667-05.....Fasteners: Nails, Spikes and Staples

C. Masonry Industry Council:

All Weather Masonry Construction Manual, 2000.

D. American Welding Society (AWS):

D1.4-05 Structural Welding Code – Reinforcing Steel.

E. Federal Specifications (FS):

FF-S-107C-00.....Screws, Tapping and Drive

F. Brick Industry Association - Technical Notes on Brick Construction (BIA):

11-1986.....Guide Specifications for Brick Masonry, Part I

11A–1988.....Guide Specifications for Brick Masonry, Part II

11B–1988.....Guide Specifications for Brick Masonry, Part III Execution

11C-1998.....Guide Specification for Brick Masonry Engineered Brick Masonry, Part IV

11D-1988.....Guide Specifications for Brick Masonry Engineered Brick Masonry, Part IV continued

G. Masonry Standards Joint Committee; Specifications for Masonry Structures (ACI 530.1-05/ASCE 6-05/TMS 602-99) (MSJC).

PART 2 - PRODUCTS

2.1 BRICK

A. Face Brick:

1. ASTM C216, Grade SW, Type FBS.
2. Brick when tested in accordance with ASTM C67: Classified "not effloresced."
3. Size:
   a. Modular
4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 6400 psi (44.1 Mpa).
5. Initial Rate of Absorption: Less than 20 g/30 sq. in. (20 g/194 sq. cm) per minute when tested per ASTM C 67.

2.2 CONCRETE MASONRY UNITS

A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.

1. Unit Weight: Normal weight, unless otherwise indicated.
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 bullnose concrete masonry units at corners exposed in finished work with 25 mm (one inch) minimum radius rounded vertical exterior corners (bullnose units).

2.3 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).

2.4 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. Hot-dip galvanized carbon-steel wire for both interior and exterior walls.
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 5 mm (0.20 inch) diameter wire.
   b. Cross wires4 mm (0.16 inch) diameter.
10. Trussed Design:
   a. Longitudinal and cross wires not less than 4 mm (0.16 inch nominal) diameter.
   b. Longitudinal wires deformed.

11. Multiple Wythes and Cavity wall ties:
    a. Longitudinal wires 4 mm (0.16 inch) with U shape 2.6 mm (0.10 inch) rectangular ties extending into other wythe not less than 75 mm (3 inches) spaced 400 mm o.c. (16 inches). Adjustable type with U shape tie designed to receive 4 mm (0.16 inch) pintle projecting into other wythe 75 mm (3 inches) minimum.

2.5 ANCHORS, TIES, AND REINFORCEMENT

A. Steel Reinforcing Bars: ASTM A615M, deformed bars, grade as shown.

B. Joint Reinforcement:
1. Form from wire complying with ASTM A951.
2. Hot-dip galvanized after fabrication.
3. Width of joint reinforcement 40 mm (0.16 inches) less than nominal width of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcement at least 3000 mm (10 feet) in length.
6. Joint reinforcement in rolls is not acceptable.
7. Joint reinforcement that is crimped to form drip is not acceptable.
8. Maximum spacing of cross wires 400 mm (16 inch) to longitudinal wires.
9. Ladder Design:
    a. Longitudinal wires deformed 5 mm (0.20 inch) diameter wire.
    b. Cross wires 4 mm (0.16 inch) diameter.
10. Trussed Design:
    a. Longitudinal and cross wires not less than 4 mm (0.16 inch nominal) diameter.
    b. Longitudinal wires deformed.
11. Multiple Wythes and Cavity wall ties:
    a. Longitudinal wires 4 mm (0.16 inch) with U shape 4 mm (0.16 inch) rectangular ties extending into other wythe not less than 75 mm (3 inches) spaced 400 mm o.c. (16 inches). Adjustable type with U shape tie designed to receive 4 mm (0.16 inch) pintle projecting into other wythe 75 mm (3 inches min.).

C. 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 hot-dip 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 hot-dip 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.

D. Dovetail Anchors:

1. Corrugated steel dovetail anchors formed of 1.5 mm (0.0598 inch) thick by 25 mm (1 inch) wide hot-dip galvanized steel, 90 mm (3-1/2 inches) long where used to anchor 100 mm (4 inch) nominal thick masonry units, 140 mm (5-1/2 inches) long for masonry units more than 100 mm (4 inches) thick.
2. Triangular wire dovetail anchor 100 mm (4 inch) wide formed of 4 mm (9 gage) steel wire with hot-dip galvanized steel dovetail insert. Anchor length to extend at least 75 mm (3 inches) into masonry, 25 mm (1 inch) into 40 mm (1-1/2 inch) thick units.
3. Form dovetail anchor slots from 0.6 mm (0.0239 inch) thick hot-dip galvanized steel (with felt or fiber filler).

E. Individual ties:

1. Rectangular ties: Form from 5 mm (3/16 inch) diameter hot-dip 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.
2. Adjustable Cavity Wall Ties:
   a. Two piece type permitting up to 40 mm (1-1/2 inch) adjustment.
   b. Form ties from 5 mm (3/16 inch) diameter hot-dip galvanized steel wire.
   c. Form one piece to a rectangular shape 105 mm (4-1/8 inches) wide by length required to extend into the bed joint 50 mm (2 inches).
   d. Form the other piece to a 75 mm (3 inch) long by 75 mm (3 inch) wide shape, having a 75 mm (3 inch) long bent section for engaging the 105 mm (4-1/8 inch) wide piece to form adjustable connection.

F. Wall Ties:

1. Rectangular wire wall ties formed of W1.4, 3 mm, (9 gage) hot-dip galvanized steel wire 50 mm (2 inches) wide by 200 mm (8 inches) long.

G. Corrugated Wall Tie:
   1. Form from 1.5 mm (0.0598 inch) thick corrugated, hot-dip galvanized steel 30 mm (1-1/4 inches) wide by lengths so as to extend at least 100 mm (4 inches) into joints of new masonry plus 38 mm (1-1/2 inch) turn-up.
   2. Provide 5 mm (3/16 inch) hole in turn-up for fastener attachment.

H. Adjustable Steel Column Anchor:
   1. Two piece anchor consisting of a 6 mm (1/4 inch) diameter steel rod to be welded to steel with offset ends, rod to permit 100 mm (4 inch) vertical adjustment of wire anchor.
   2. Triangular shaped wire anchor 100 mm (4 inches) wide formed from 5 (3/16 inch) diameter hot-dip galvanized wire, to extend at least 75 mm (3 inches) into joints of masonry.

I. Adjustable Steel Beam Anchor:
   1. Z or C type steel strap, 30 mm (1 1/4 inches) wide, 3 mm (1/8 inch) thick.
   2. Flange hook not less than 38 mm (1 1/2 inches) long.
   3. Length to embed in masonry not less than 50 mm (2 inches) in 100 mm (4 inch) nominal thick masonry and 100 mm (4 inches) in thicker masonry.
   4. Bend masonry end not less than 40 mm (1 1/2 inches).

J. Ridge Wall Anchors:
   1. Form from hot-dip galvanized steel not less than 25 mm (1 inch) wide by 5 mm (3/16 inch) thick by 600 mm (24 inches) long, plus 50 mm (2 inch) bends.
   2. Other lengths as shown.

2.6 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.

2.7 ACCESSORIES

A. Weep Hole Wicks: Glass fiber ropes, 10 mm (3/8 inch) minimum diameter, in length required to produce 50 mm (2 inch) exposure on exterior and 450 mm (18 inch) in cavity between wythes.

B. Cavity Drainage Material (Mortar Net): Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
   1. Strips full-depth of cavity and 10 inches (250 mm) wide, with dovetail shaped notches 7 inches (175 mm) deep that prevent mesh

from being clogged with mortar droppings. Thickness as shown on drawings.

C. 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.

D. 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.

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Fabricate from the following metal complying with requirements specified in Section 07 60 00, FLASHING AND SHEET METAL and below:

1. Stainless Steel: 0.0156 inch (0.4 mm) thick, unless otherwise noted in Division 07 60 00, FLASHING AND SHEET METAL.
2. Fabricate metal expansion-joint strips from sheet metal indicated above formed to shape indicated.
3. Fabricate metal drip edges from sheet metal indicated above. Extend at least 3 inches (75 mm) into wall and 1/2 inch (13 mm) out from wall, with a hemmed outer edge bent down 30 degrees.
4. Fabricate metal flashing terminations from sheet metal indicated above. Extend at least 3 inches (75 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and then down into joint 3/8 inch (10 mm) to form a stop for retaining sealant backer rod.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 60 00, FLASHING AND SHEET METAL.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by the flashing manufacturer for bonding flashing sheets to each other and to substrates.

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. Install steel lintels where indicated.
2. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
3. Provide minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

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.
6. Use not less than 100 mm (4 inches) nominal thick masonry for free standing furring unless shown otherwise.
7. Do not abut existing plastered surfaces except suspended ceilings with new masonry partitions.

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. When new masonry partitions start on existing floors, machine cut existing floor finish material down to concrete surface.

J. 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.

K. Chases:

1. Do not install chases in masonry walls and partitions exposed to view in finished work, including painted or coated finishes on masonry.
2. Masonry 100 mm (4 inch) nominal thick may have electrical conduits 25 mm (1 inch) or less in diameter when covered with soaps, or other finishes.
3. Full recess chases after installation of conduit, with mortar and finish flush.
4. When pipes or conduits, or both occur in hollow masonry unit partitions retain at least one web of the hollow masonry units.

L. Wetting and Wetting Test:

1. Test and wet brick or clay tile in accordance with BIA 11B.
2. Do not wet concrete masonry units before laying.

M. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.

N. 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.

O. 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.

3.4 ANCHORAGE

A. Veneer to Frame Walls:

1. Use adjustable veneer anchors.
2. Fasten anchor to stud through sheathing with self drilling and tapping screw, one at each end of loop type anchor.
3. Space anchors not more than 400 mm (16 inches) on center vertically at each stud.

B. 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.

C. Masonry Facing to Backup and Cavity Wall Ties:

1. Use individual ties for new work.
2. Stagger ties in alternate courses, and space at 400 mm (16 inches) maximum vertically, and 600 mm (2 feet) horizontally.
3. At openings, provide additional ties spaced not more than 900 mm (3 feet) apart vertically around perimeter of opening, and within 300 mm (12 inches) from edge of opening.
4. Anchor new masonry facing to existing masonry with corrugated wall ties spaced at 400 mm (16 inch) maximum vertical intervals and at every second masonry unit horizontally. Fasten ties to masonry with masonry nails.
5. Option: Use joint reinforcing for multiple wythes and cavity wall ties spaced not more than 400 mm (16 inches) vertically.
6. Tie interior and exterior wythes of reinforced masonry walls together with individual ties. Provide ties at intervals not to exceed 600 mm (24 inches) on center horizontally, and 400 mm (16 inches) on center vertically. Lay ties in the same line vertically in order to facilitate vibrating of the grout pours.

D. Anchorage of Abutting Masonry:

1. Anchor abutting masonry walls and partitions to concrete with dovetail anchors. Install dovetail slots vertically in concrete at centerline of abutting wall or partition. Locate dovetail anchors at

400 mm (16 inch) maximum vertical intervals. Secure anchors to existing wall with two 9 mm (3/8 inch) by 75 mm (3 inch) expansion bolts or two power-driven fasteners.

E. 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.

F. 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 CMU wythe of combination brick and CMU, cavity walls, and single wythe concrete masonry unit walls or partitions.
2. Reinforcing may be used in lieu of individual ties for anchoring brick facing to CMU backup in exterior masonry walls.
3. Brick veneer over frame backing walls does not require joint reinforcement.
4. Locate joint reinforcement in mortar joints at 400 mm (16 inch) maximum vertical intervals.
5. 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.
6. Joint reinforcement is required in every other course of stack bond CMU masonry.
7. Wherever brick masonry is backed up with stacked bond masonry, joint reinforcement is required in every other course of CMU backup, and in corresponding joint of facing brick.

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 BRICK EXPANSION AND CMU CONTROL JOINTS.

A. Provide brick expansion (BEJ) and 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 BRICKWORK

A. Lay clay brick in accordance with BIA Technical Note 11 series.

B. Laying:

1. Lay brick in running bond with course of masonry bonded at corners unless shown otherwise.
2. Maintain bond pattern throughout.
3. Do not use brick smaller than half-brick at any angle, corner, break or jamb.
4. Where length of cut brick is greater than one half but less than a whole brick, maintain the vertical joint location of such units.
5. Lay exposed brickwork joints symmetrical about center lines of openings.
6. Do not structural bond multi wythe brick walls unless shown.
7. Before starting work, lay facing brick on foundation wall and adjust bond to openings, angles, and corners.
8. Lay brick for sills with wash and drip, unless shown otherwise.
9. Build solid brickwork as required for anchorage of items.

C. Joints:

1. Exterior and interior joint widths: Lay for three equal joints in 200 mm (eight inches) vertically, unless shown otherwise.
2. Rake joints for pointing with colored mortar when colored mortar is not full depth.
3. Arches:
   a. Flat arches (jack arches) lay with camber of 1 in 200 (1/16 inch per foot) of span.

b. Face radial arches with radial brick with center line of joints on radial lines.

c. Form Radial joints of equal width.

d. Bond arches into backing with metal ties in every other joint.

D. Weep Holes:

1. Install weep holes at 400 mm (16 inches) on center in bottom of vertical joints of exterior masonry veneer or cavity wall facing over foundations, bond beams, and other water stops in the wall.
2. Form weep holes using wicks made of mineral fiber insulation strips turned up 200 mm (8 inches) in cavity. Anchor top of strip to backup to securely hold in place.
3. Install sand or pea gravel in cavity approximately 75 mm (3 inches) high between weep holes.

E. Solid Exterior Walls:

1. Build with 100 mm (4 inches) of nominal thick facing brick, backed up with concrete masonry units.
2. Construct solid brick jambs not less than 20 mm (.8 inches) wide at exterior wall openings and at recesses, except where exposed concrete unit backup is shown.
3. Do not use full bonding headers.
4. Parging:

   a. For solid masonry walls, lay backup to height of six brick courses, parge backup with 13 mm (1/2 inch) of mortar troweled smooth; then lay exterior wythe to height of backup.

   b. Make parging continuous over backup, and extend 150 mm (six inches) onto adjacent concrete or masonry.

   c. Parge, with mortar, the ends and backs for recesses in exterior walls to a thickness of 13 mm (1/2 inch).

   d. Parge with mortar to true even surface the inside surface of exterior walls.

F. Cavity Type Exterior Walls:

1. Keep air space clean of mortar accumulations and debris.

   a. Clean cavity by use of hard rubber, wood or metal channel strips having soft material on sides contacting wythes.

   b. Lift strips with wires before placing next courses of horizontal joint reinforcement or individual ties or adjustable cavity wall ties.

2. For each lift lay two courses of concrete masonry units, followed by six courses of brick facing.
3. Veneer Framed Walls:
   a. Build with 100 mm (4 inches) of face brick over sheathed stud wall with air space.
   b. Keep air space clean of mortar accumulations and debris.

3.10 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. Do not use brick jambs in exposed finish work.
5. Use concrete building brick only as filler in backup material where not exposed.
6. Masonry assemblies shall meet the required fire resistance in fire rated partitions of type and construction that will provide fire rating as shown.
7. Where lead lined concrete masonry unit partitions terminate below the underside of overhead floor or roof deck, fill the remaining open space between the top of the partition and the underside of the overhead floor or roof deck, with standard concrete masonry units of same thickness as the lead lined units.

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. Provide a 6 mm (1/4 inch) open joint for caulking between existing construction, exterior walls, concrete work, and abutting masonry partitions.
8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
9. 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).
10. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
11. Install deformed reinforcing bars of sizes shown.
12. Steel reinforcement, at time of placement, free of loose flaky rust, mud, oil, or other coatings that will destroy or reduce bond.
13. Steel reinforcement in place before grouting.
14. Minimum clear distance between parallel bars: One bar diameter.
15. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacings noted.
16. Support vertical bars near each end and at intermediate intervals not exceeding 192 bar diameters.
17. Reinforcement shall be fully encased by grout or concrete.
18. 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.
19. Stagger splices in adjacent horizontal reinforcing bars. Lap reinforcing bars at splices a minimum of 40 bar diameters.
20. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.
21. Cavity and joint horizontal reinforcement may be placed as the masonry work progresses.

3.12 POINTING

A. Fill joints with pointing mortar using rubber float trowel to rub mortar solidly into raked joints.

C. Finish exposed joints in finish work with a jointing tool to provide a smooth concave joint unless specified otherwise.

D. At joints with existing work match existing joint.

3.13 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. Double wythe masonry constructed grouted in lifts not to exceed 300 mm (12 inches) or less than 50 mm (2 inches) wide.
2. Consolidate by puddling with a grout stick during and immediately after placing.
3. 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.

3.14 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. Splice reinforcement bars where shown; do not splice at other places unless accepted by the COTR. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.

D. Provide not less than minimum lap as indicated on shop drawings, or if not indicated, as required by governing code.

E. 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.

F. 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.

G. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.

H. Anchor reinforced masonry walls to non-reinforced masonry where they intersect.

3.15 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. Columns, Piers and Pilasters:

1. Use CMU units of the size, shape and number of vertical core spaces shown. If not shown, use units which provide minimum clearances and grout coverage for number and size of vertical reinforcement bars shown.
2. Provide pattern bond shown, or if not shown, alternate head joints in vertical alignment.

F. 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.
3. Grouting Technique: At the Contractor’s option, use either low-lift or high-lift grouting techniques subject to requirements which follow.

G. Low-Lift Grouting:

1. Provide minimum clear dimension of 50 mm (2 inches) and clear area of 5160 mm^2 (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 hour. 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.
6. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.
7. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.
8. Place grout by pumping into grout spaces unless alternate methods are acceptable to the COTR.
9. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Place grout in lifts which do not exceed 1.5 m (5 feet). Allow not less than 30 minutes, nor more than one hour between lifts of a given pour. Mechanically consolidate each grout lift during pouring operation.
10. Place grout in lintels or beams over openings in one continuous pour.

11. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 25 mm (1 inch) of vertically reinforced cavities, during construction of masonry.
12. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 38 mm (1-1/2 inches) of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

3.16 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. Brickwork:
   1. First wet surfaces with clean water, then wash down with a solution of soapless detergent. Do not use muriatic acid.
   2. Brush with stiff fiber brushes while washing, and immediately thereafter hose down with clean water.
   3. Free clean surfaces of traces of detergent, foreign streaks, or stains of any nature.

C. Concrete Masonry Units:
   1. Immediately following setting, brush exposed surfaces free of mortar or other foreign matter.
   2. Allow mud to dry before brushing.

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SECTION 04 72 00

CAST STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This sections specifies manufactured concrete units to simulate a natural stone.

B. Installation of cast stone units.

1.2 RELATED WORK

A. Setting and pointing mortar: Section 04 05 13, MASONRY MORTARING and 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. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples:

1. Cast stone, sample panel, size 100 by 300 by 300 mm (4 by 12 by 12 inches) each color and finish.
2. Show finish on two 100 mm (4-inch) edges and 300 by 300 mm (12 by 12 inch) surface.

C. Shop Drawings:

1. Cast stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.
2. Setting drawings with setting mark.

D. Certificates: Test results indicating that the cast stone meets specification requirements and proof of plant certification.

E. Submit manufacturers test results of cast stone previously made by manufacturer.

F. Laboratory Data: Description of testing laboratories facilities and qualifications of its principals and key personnel.

G. 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

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):

A167-99 (2004).....Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A185-07.....Steel, Welded Wire Fabric, Plain for Concrete

A615/A615M-08.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

C33-07.....Concrete Aggregates

C150-07.....Portland Cement

C979-05.....Pigments for Integrally Colored Concrete

C1194-06.....Compressive Strength of Architectural Cast Stone

C1195-03.....Absorption of Architectural Cast Stone

C1364-07.....Architectural Cast Stone.

D2244-07.....Calculation of Color Differences from Instrumentally Measured Color Coordinates.

1.7 QUALITY ASSURANCE

A. 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).

B. Stone setter: Must have ten (5) years experience setting cast or natural building stone.

C. Testing: One (1) sample from production units may be selected at random from the field for each 500 cubic feet (14 m^3) 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 ASTMC 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. (3mm), 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

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 (14m^3) 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.

D. Fabricate units with sharp arris and details accurately reproduced with indicated texture on all exposed surfaces, unless otherwise indicated:
1. Slope exposed horizontal surfaces 1:12, unless otherwise indicated.
2. Provide drips on projecting elements, unless otherwise indicated.

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, hot-dip galvanized steel, brass, or stainless steel Type 302 or 304.

2.3 COLOR AND FINISH

A. To be selected by the Architect from manufacturer's full range.

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^2 ($25mm^2$) and not obvious under direct daylight illumination at a 5 ft. (1.5m)distance.

C. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 ft (3m) 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 1.5in. (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 (6m) 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

Cure units in a warm curing chamber 1000 F (537.8 C) at 95 percent relative humidity for approximately 12hours, or cure in a 95 percent moist environment at a minimum 700F (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 @ 500F (260.0 C) or 5 days @ 700F (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

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/brick joints 3/8 in. (9.5 cm).
2. At stone/stone joints in vertical position 3/8 in. (9.5 mm).
3. 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.
6. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   a. Do not use calcium chloride in mortar.
   b. Limit cementitious materials in mortar to portland cement and lime.

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. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated. Keep joints free of mortar and other rigid materials.
   1. Form open joint of width indicated, but not less than 3/8 inch (10 mm).
E. Remove excess mortar from unit faces immediately after setting.
F. Tuck point unit joints to a slight concave profile.

3.5 INSTALLATION TOLERANCES

A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
B. Variation from Level: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.
D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch (1.5 mm), except due to warpage of units within tolerances specified.

3.6 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.

3.7 REPAIR AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect; 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.

1. In-Progress Cleaning: Clean cast stone as work progresses.
   a. Remove mortar fins and smears before tooling joints.
   b. Remove excess sealant immediately, including spills, smears, and spatter.
2. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
   a. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   b. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   c. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
   b. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20.

3.8 INSPECTION AND ACCEPTANCE

Inspect finished installation according to Bulletin #36 published by the Cast Stone Institute.

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0SECTION 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. It includes all labor and materials required to furnish and install the structural steel shown on the Drawings and required by these Specifications, including that shown on mechanical or electrical Drawings, or required in their Specification Sections.

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. Metal Stud Framing: Section 05 40 00, COLD-FORMED METAL FRAMING.

D. Fireproofing: Section 07 81 00, APPLIED FIREPROOFING.

1.3 QUALITY ASSURANCE:

A. 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 COTR.

B. Welders' Qualifications: Personnel and procedures are to be qualified in accordance with AWS D1.1/D1.1M:2008.

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 ASD Manual, Ninth Edition, Page 1-145), except as follows:

A. Elevation tolerance for top surface of steel beams and girders at connections to columns at time roof is erected is 13 mm (1/2 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 COTR 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 COTR. 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.

B. The Engineer has designed a project which will be safe after full completion. The Engineer has no expertise in, and takes no responsibility for, construction means and methods or job site safety during construction, which are exclusively the Contractor's responsibility. Processing and/or approving submittals made by the Contractor which may contain information related to construction methods or safety issues, or participation in meetings where such issues might be discussed, shall not be construed as voluntary assumption by the Engineer of any responsibility for safety procedures.

1.6 REGULATORY REQUIREMENTS:

A. AISC: Specification for Structural Steel Buildings - Allowable Stress Design.

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.

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 (Thirteenth Edition, 2005)
2. Code of Standard Practice for Steel Buildings and Bridges (March 2005).

C. American National Standards Institute (ANSI):

B18.22.1-98.....Plain Washers

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

A6/A6M-02.....Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A36/A36M-01.....Standard Specification for Carbon Structural Steel

A53/A53M-01.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

A123/A123M-02.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A242/A242M-01.....Standard Specification for High-Strength Low-Alloy Structural Steel

A283/A283M-00.....Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

A307-00.....Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

A325-02.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A490-02.....Standard Specification for Heat-Treated Steel Structural Bolts 150 ksi Minimum Tensile Strength

A500-01.....Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

A501-01.....Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

A572/A572M-01.....Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

A992/A992M-02.....Standard Specification for Structural Steel Shapes

E. American Welding Society (AWS):
D1.1-02.....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 Wide Flange Shapes: Fy=50 ksi Steel - ASTM A572, or ASTM A992.

B. Structural Steel Channels, Angles, Plates, Bars, Etc.: Fy=36 ksi Steel - ASTM A36.

C. Structural Tubing: Fy= 46 ksi - ASTM A500, Grade B.

D. Structural Tubing: Fy= 35 ksi - ASTM A501.

E. Steel Pipe: Fy= 35 ksi - ASTM A53, Grade B.

F. Bolts, Nuts and Washers:
1. High-strength bolts, including nuts and washers: ASTM A325-07a.
2. Bolts and nuts, other than high-strength: ASTM A307, Grade A. Provide washers and heavy nuts for anchor bolts (both ends).
3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ANSI Standard B18.22.1.

G. Zinc Coating: ASTM A123.

H. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035.

I. Welding Electrodes:
1. For Carbon Steels: Conform to requirements of AWS D1.1/D1.1M:2008, using Series E70 electrodes, appropriate for the materials being welded.

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 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:

A. Fabrication in accordance with Chapter M, Specification for Steel Buildings - Allowable Stress Design and Plastic Design

B. Connection Design:
Select connections per AISC standards for forces and moments given on the Drawings. Where none are given, select connection for the full uniform load capacity of the member.

C. Bearing and Base Plates: Column base plates are to be shop attached. Beam bearing plates may be attached or loose.

D. Holes: Drill or punch holes in members as required for passage of conduit and piping, and attachment of joists, nailers, etc. Burning such holes is not permitted. If opening is not shown on structural Drawings, obtain prior approval.

E. Cleaning:
1. Remove oil, dirt, loose mill scale, or other material which would impair welding, performance of slip critical connections, or adherence of sprayed fireproofing.
2. For steel that is to be painted, cleaning techniques are to be as required by the appropriate SSPC paint Specification listed in Section 09 91 00, PAINTING..

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. Steel not exposed to view in the finished structure.

D. See the Architectural Drawings for galvanized steel items to be painted.

3.4 GALVANIZING:

A. 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.

B. Prior to galvanizing, clean steel of foreign substances per ASTM A385-08.

C. Do not treat galvanized finish with a stain-inhibiting chromate treatment.

D. Galvanize all shelf angles, brick lintels in exterior walls, all exterior steel exposed to the elements, and all items indicated on the Drawings as "galvanized."

3.5 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.

C. This structure is designed to be self-supporting and stable after the building is fully completed. It is solely the Contractor's responsibility to determine erection procedures and sequence, and to ensure the stability of the building and its component parts, and the adequacy of temporary or incomplete connections, during erection. This includes the addition of any shoring, sheeting, temporary guys, bracing or tie-downs that might be necessary. Such material is not shown on the Drawings. If applied, they shall be removed as conditions permit, and shall remain the Contractor's property.

D. Safety: It is solely the Contractor's responsibility to follow all applicable safety codes and regulations governing this work.

E. Tolerances: Per AISC Code of Standard Practice.

3.6 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.

3.7 FIELD QUALITY CONTROL

A. Inspection agency shall perform the following:

1. Review qualifications of welders, operators, and welding procedures submitted by the Contractor.
2. Review materials' proofs of compliance. Identify markings of structural steel shapes to conform to ASTM standards specified. Review structural steel shapes certificates of compliance.
3. Inspect bolted connections, per the requirements of the AISC Specification for Structural Joints. Periodically identify markings of bolts to conform to ASTM standards specified. Periodically inspect bearing type bolts. Review bolt manufacturer’s certificates of compliance.
4. Inspect welded connections per the requirements of AWS D1.1/D1.1M:2008, Chapter 6. Identify markings of weld filler materials to conform to AWS specifications specified. Review weld filler materials certificates of compliance. Periodically inspect and test single pass fillet welds by visual methods.
5. Inspect the application of joint details at each connection for compliance with the construction documents.

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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, bridging and required accessories as shown and specified. This Section includes the following:

1. Exterior load-bearing steel stud walls and headers.
2. Interior load-bearing steel stud walls and headers.
3. Interior steel stud shear walls.

1.2 RELATED WORK:

A. Structural steel framing: Section 05 12 00, STRUCTURAL STEEL FRAMING.

B. Roof Trusses: Section 06 17 53, PREFABRICATED WOOD TRUSSES.

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.

E. Wood sheathing: Section 06 10 00, ROUGH CARPENTRY.

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 with the minimum physical and structural properties indicated.

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.

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 (2007)

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

A36/A36M(REV. A)-2003...Standard Specifications for Carbon Structural Steel

A123/A123M-2002.....Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153/A153M-2003.....Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A307-2002.....Standard Specifications for Carbon Steel Bolts and Studs

A653/A653M-2003.....Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

C955-2003.....Standard Specifications for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases

E488-96(Reapproved 2003)Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

E1190-95(Reapproved 2000)Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members

D. American Welding Society (AWS):

D1.3-(2008).....Structural Welding Code-Sheet Steel

E. Military Specifications (Mil. Spec.):

MIL-P-21035B(Reinst. Notice 2) Paint, High Zinc Dust Content, Galvanizing Repair

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Sheet Steel for studs and accessories 16 gage and heavier: ASTM A653, structural steel, zinc coated G90, Grade 50 (Class 1 or 2) with a yield of 340 MPa (50 ksi) minimum.

B. Sheet Steel for studs and accessories 18 gage and lighter: ASTM A653, structural steel, zinc coated G60, with a yield of 230 MPa (33 ksi) minimum.

C. Galvanizing Repair Paint: MIL-P-21035B.

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:
      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:
      (1-5/8 inches)
      (2 inches)
      (2-1/2 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: 16 gage.
   2. Flange Width: Manufacturer’s standard deep flange, 1 5/16 inch minimum.

2.3 FRAMING ACCESSORIES:

A. Fabricate steel framing accessories of the same material, finish, and yield strength used for framing members.
B. Provide accessories of manufacturer’s standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging (16 gage minimum), and solid blocking.
   3. Web stiffeners.
   4. Deflection track and vertical slide clips.
   5. Stud kickers and girts.
   6. End closures.
   7. Clip angles and reinforcement plates: 14 gage minimum galvanized.

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. Cadmium plated meeting requirements of Federal Specification QQ-P 416A, Type II, Class #1; 0.0005 inch thick. Minimum size of screw fasteners shall be #10-16.

2.6 REQUIREMENTS:

A. Welding in accordance with AWS D1.3

B. Furnish members and accessories by one manufacturer only.

C. Identification: All members to receive painted identification stripe (nominal 1 inch wide) at approximately 1/3 points on both flanges. Provide separate and distinct color for each gauge member delivered to job. All identification marking to be done at the mill.

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.

F. Provide full bearing against inside track webs, before attaching stud to track. Bridging shall be solidly connected to each stud in accordance with manufacturer's recommendations.

G. Welding equipment and welder's qualifications to meet the requirements of AWS D1.3/D1.3M-2008. Qualify all welders. Evidence of questionable weld quality will be cause to reject all welding and require certification of all welds by an independent testing laboratory. Cost of testing to be borne by Contractor.

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.

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 at a maximum spacing of 3 feet 6 inches for exterior walls and interior bearing walls and 5 feet for interior shear walls.

I. Studs in one piece for their entire length, splices will not be permitted.

J. Stud spacing shall be 16 inch c/c unless otherwise shown on structural Drawings.K. Provide joist bridging and web stiffeners at reaction points where shown.

K. Heads of openings shall consist of stud and track sections as shown in the Header Schedule. Jamb sections shall consist of heavier gage studs, multiple studs, or both as shown in the Header Schedule. Multiple jamb studs shall be connected together at 12" o.c.

L. Provide temporary bracing and leave in place until framing is permanently stabilized.

M. Blocking: Provide blocking in framing for all wall-mounted items, including door stops, equipment or casework.

N. 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:

A. Touch-up damaged galvanizing and welds with galvanizing repair paint.

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SECTION 06 06 60

TRANSLUCENT RESIN PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to this Section.

1.2 RELATED SECTIONS

A. SECTION 09 06 00 SCHEDULE FOR FINISHES

1.3 SUMMARY

A. This Section includes the Resin Fabrication as shown and specified in the described system(s):

1. Decorative Wall Panels
2. Interior Door Glazing
3. Interior Window Glazing

1.4 SUBMITTALS

A. General: Submit the following in accordance with conditions of contact and Division 1 specification section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Product Data: Indicate product description, fabrication information, and compliance with specified performance requirements.

C. Submit material test results or certifications indicating each type and class of panel system complies with the project performance requirements

1. Test results required are:
   a. Tensile Strength (ASTM D 638)
   b. Tensile Modulus (ASTM D 638)
   c. Flexural Strength (ASTM D 790)
   d. Flexural Modulus (ASTM D 790)
   e. Rate of Burning (ASTM D 635)
   f. Density of Smoke (ASTM D 2843)
   g. Impact Strength (ASTM D 256)
   h. Abrasion Resistance (ASTM D 1044)
   i. Max Continuous Service Temperature
   j. Coefficient of Thermal Expansion (ASTM D 696)
   k. Thermal Conductivity (ASTM C 177)

D. Samples for Verification:

1. Submit minimum 8 inch by 8 inch sample for each type, texture, pattern and color of Resin.

E. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Materials and systems shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least 7 consecutive years.

B. Material Properties

1. Minimum light transmission of 92% through clear resin portion of panel.
2. Minimum tensile modulus of 490,000 psi.
3. Resin will not yellow or degrade with exposure to sunlight.

C. Performance Criteria

1. Tensile Strength (ASTM D 638): Minimum 11,000 psi
2. Tensile Modulus (ASTM D 638): Minimum 490,000 psi
3. Flexural Strength (ASTM D 790): Minimum 17,000 psi
4. Flexural Modulus (ASTM D 790): Minimum 490,000 psi
5. Rate of Burning (ASTM D 635): CC2
6. Density of Smoke (ASTM D 2843): Maximum 5%
7. Impact Strength (ASTM D 256): Minimum .28 ft-lb/in notch
8. Abrasion Resistance (ASTM D 1044): Maximum 25% @ 200 cycles
9. Max Continuous Service Temperature: 170°F
10. Coef of Thermal Expansion (ASTM D 696): Maximum 3.0x10e-5 in/(in-°F)
11. Thermal Conductivity (ASTM C 177): Maximum 0.90 BTU-in/(hr-ft²-°F)

D. Allowable Tolerances:

1. Flatness: 1/16" maximum deviation over 12"
2. Thickness: ±10%
3. Height/Width: ±1/2"

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver no components to project site until areas are ready for installation.

B. Handle materials to prevent damage to finished surfaces and edges.

C. Keep protective masking in place while fabricating.

D. Provide protective coverings to prevent damage or staining following installation for duration of project.

E. Store components on edge, fully supported at 10 off vertical, indoors where atmospheric conditions are controlled to avoid temperature extremes and exposure to ultraviolet light and moisture.

F. Follow Manufactures recommendations for storage and handling.

G. Before installing Resin Fabrications, permit them to reach room temperature.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install Resin Panels until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 WARRANTY

A. Provide manufacturers 1 year warranty against defects in materials. Warranty shall provide material to repair, or replace, defective materials.

B. The warranty shall not deprive the owner of other rights or remedies the Owner may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material:

1. Sheet Size: Standard 4’ x 8’, maximum 5’ x 10’
2. Thickness: Minimum 1/4”
3. Finishes: Matte
4. Options:
   a. UV protection layer

B. Description:

Minimum thickness per specifications and manufacturer’s recommendation translucent resin panel as specified in SECTION 09 06 00, SCHEDULE FOR FINISHES, cut to size, edge sealed per manufacturer Fabrication Guide, and installed per architect’s drawings.

C. Interlayer Materials: Compatible with acrylic and bonding process to create a monolithic sheet of material when complete.

2.2 FABRICATION

A. General: Fabricate Resin Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings.

B. Comply with manufacturer's written recommendations for fabrication.

C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.

1. Sawing: Select equipment and blades suitable for type of cut required.
2. Drilling: Drills specifically designed for use with Resin products.
3. Milling: Climb cut where possible.
4. Routing

2.3 MISCELLANEOUS MATERIALS

A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaner: Mild soap and water or common acrylic cleaners such as Novus or Gel-Gloss.

C. Fasteners: Use screws designed specifically for Resins. Provide threaded metal or nylon inserts for applications requiring frequent disassembly.

D. Drilled Panel Wall Anchors: As provided by the manufacturer. Provide extensions to accommodate thicknesses scheduled or illustrated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of Resin Fabrications will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for the installation of Resin Fabrications.

B. Shop fabricate items to the greatest degree possible.

C. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.

D. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

E. Form field joints using manufacturer's recommended procedures. Locate seams in panels so that they are not directly in line with seams in substrates.

3.3 CLEANING AND PROTECTION

A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

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SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies wood blocking, framing, sheathing, furring, nailers, sub-flooring, rough hardware, and light wood construction.

1.2 RELATED WORK:

A. Milled woodwork: Section 06 20 00, FINISH CARPENTRY.

B. Gypsum sheathing: Section 09 29 00, GYPSUM BOARD.

C. Cement board sheathing: Section 06 16 63, CEMENTITIOUS SHEATHING.

D. Stud walls: Section 05 40 00, COLD-FORMED METAL FRAMING.

1.3 SUMBITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. 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 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):
National Design Specification for Wood Construction
NDS-05.....Conventional Wood Frame Construction

C. American Institute of Timber Construction (AITC):
A190.1-02.....Structural Glued Laminated Timber

D. American Society of Mechanical Engineers (ASME):

B18.2.1A-96(R2005).....Square and Hex Bolts and Screws

B18.2.2-87(R2005).....Square and Hex Nuts

B18.6.1-81 (R97).....Wood Screws

B18.6.4-98(R2005).....Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws

E. American Plywood Association (APA):

E30-03.....Engineered Wood Construction Guide

F. American Society for Testing And Materials (ASTM):

A47-99(R2004).....Ferritic Malleable Iron Castings

A48-03.....Gray Iron Castings

A653/A653M-07.....Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process

C954-04.....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

C1002-04.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs

D143-94(R2004).....Small Clear Specimens of Timber, Method of Testing

D1760-01.....Pressure Treatment of Timber Products

D3498-03.....Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems

F844-07.....Washers, Steel, Plan (Flat) Unhardened for General Use

F1667-05.....Nails, Spikes, and Staples

G. Federal Specifications (Fed. Spec.):

MM-L-736C.....Lumber; Hardwood

H. Commercial Item Description (CID):

A-A-55615.....Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)

I. U.S. Department of Commerce Product Standard (PS)

PS 1-07.....Construction and Industrial Plywood

PS 2-04.....Wood-Based Structural-Use Panels

PS 20-05.....American Softwood Lumber Standard

PART 2 - PRODUCTS

2.1 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 (including top plates and roof framing): Southern Pine No. 2 or better. Minimum allowable design stresses per the National Design Specification Supplement.

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. 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.

2.2 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 Structural I, Exposure 1 or Exterior; panel grade CD or better.
2. Wall sheathing:
   a. 12 mm (15/32 inch) thick with supports 400 mm (16 inches) on center unless specified otherwise.
3. Roof sheathing:
   a. Minimum 19 mm (3/4 inch) thick or span rating of 48/24 for supports 600 mm (24 inches) on center (with plywood clips).

2.3 STRUCTURAL-USE PANELS

A. Comply with APA PRP-108 and Voluntary Product Standard PS2-04.

B. Bearing the mark of a recognized association or independent agency that maintains continuing control over quality of panel which identifies compliance by end use, Span Rating, and exposure durability classification.

C. Roof Sheathing only:

1. APA Rated sheathing panels, durability classification of Exposure 1 or Exterior, minimum 19 mm (3/4 inch) thick or Span Rating of 48/24 for supports 600 mm (24 inches) on center.

2.4 ROUGH HARDWARE AND ADHESIVES:

A. Miscellaneous Bolts: ASTM A307, Grade A.

B. Washers

1. ASTM F844.
2. Use zinc or cadmium coated steel or cast iron for washers exposed to weather.

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.

PART 3 - EXECUTION

3.1 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. APA for installation of plywood or structural use panels.

B. Fasteners:

1. Nails.

a. Nail in accordance with the IBC Fastening Schedule 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 32 mm (1-1/4 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.

4) Sheathing:

a) 150 mm (6 inch) wide or less to each joist face nail two-8d.

b) Plywood or structural use panel to each stud or joist face nail 8d or 6d ring-shank, at supported edges 150 mm (6

inches) on center and at intermediate supports 250 mm (10 inches) on center.

5) Sole plate to joist or blocking, through sub floor face nail 20d nails, 400 mm (16 inches) on center.
6) Top plate to stud, end nail two-16d.
7) Stud to sole plate, toe nail or framing anchor. Four-8d
8) Doubled studs, face nail 16d at 600 mm (24 inches) on center.
9) Built-up corner studs 16d at 600 mm (24 inches) (24 inches) on center.
10) Doubled top plates, face nails 16d at 400 mm (16 inches) on center.
11) Top plates, laps, and intersections, face nail two-16d.
12) Continuous header, two pieces 16d at 400 mm (16 inches) on center along each edge.
13) Ceiling joists to plate, toenail three-8d or framing anchor.
14) Continuous header to stud, four 16d.
15) Ceiling joists, laps over partitions, face nail three-16d or framing anchor.
16) Ceiling joists, to parallel rafters, face nail three-16d.
17) Rafter to plate, toe nail three-8d. or framing anchor. Brace 25 mm (1 inch) thick board to each stud and plate, face nail three-8d.
18) Built-up girders and beams 20d at 800 mm (32 inches) on center along each edge.

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. 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.

D. 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.

E. Bridging:
1. Use 25 mm by 75 mm (1 inch by 3 inch) lumber with ends beveled for slope. Option: Metal bridging may be used for wood bridging.
2. Install one row of bridging for joist spans over 2400 mm (8 feet), but less than 4800 mm (16 feet) long; install two rows for spans over 4800 mm (16 feet) long.
3. Install an extra row of bridging between trimmer and next two joists if header is more than 600 mm (2 feet) from end of trimmer or from regular row of bridging.
4. Secure with two nails at ends.
5. Leave bottom ends loose until after roof sheathing is installed.

6. Install single row of bridging at centerline of span and two rows at the third points of span unless otherwise shown.
7. Provide and install bridging for prefabricated wood trusses as indicated on the truss manufacturer's approved Shop Drawings.

F. Roof Framing:
1. Set rafters with crown edge up.
2. Form a true plane at tops of rafters.
3. Valley, Ridge, and Hip Members:
   a. Size for depth of cut on rafters.
   b. Straight and true intersections of roof planes.
   c. Secure hip and valley rafters to wall plates by using framing connectors.
   d. Double valley rafters longer than the available lumber, with pieces lapped not less than 1200 mm (4 feet) and spiked together.
   e. Butt joint and scab hip rafters longer than the available lumber.
4. Spike to wall plate and to ceiling joists except when secured with framing connectors.
5. Frame openings in roof with headers and trimmer rafters. Double headers carrying more than one rafter unless shown otherwise.
6. Install 50 mm by 100 mm (2 inch by 4 inch) strut between roof rafters and ceiling joists at 1200 mm (4 feet) on center unless shown otherwise.

G. Framing of Dormers:
1. Frame as shown, with top edge of ridge beveled to pitch of roof header.
2. Set studs on doubled trimmer rafters.
3. Double studs at corners of dormers.
4. Double plate on studs and notch rafters over plate and bear at least 75 mm (3 inches) on plates.
5. Frame opening to receive window frame or louver frame.

H. Sheathing:
1. Use plywood for shear walls and use plywood or structural-use panels for roof sheathing.
2. Lay panels with joints staggered, with edge and ends 3 mm (1/8 inch) apart and nailed over bearings as specified.
3. Set nails not less than 9 mm (3/8 inch) from edges.
4. 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.

3.2 ACCEPTANCE

A. Members with excessive knots, twists, checks, or shakes, or other obvious imperfections, will be rejected.

- - - E N D - - -

SECTION 06 10 10

ROUGH CARPENTRY (ARCHITECTURAL)

PART 1 – GENERAL

1.1 DESCRIPTION:

Section specifies wood blocking, framing, sheathing, furring, nailers, rough hardware, light wood construction and plywood backing panels.

1.2 RELATED WORK:

A. Stud Walls: Section 05 40 00, COLD-FORMED METAL FRAMING.

B. Milled woodwork: Section 06 20 00, FINISH CARPENTRY.

C. Gypsum sheathing: Section 09 29 00, GYPSUM BOARD.

1.3 SUMBITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. 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 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):
National Design Specification for Wood Construction
NDS-05.....Conventional Wood Frame Construction

C. American Institute of Timber Construction (AITC):
A190.1-02.....Structural Glued Laminated Timber

D. American Plywood Association (APA):
E30-03.....Engineered Wood Construction Guide

E. American Society of Mechanical Engineers (ASME):

B18.2.1A-96 (R2005).....Square and Hex Bolts and Screws

B18.2.2-87 (R2005).....Square and Hex Nuts

B18.6.1-81 (R97).....Wood Screws

B18.6.4-98 (R2005).....Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws

F. American Society for Testing And Materials (ASTM):

A47-99 (R2004).....Ferritic Malleable Iron Castings

A48-03.....Grey Iron Castings

A653/A653M-07.....Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process

C954-04.....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

C1002-04.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs

D143-94 (R2004).....Small Clear Specimens of Timber, Method of Testing

D1760-01.....Pressure Treatment of Timber Products

D2559-04.....Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions

D3498-03.....Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems

F844-07.....Washers, Steel, Plan (Flat) Unhardened for General Use

F1667-05.....Nails, Spikes, and Staples

G. Federal Specifications (Fed. Spec.):

MM-L-736C.....Lumber; Hardwood

H. Commercial Item Description (CID):

A-A-55615.....Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)

I. Military Specification (Mil. Spec.):

MIL-L-19140E.....Lumber and Plywood, Fire-Retardant Treated

J. U.S. Department of Commerce Product Standard (PS)

PS 1-95.....Construction and Industrial Plywood

PS 2-04.....Wood-based Structural-Use Panels

PS 20-05.....American Softwood Lumber Standard

PART 2 - PRODUCTS

2.1 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 (including top plates and roof framing): Southern Pine No. 2 or better. Minimum allowable design stresses per the National Design Specification Supplement.

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. 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.

2.2 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. Plywood Backing Panels:

1. APA rated Exposure 1 or Exterior; panel grade CD or better, in thickness indicated or, if not indicated, not less than ½-inch (13-mm) nominal thickness.

D. Sheathing:

1. APA rated Structural I, Exposure 1 or Exterior; panel grade CD or better.
2. Wall sheathing:
   a. 12 mm (15/32 inch) thick with supports 400 mm (16 inches) on center unless specified otherwise.
3. Roof sheathing:
   a. Minimum 19 mm (3/4 inch) thick or span rating of 48/24 for supports 600 mm (24 inches) on center (with plywood clips).

2.3 STRUCTURAL-USE PANELS

A. Comply with APA PRP-108 and Voluntary Product Standard PS2-04.

B. Bearing the mark of a recognized association or independent agency that maintains continuing control over quality of panel which identifies compliance by end use, Span Rating, and exposure durability classification.

C. Roof Sheathing Only:

1. APA Rated sheathing panels, durability classification of Exposure 1 or Exterior, minimum 19 mm (3/4 inch) thick or Span Rating of 48/24 for supports 600 mm (24 inches) on center.

2.4 ROUGH HARDWARE AND ADHESIVES:

A. Miscellaneous Bolts: ASTM A307, Grade A.

B. Washers

1. ASTM F844.
2. Use zinc or cadmium coated steel or cast iron for washers exposed to weather.

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.

2.5 FASTENERS:

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
   1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

PART 3 - EXECUTION

3.1 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. APA for installation of plywood or structural use panels.

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 32 mm (1 1/4 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.
      4) Sheathing:
         a) 150 mm (6 inch) wide or less to each joist face nail two-8d.
         b) Plywood or structural use panel to each stud or joist face nail 8d or 6d ring-shank, at supported edges 150 mm (6 inches) on center and at intermediate supports 250 mm (10 inches) on center.
      5) Sole plate to joist or blocking, through sub floor face nail 20d nails, 400 mm (16 inches) on center.
      6) Top plate to stud, end nail two-16d.

7) Stud to sole plate, toe nail or framing anchor. Four-8d
8) Doubled studs, face nail 16d at 600 mm (24 inches) on center.
9) Built-up corner studs 16d at 600 mm (24 inches) on center.
10) Doubled top plates, face nails 16d at 400 mm (16 inches) on center.
11) Top plates, laps, and intersections, face nail two-16d.
12) Continuous header, two pieces 16d at 400 mm (16 inches) on center along each edge.
13) Ceiling joists to plate, toenail three-8d or framing anchor.
14) Continuous header to stud, four 16d.
15) Ceiling joists, laps over partitions, face nail three-16d or framing anchor.
16) Ceiling joists, to parallel rafters, face nail three-16d.
17) Rafter to plate, toe nail three-8d. or framing anchor. Brace 25 mm (1 inch) thick board to each stud and plate, face nail three-8d.
18) Built-up girders and beams 20d at 800 mm (32 inches) on center along each edge.

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. 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.

D. 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.

E. Bridging:

1. Use 25 mm by 75 mm (1 inch by 3 inch) lumber with ends beveled for slope. Option: Metal bridging may be used for wood bridging.

2. Install one row of bridging for joist spans over 2400 mm (8 feet), but less than 4800 mm (16 feet) long; install two rows for spans over 4800 mm (16 feet) long.

3. Install an extra row of bridging between trimmer and next two joists if header is more than 600 mm (2 feet) from end of trimmer or from regular row of bridging.

4. Secure with two nails at ends.

5. Leave bottom ends loose until after subflooring or roof sheathing is installed.

6. Install single row of bridging at centerline of span and two rows at the third points of span unless otherwise shown.

F. Roof Framing:

1. Set rafters with crown edge up.

2. Form a true plane at tops of rafters.

3. Valley, Ridge, and Hip Members:
   a. Size for depth of cut on rafters.
   b. Straight and true intersections of roof planes.
   c. Secure hip and valley rafters to wall plates by using framing connectors.
   d. Double valley rafters longer than the available lumber, with pieces lapped not less than 1200 mm (4 feet) and spiked together.
   e. Butt joint and scab hip rafters longer than the available lumber.
4. Spike to wall plate and to ceiling joists except when secured with framing connectors.
5. Frame openings in roof with headers and trimmer rafters. Double headers carrying more than one rafter unless shown otherwise.
6. Install 50 mm by 100 mm (2 inch by 4 inch) strut between roof rafters and ceiling joists at 1200 mm (4 feet) on center unless shown otherwise.

G. Framing of Dormers:
1. Frame as shown, with top edge of ridge beveled to pitch of roof header.
2. Set studs on doubled trimmer rafters.
3. Double studs at corners of dormers.
4. Double plate on studs and notch rafters over plate and bear at least 75 mm (3 inches) on plates.
5. Frame opening to receive window frame or louver frame.

H. Sheathing:
1. Use plywood for shear walls and use plywood or structural-use panels for roof sheathing.
2. Lay panels with joints staggered, with edge and ends 3 mm (1/8 inch) apart and nailed over bearings as specified.
3. Set nails not less than 9 mm (3/8 inch) from edges.
4. 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.

3.2 ACCEPTANCE:

A. Members with excessive knots, twists, checks or shakes, or other obvious imperfections, will be rejected.

- - - E N D - - -

SECTION 06 20 00

FINISH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies exterior and interior millwork.

B. Items specified.

- Interior standing and running trim.
- Interior ornamental work.
- Interior borrowed light.
- Custom wood cabinets.
- Plastic laminate cabinets.
- Plastic laminate countertops.
- Solid-surfacing-material countertops and vanity (integral sink) bowl.
- Closet shelving and clothes rods.
- Exterior bead board ceiling.
- Exterior frames and jambs.
- Exterior ornamental work.
- Shop finishing of interior woodwork.
- Shop priming exterior woodwork.
- Shop finishing of exterior woodwork.

1.2 RELATED WORK

A. Framing, furring and blocking: Section 06 10 00, ROUGH CARPENTRY.

B. Wood doors: Section 08 14 00, WOOD DOORS.

C. Color and texture of finish: Section 09 06 00, SCHEDULE FOR FINISHES.

D. Stock Casework: Section 12 32 00, MANUFACTURED WOOD CASEWORK.

E. Electrical light fixtures and duplex outlets: Division 26, ELECTRICAL.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:

1. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   a. Show details full size.
   b. Show locations and sizes of furring, blocking, and hanging strips,

including concealed blocking and reinforcement specified in other Sections.

c. Product cut sheets of cabinet hardware.

2. Samples for Initial Selection:

a. Shop-applied transparent finishes.

b. Shop-applied opaque finishes.

c. Plastic laminates.

d. Solid-surfacing materials.

C. Samples for Verification:

1. Veneer-faced panel products with or for transparent finishes, Plastic laminate finished plywood or particleboard, and Solid-surfacing materials, 150 mm by 300 mm (six by twelve inches).

2. Corner pieces as follows:

a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 450 mm (18 inches) high by 450 mm (18 inches) wide by 150 mm (6 inches)deep.

b. Miter joints for standing trim.

3. Exposed cabinet hardware and accessories, one unit for each type and finish.

4. Counter top, plastic laminate, 150 mm (six inch) square

D. Certificates:

1. Indicating preservative treatment of materials meet the requirements specified.

2. Indicating moisture content of materials meet the requirements specified.

3. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

4. Qualification Data: For Installer.

E. List of acceptable sealers for preservative treated materials.

F. Manufacturer's literature and data:

1. Finish hardware

2. Sinks with fittings

3. 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 COTR. 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):

A53-06.....Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless

A167-99 (R2004).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

B26/B26M-05.....Aluminum-Alloy Sand Castings

B221-06.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

E84-07.....Surface Burning Characteristics of Building Materials

F436-07.....Hardened Steel Washers

C. American Hardboard Association (AHA):

A135.4-04.....Basic Hardboard

D. Builders Hardware Manufacturers Association (BHMA):

A156.9-03.....Cabinet Hardware

A156.11-04.....Cabinet Locks

A156.16-02.....Auxiliary Hardware

E. Hardwood Plywood and Veneer Association (HPVA):

HP1-04.....Hardwood and Decorative Plywood

F. National Particleboard Association (NPA):

A208.1-99.....Wood Particleboard

G. American Society of Mechanical Engineers (ASME):

B18.2.1-96(R2005).....Square and Hex Bolts and Screws (Inch Series)

H. American Wood-Preservers' Association (AWPA):

AWPA C1-03.....All Timber Products – Preservative Treatment by Pressure Processes

I. Architectural Woodwork Institute (AWI):

AWI-99.....Architectural Woodwork Quality Standards and Quality Certification Program

J. National Electrical Manufacturers Association (NEMA):

LD 3-05.....High-Pressure Decorative Laminates

LD 3.1-95.....Application, Fabrication and Installation of High-Pressure Decorative Laminates

K. U.S. Department of Commerce, Product Standard (PS):

PS1-95.....Construction and Industrial Plywood

PS20-05.....American Softwood Lumber Standard

L. Military Specification (Mil. Spec):

MIL-L-19140E.....Lumber and Plywood, Fire-Retardant Treated

M. Federal Specifications (Fed. Spec.):

A-A-1922A.....Shield Expansion

A-A-1936.....Contact Adhesive

FF-N-836D.....Nut, Square, Hexagon Cap, Slotted, Castle

FF-S-111D(1).....Screw, Wood

MM-L-736(C).....Lumber, Hardwood

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance.

B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating plastic laminate casework without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: Red oak, plain sawn or sliced, unless otherwise noted.

C. Wood Species for Opaque Finish: Any closed-grain hardwood, unless otherwise specified.

2.2 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, vertical grain for transparent finish including stain transparent finish.
2. Use Prime for painted or opaque finish.
3. Use DOC PS 1, Exterior for exterior locations.

E. Use edge grain Wood members exposed to weather.2.3 PLYWOOD

A. Softwood Plywood:

1. Prod. Std.
2. Grading and Marking:
   a. Each sheet of plywood shall bear the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood.
   b. The mark shall identify the plywood by species group or identification index, and shall show glue type, grade, and compliance with PS1.
3. Plywood, 13 mm (1/2 inch) and thicker; not less than five ply construction, unless otherwise shown or specified.
4. Plastic Laminate Plywood Cores:
   a. Exterior Type, and species group.
   b. Veneer Grade: A-C.

B. Hardwood Plywood:

1. HPVA: HP.1
2. Species of face veneer shall be as shown or as specified in connection with each particular item.
3. Inside of Building:
   a. Use Type I (exterior) A Grade veneer for transparent finish.
4. On Outside of Building:
   a. Use Type I, (exterior) A Grade veneer for natural or stained and varnish finish.

5. Use plain sliced red oak, unless specified otherwise.

2.4 PARTICLEBOARD

A. NPA A208.1

B. Plastic Laminate Particleboard Cores:

1. Use High-density, Type 2, Grade 2-M-2, exterior bond, made with adhesive containing no urea formaldehyde.

2.5 PLASTIC LAMINATE

A. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

B. Chemical-Resistant, High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard and as follows:

1. Laminate has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.9.5:

a. Nitric Acid (30 Percent): Moderate effect.

b. Sulfuric Acid (77 Percent): Moderate effect.

c. Phosphoric Acid (75 Percent): No effect.

d. Acetic Acid (98 Percent): No effect.

e. Formaldehyde: No effect.

f. Ethyl Acetate: No effect.

g. Ethyl Ether: No effect.

h. Phenol 85 Percent): Moderate effect.

i. Benzene: No effect.

j. Xylene: No effect.

k. Butyl Alcohol: No effect.

l. Furfural: No effect.

m. Methyl Ethyl Ketone: No effect.

n. Sodium Hydroxide (25 Percent): No effect.

o. Sodium Sulfide (15 Percent): No effect.

p. Ammonium Hydroxide (28 Percent): No effect.

q. Zinc Chloride: No effect.

r. Gentian Violet: No effect.

s. Methyl Red: No effect.

2.6 SOLID-SURFACING MATERIAL:

A. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

B. Solid-Surfacing-Material Thickness: ½ inch.

C. Colors and Patterns: As selected by Architect and shown in appropriate schedules within these Contract Documents.

D. Fabricate tops in one piece with shop-applied back splashes and edges, unless otherwise indicated. Comply with solid-surfacing material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

E. Install integral sink bowls in countertops in shop.

F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

G. Edge Treatment: Same material as top layered to 1 ½" thickness with top and bottom edge eased, 1/8" radius, oval detailed.

H. Core Material: High-density particleboard.

I. Core Material at Sinks: Exterior-grade plywood.

2.7 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.

C. For Exterior Millwork: Unextended melamine resin, phenol resin, or resorcinol resin.

2.8 STAINLESS STEEL

ASTM A167., Type 304.

2.9 ALUMINUM CAST

ASTM B26

2.10 ALUMINUM EXTRUDED

ASTM B221

2.11 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. Use galvanized coating on ferrous metal for exterior work unless non-ferrous metals or stainless is used.
3. 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; solid metal, 100 mm (4 inches) long, 8 mm (5/16 inch) in diameter.
   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.
      1) Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
      2) Box Drawer Slides: Grade 1HD-100; for drawers not more than 150 mm (6 inches) high and 600 mm (24 inches) wide.
      3) File Drawer Slides: Grade 1HD-200; for drawers more than 150 mm (6 inches)high or 600 mm (24 inches) wide.
   c. Adjustable Shelf Standards (steel): B84071 with shelf rest B84081. Cabinet Interior – All Zinc plated.
      1) Pilaster: Color - Brown
      2) Supports: Color – Walnut
   d. Heavy-Duty Standards, Brackets and Shelf Fasteners:
      1) Standards: B84102
      2) Brackets: B84112
      3) Shelf Fasteners: Grade 1
   e. Surface mounted Pilaster and Supports (at patient server):
      1) Pilaster: B84061, color: zinc
      2) Supports: B84081, color: zincf. Concealed Hinges (European Style): B1602, minimum 110 degree opening.
   g. Cabinet Door Catch: B03131.
2. Cabinet Locks: ANSI A156.11.
   a. Door Locks: E07121, cam lock; keyed alike if more than one cam lock is specified.
   b. Drawer Locks: E07141, cam lock; keyed alike if more than one cam lock is specified.
3. Grommets for Cable Passage through Countertops: 2 ½-inch OD, color to match countertop, Grade 1, molded-plastic grommets and matching plastic caps with slot for wire passage.
   a. Install one grommet per every 5 lineal fee of counter, min, unless
4. otherwise indicated. Color as selected by Architect from manufacturer’s full range.Fill and finish all nail holes with wood putty of matching color.

5. Exposed Cabinetry: Cover all fastener heads with wood cap or plug; color to match wood finish.

2.12 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. Exterior treated or untreated finish lumber and trim 100 mm (4 inches) or less in nominal thickness: 15 percent.
3. Moisture content of other materials shall be in accordance with the standards under which the products are produced.

2.13 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.

B. Use Grade A, exterior plywood for treatment.

2.14 ACOUSTICAL PANEL

A. Performance criteria:

1. NRC 19 mm (3/4 inch) adhesive mounting direct to substrate.
2. Composite flame spread: ASTM E84, 25 or less.
3. Smoke developed: ASTM E84, 140 or less.

B. Glass fiber panel covered with fabric.

1. Glass fiber panel one inch thick minimum, self supporting of density required for minimum NRC.
2. Fabric covering treated to resist stains and soil, bonded directly to the glass fiber panel face, flat bonded directly to the glass fiber panel face, flat wrinkle-free surface.

C. Adhesive: As recommended by panel manufacturers.

2.15 FABRICATION

A. General:

1. Except as otherwise specified, use AWI Custom Grade for architectural woodwork and interior millwork.
2. Except as otherwise specified, architectural woodwork shall be stained.
3. Finish woodwork shall be free from pitch pockets.
4. Except where special profiles are shown, trim shall be standard stock molding and members of the same species.

5. Plywood shall be not less than 13 mm (1/2 inch), unless otherwise shown or specified.
6. Edges of members in contact with concrete or masonry shall have a square corner caulking rebate.
7. Fabricate members less than 4 m (14 feet) in length from one piece of lumber, back channeled and molded a shown.
8. Interior trim and items of millwork to be painted may be fabricated from jointed, built-up, or laminated members, unless otherwise shown on drawings or specified.
9. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
   a. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 19 mm (3/4 inch) thick or less: 1.6 mm (1/16 inch).
   b. Corners of Cabinets and Edges of Rails and Similar Members More Than 19 mm (3/4 inch) Thick: 3 mm (1/8 inch).
10. Plastic Laminate Work:
   a. Factory glued to either a plywood or a particle board core, thickness as shown or specified.
   b. Cover exposed edges with plastic laminate, unless otherwise specified.
   c. Provide plastic backing sheet on underside of countertops 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. Fabrication with plastic laminate over 32 mm (1-1/4 inch) thick core unless shown otherwise.
   a. Use decorative laminate for exposed edges of tops 38 mm (1-1/2 inches) wide and on back splash and end splash, unless otherwise shown or specified. b. Assemble back splash and end splash to counter top.
   b. Use one piece counters for straight runs.
   c. Miter corners for field joints with overlapping blocking on underside of joint.

2.16 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Grade: Custom.

B. Wood Species and Cut: Red oak, plain sawn or sliced.

C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

D. Assemble casings in plant except where limitations of access to place of installation require field assembly.

E. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

2.17 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Grade: Custom.

B. Wood Species: Poplar

C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

2.18 INTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

A. Grade: Custom.

B. Wood Species and Cut: Red oak, plain sawn or sliced.

C. Includes railing.

2.19 INTERIOR ORNAMENTAL WORK FOR OPAQUE FINISH

A. Grade: Custom.

B. Wood Species and Cut: Poplar.

C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

2.20 INTERIOR BORROWED LIGHT

A. Grade: Custom.

B. Wood Species and Cut: Red oak, plain sawn or sliced.

2.21 CUSTOM WOOD CABINETS FOR TRANSPARENT FINISH

A. Grade: Custom.

B. AWI Type of Cabinet Construction: Flush inset with face frame. Door Style: Raised Panel, Square Wall and Square Base Doors.

C. Reveal Dimension: As indicated.

D. Wood Species and Cut for Exposed Surfaces: Red oak, plain sawn or sliced.

1. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
2. Matching of Veneer Leaves: Book match.

E. Semiexposed Surfaces: Provide surface materials indicated below, unless otherwise indicated:
   1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
   2. Drawer Sides and Backs: Solid-hardwood lumber. High pressure decorative plastic laminate; Grade as specified.
   3. Drawer Bottoms: Hardwood plywood. High pressure decorative plastic laminate; Grade as specified.
   4. Countertops: High pressure decorative plastic laminate; Grade as specified.
F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.
G. Door and Drawer Fronts: Solid-wood stiles and rails, 5/8 inch (16 mm) thick, with 3/4-inch- (19-mm-) thick, solid-wood center panels.
H. Face Frames: 3/4-by-1-5/8-inch (19-by-41-mm) solid wood.
I. Exposed Cabinet End Finish: Wood veneer to match cabinet.
J. Cabinet End Construction: 3/4-inch- (19-mm-) thick veneered plywood with flush design.
K. Cabinet Tops and Bottoms: 5/8-inch- (16-mm-) thick particleboard or 1/2-inch- (12.7-mm-) thick plywood, fully supported by and secured in rabbets in end panels, front frame (if any), and back rail.
L. Back, Top, and Bottom Rails: 3/4-by-2-1/2-inch (19-by-63-mm) solid wood, interlocking with end panels and rabbeted to receive top and bottom panels. Back rails secured under pressure with glue and with mechanical fasteners.
M. Wall-Hung-Unit Back Panels: 3/16-inch- (4.8-mm-) thick plywood fastened to rear edge of end panels and to top and bottom rails, unless otherwise specified.
N. Base-Unit Back Panels: 3/16-inch- (4.8-mm-) thick plywood fastened to rear edge of end panels and to top and bottom rails, unless otherwise specified.
O. Front Frame Drawer Rails: 3/4-by-1-1/4-inch (19-by-32-mm) solid wood mortised and fastened into face frame.
P. Drawers: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
Q. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
R. Subfronts, Backs, and Sides: 1/2-inch- (12.7-mm-) thick solid wood.

S. Bottoms: 1/4-inch- (6.4-mm-) thick plywood.

T. Shelves: 5/8-inch- (16-mm-) thick plywood.

U. Joinery: Rabbet backs flush into end panels and secure with concealed mechanical fasteners. Connect tops and bottoms of wall cabinets and bottoms and stretchers of base cabinets to ends and dividers with mechanical fasteners. Rabbet tops, bottoms, and backs into end panels.

V. Cabinet Construction: All plywood construction, unless otherwise noted.

2.22 PLASTIC LAMINATE CABINETS

A. Grade: Custom.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with NEMA LD3 and the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS 1.22 mm (0.048 inch) nominal thickness.
2. Vertical Surfaces: Grade HGS 1.22 mm (0.048 inch) nominal thickness.
3. Edges: Grade HGS 1.22 mm (0.048 inch) nominal thickness, matching laminate in color, pattern, and finish.
4. Flat Rolled Edge: HGP 1.0 mm (0.039 inch) thick, matching laminate in color, pattern, and finish.
5. Colors, Patterns and Finishes: as selected by Architect and listed in appropriate schedules within these Contract Documents.

D. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade HGS, 1.22 mm (0.048 inch) nominal thickness; use same laminate as on fully exposed surfaces.
   a. Edges of Plastic-Laminate Shelves: HGS, 1.22 mm (0.048 inch) nominal thickness, matching laminate in color, pattern, and finish.
2. Drawer Sides and Backs: Solid-hardwood lumber with high-pressure decorative laminate, Grade VGS.
3. Drawer Bottoms: Hardwood plywood with high-pressure decorative laminate, Grade VGS.

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations in appropriate schedules within these Contract Documents.

F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

G. Provide shelf supports minimum 1 per every sheet, whether or not indicated on drawings.

H. Provide grommets minimum 1 per every 5 feet, or as shown on drawings.

2.23 PLASTIC LAMINATE COUNTERTOPS

A. Grade: Custom.

B. High-Pressure Decorative Laminate Grade: As indicated.

1. Countertops with wood Bull Nose Edge: HGS 1.22 mm (0.048 inch) nominal thickness, matching laminate in color, pattern, and finish.
2. Countertops with Flat Rolled Edge: HGP 1.0 mm (0.039 inch) thick, matching laminate in color, pattern, and finish.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations in appropriate schedules within these Contract Documents.

D. Edge Treatment: Same as laminate cladding on horizontal surfaces or 1 ½ inch stained half round edge for transparent finish matching wood species and cut on cabinet surfaces where indicated.

E. Grain Direction: Parallel to cabinet fronts.

F. Quality Standard: KCMA A161.2.

G. Configuration: Provide countertops with the following front, backsplash, and endsplash style:

1. Front: Flat rolled edge.
2. Backsplash: Square edge.
3. Endsplash: Square edge.
4. Plastic-Laminate Substrate: Particleboard not less than 3/4 inch (19mm) thick.
   a. For countertops at sinks and lavatories, use 3/4 inch (19 mm) thick exterior-grade plywood.
   b. Build up countertop thickness to 1-1/2 inches (38 mm) at front, back, and ends with additional layers of particleboard laminated to top.

H. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

I. Countertops with Flat Rolled Edge: HGP 0.039” thick (1.0mm), matching laminate in color, pattern, and finish.

J. Provide through-color plastic laminate.

K. Grade for Backer Sheet: BKL.

L. Paper Backing: Provide paper backing on underside of countertop substrate.

M. Particleboard: ANSI A208.1, **G**rade M-2-Exterior Glue.

N. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

O. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement or PVA and as recommended by manufacturer.

1. Use water based adhesive for on site application.
2. Adhesive for Bonding Edges: Hot-melt adhesive.

2.24 SOLID-SURFACING MATERIALS COUNTERTOPS AND VANITY (INTEGRAL SINK) BOWL

A. Grade: Custom.

B. Solid-Surfacing-Material Thickness: 13 mm (1/2 inch).

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. As indicated by manufacturer's designations on appropriate schedules within these Contract Documents.

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.
2. Fabricate tops with shop-applied backsplashes.

E. Install integral sink bowls in countertops in shop.

F. Drill holes in countertops for plumbing fittings in shop.

2.25 CLOSET SHELVING AND CLOTHES ROD

A. Grade: Custom.

B. Shelf Material: 19 mm (3/4 inch) particle board with high-pressure plastic laminate, Grade HGS.

C. Cleats: 19 mm (3/4 inch) with high-pressure plastic laminate, Grade HGS.

D. Wood Species (for clothes rod): Red oak.

1. 39 mm (1-1/2 inch) diameter clear, kiln dried rod.
2. Rod Flanges: Chrome, formed steel.

2.26 EXTERIOR ORNAMENTAL WORK FOR OPAQUE FINISH

A. Grade: Custom.

B. Includes crown molding.

C. Wood Species: Western red cedar.

2.27 EXTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

A. Grade: Custom.

B. Wood Species: Western red cedar.

2.28 EXTERIOR BEAD BOARD PANEL CEILING: PLYWOOD TYPE FOR SEMI-TRANSPARENT STAIN FINISH

A. Thickness: 9.5 mm (3/8 inch).

B. Rating: APA Series V-171.

C. Face Species: Oak.

D. Pattern: Manufacturer Standard "V" type, or double bead approximately 39 mm (1-1/2 inch) O.C.

E. Surface: Sanded.

2.29 SHOP FINISHING (INTERIOR ARCHITECTURAL WOODWORK)

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation. The extent to which the final finish is applied at fabrication shop is Contractor's option, except shop shall apply at least the prime coat before delivery.

C. Shop Priming: Shop apply the prime coat including backpriming, if any, for items specified to be field finished. Refer to Division 09 painting Sections for material and application requirements.

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

E. Transparent Finish:

1. Grade: Custom.

2. AWI Finish System: Catalyzed lacquer.

3. Staining: Match approved sample for color.
4. Open Finish for Open-Grain Woods: Do not apply filler to open grain woods.
5. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

F. Opaque Finish:
1. Grade: Custom.
2. AWI Finish System: Catalyzed lacquer.
3. Staining: Match approved sample for color.
4. Open Finish for Open-Grain Woods: Do not apply filler to open grain woods.
5. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

2.30 SHOP PRIMING (EXTERIOR ARCHITECTURAL WOODWORK)

A. Woodwork for Transparent Finish: Shop seal woodwork for transparent finish with stain (if required), other required pretreatments, and first coat of finish as specified.

B. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. **Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.**

2.31 SHOP FINISHING (EXTERIOR ARCHITECTURAL WOODWORK)

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Entire finish of exterior architectural woodwork is specified in this Section. To greatest extent possible, finish architectural woodwork at fabrication shop. Defer only final touchup and cleaning until after installation.

C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
1. Backpriming: Apply one coat of sealer or primer, compatible with

finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

D. Opaque Finish:

1. AWI Finish System: Catalyzed polyurethane.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

A. Maintain work areas and storage areas to a minimum temperature of 21^0C (70^0F) 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 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.
8. Exterior Work: Joints shall be close fitted, metered, tongue and grooved, rebated, or lapped to exclude water and made up in thick white lead paste in oil.

B. Shelves:

1. Install mounting strip at back wall and end wall for shelves in closets where shown secured with toggle bolts at each end and not over 600 mm (24 inch) centers between ends.
   a. Nail Shelf to mounting strip at ends and to back wall strip at not over 900 mm (36 inches) on center.

b. Install metal bracket, ANSI A156.16, B04041, not over 1200 mm (4 feet) centers when shelves exceed 1800 mm (6 feet) in length.
c. Install metal bracket, ANSI A156.16, B04051, not over 1200 mm (4 feet) on centers where shelf length exceeds 1800 mm (6 feet) in length with metal rods, clothes hanger bars ANSI A156.16, L03131, of required length, full length of shelf.

2. Install vertical slotted shelf standards, ANSI A156.9, B04103 to studs with toggle bolts through each fastener opening. Double slotted shelf standards may be used where adjacent shelves terminate.
   a. Install brackets ANSI A156.9, B04113, providing supports for shelf not over 900 mm (36 inches) on center and within 13 mm (1/2 inch) of shelf end unless shown otherwise.
   b. Install shelves on brackets so front edge is restrained by bracket.

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SECTION 06 17 53

PREFABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: All labor and materials required to furnish and install the wood trusses shown on the Drawings and as required by these Specifications. Include all bridging, bracing, blocking, anchors, extensions, etc. required for a complete installation.

B. The Engineer has designed a project which will be safe after full completion. The Engineer has no expertise in, and takes no responsibility for, construction means and methods or job site safety during construction, which are exclusively the Contractor's responsibility. Processing and/or approving submittals made by the Contractor which may contain information related to construction methods or safety issues, or participation in meetings where such issues might be discussed, shall not be construed as voluntary assumption by the Engineer of any responsibility for safety procedures.

C. Related Sections: Carefully examine all other Sections and all Drawings for related work which includes but is not limited to:

1. Section 05 40 00, “Cold-Formed Metal Framing”
2. Section 06 10 00, "Rough Carpentry"

1.02 QUALITY ASSURANCE

A. Reference Standards:

1. National Design Specification for Wood Construction, 2005 Edition, by the American Forest and Paper Association.
2. National Design Standard for Metal Plate Connected Wood Trusses, ANSI/TPI 1-2007 by the Truss Plate Institute.
3. Guide to Good Practice for Handling, Installing and Bracing of Metal Plate Connected Wood Trusses, BCSI 2008 by the Truss Plate Institute and the Wood Truss Council of America.

B. Manufacturer's Qualifications: Minimum three (3) years' experience for manufacturing comparable wood trusses.

C. Tolerances:

1. Outside Dimensions: $\pm$ 1/16 inch up to 20 feet length; for greater lengths, 1/16 inch per 20 feet length.
2. Square End Cuts: square within 1/16 inch per foot of depth and width.

3. Connector Locations: ± 1/4 inch from locations shown on shop drawings.

1.03 SUBMITTALS

A. Shop Drawings:

1. Indicate mark, number, and location of all trusses.
2. Indicate all member sizes for each truss mark, including chords, webs, and connectors.
3. Indicate bridging, bearing details, anchorage, bracing, etc.
4. Indicate handling instructions and erection sequence, if critical.
5. Notwithstanding any other requirements specified elsewhere in these specifications, three (3) sets of prints and one (1) set of reproducible shop drawings shall be submitted for approval. The reproducible set will be returned to the Contractor, who will make and distribute as many copies as needed. Only prints with the approval stamp printed on them shall be permitted on the site.
6. Shop drawings shall exhibit the seals of the Engineer responsible for the truss design.

B. Design Analysis:

1. Submit stress diagram indicating design force in each truss member, or submit a printout of the computer design.

C. Certification: Submit, on request only, written certification that the trusses will sustain the design loads at the specified moisture content.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle trusses with care, following the manufacturer's instructions.

B. Store in upright position.

C. Provide bearing supports and bracing to avoid damage from bending or overturning.

D. Protect from construction operations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Lumber:

1. Maximum moisture content 19%.
2. Design to be based on Southern Pine #2.

B. Metal connector plates (internal connections):

1. Galvanized steel sheet, ASTM A653/A653M-08, Grade 33, coating class G60.

2. Manufacture with holes, plugs, teeth, or prongs uniformly spaced and formed.

C. Metal Connector Plates (external connection): Use products of the Simpson Company or equivalent.

2.02 DESIGN

A. Sizes shown on the Drawings are to be considered minimums.

B. Final design of members and connections is to be by a professional engineer, registered in Georgia, experienced in similar design, retained by the manufacturer.

C. Overall dimensions and loads are shown on the Drawings.

D. Where dimensions shown on the Drawings exceed practical shipping size, trusses may be designed using "piggy-back" arrangement. Design field connections to transfer all design forces, including wind uplift.

E. Maximum live load deflection is to be L/360.

F. Maximum total load deflection is to be L/240.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Prior to beginning work of this Section, verify that the installed work of other trades is complete and correct to the extent necessary for proper execution of the work of this Section.

B. In the event of discrepancies, immediately notify the Architect. Do not proceed with work affected by the discrepancies until they have been resolved.

3.02 ERECTION

A. Hoist trusses into position with cables, and spreader bars where required, at the designated lift points.

B. Install temporary horizontal and cross bracing to keep trusses plumb and in a safe condition until permanent bracing is installed.

C. Install permanent bracing and related components prior to application of loads to trusses.

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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. Safing insulation: Section 07 84 00, FIRESTOPPING.

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. Insulation, each type used.

C. 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 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):

C270-08.....Mortar for Unit Masonry

C553-08.....Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C665-06.....Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

D312-00(R2006).....Asphalt Used in Roofing

E84-08.....Surface Burning Characteristics of Building Materials

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. ”R” value for insulation is indicated on the drawings (wall sections).

2.2 EXTERIOR FRAMING OR FURRING AND ATTIC INSULATION:

A. Batt or Blanket Insulation.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.

2.3 ACOUSTICAL INSULATION (SOUND ATTENUATION BLANKETS):

A. Mineral Fiber Batt or Blankets: ASTM C665, Type I; without membrane facing; consisting of fibers; with maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84 and passing ASTM E136 for combustion characteristics.

B. Thickness as shown; of widths and lengths to fit tight against framing.

2.4 FASTENERS:

A. Staples or Nails: ASTM F1667, zinc-coated, size and type best suited for attic insulation baffle installation. Install attic insulation baffles according to manufacturer’s written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL:

A. Install batt or blanket insulation with tight joints and filling framing void completely.

B. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.

C. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

3.2 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.

B. Snugly place blanket insulation between metal studs or framing as indicated on drawings.

C. Snugly place blanket insulation between wood trusses or roof framing as indicated on drawings. Use nails or staples to fasten attic insulation baffles as per manufacturer's written instructions.

D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose- Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.3 ACOUSTICAL INSULATION:

A. Snugly place blanket insulation between metal studs and wall furring.

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.

C. Do not compress insulation below required thickness except where embedded items prevent required thickness.

D. Where semirigid insulation is used which is not full thickness of cavity, adhere to one side of cavity maintaining continuity of insulation and covering penetrations or embedments in insulation.

3.4 PROTECTION:

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

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SECTION 07 31 13

ASPHALT SHINGLES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies organic felt and fiberglass asphalt shingles.

1.2 RELATED WORK

A. Color of shingles: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Counterflashing and flashing of roof projections: Section 07 60 00, FLASHING AND SHEET METAL.

1.3 SUMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples: Shingles, each type, color and texture.

C. Manufacturer's Literature and Data:

1. Shingles, each type
2. Installation instructions

D. Samples for Initial Selection: For each type of asphalt shingle, ridge and hip cap shingles, and ridge vent indicated.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For the following products, of sizes indicated, to verify color selected:

1. Asphalt Shingle: Full size.
2. Ridge and Hip Cap Shingles: Full size.
3. Ridge Vent: 12-inch- (300-mm-) long Sample.
4. Self-Adhering Underlayment: 12 inches (300 mm) square.

F. Qualification Data: For Installer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for asphalt shingles.

H. Research/Evaluation Reports: For each type of asphalt shingle required, from the ICC.

I. Maintenance Data: For each type of asphalt shingle to include in maintenance manuals.

J. Warranties: Sample of special warranties. Manufacturer’s literature and data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain ridge and hip cap shingles, felt underlayment and self-adhering sheet underlayment from single source from single manufacturer.

B. Fire-Resistance Characteristics: Where indicated, provide asphalt shingles and related roofing materials identical to those of assemblies tested for fire resistance per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Exterior Fire-Test Exposure: Class A, ASTM E 108 or UL 790, for application and roof slopes indicated.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Refer to drawings (elevations) for mock-up locations.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Engage experienced asphalt shingle roofing installer, or firm, who has performed projects of similar size and complexity within the past 5 years of date of bid and is approved, authorized, or licensed by asphalt shingle roofing system manufacturer to install roofing system indicated. The experience listing requires the following; each data for a minimum of 3 similar projects:

1. Project Name.

2. Project Address.

3. Architect, including address, home number and contact.

4. General Contractor, including address, phone number and contact.

E. Preinstallation Conference: Conduct conference at Project site.

1.5 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.

1.6 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Manufacturing defects.
   b. Structural failures including failure of asphalt shingles to self-seal after a reasonable time.
2. Material Warranty Period: 40 years (Base Bid) or 25 years (Alternate No. G-11) from date of Substantial Completion, prorated, with first five years.
3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds up to 110 mph (Base Bid) or 60 mph (Alternate No. G-11) for five years from date of Substantial Completion.
4. Algae-Discoloration Warranty Period: Asphalt shingles will not discolor 10 years from date of Substantial Completion.

B. Special Project Warranty: Roofing Installer's Warranty, or warranty form at end of this Section, signed by roofing Installer, covering the Work of this Section, in which roofing Installer agrees to repair or replace components of asphalt shingle roofing that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Asphalt Shingles: 400 sq. ft (37.2 sq. m) of each type, in unbroken bundles.

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. American Society for Testing and Materials (ASTM):

D226-06.....Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

D1970-08.....Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

D2178-04.....Asphalt Glass Felt used in Roofing and Waterproofing

D3018-03.....Class A Asphalt Shingles Surfaced with Mineral Granules

D3462-07.....Asphalt, Shingles Made from Glass Felt and Surfaced with Mineral Granules

F1667-05.....Driven Fasteners: Nails, Spikes, and Staples

C. Underwriter's Laboratories Inc. (UL): UL790-04 Fire Tests of Roof Covering

PART 2 - PRODUCTS

2.1 SHINGLES (BASE BID)

A. Four-Tab Type Asphalt Fiberglass Shingles, Faux Slate: Heavy-duty glass fiber mat base, ceramically colored/UV resistant mineral surface granules across entire face of shingle, algae-resistant, dual self-sealing strips of sealant, designed to resist blow-off in high wind conditions up to 110 mph. Extra thick tabs and bold profile provide to a real slate appearance with an 8" exposure. COTR to choose color from Manufacturer's full color line.

1. Weight: 235 lb. per square (100 square feet).
2. Weather Exposure: 8".
3. Algae Resistance: Granules treated to resist algae discoloration.
4. ASTM D3018 and ASTM D3462, Type I.
5. ASTM E108 and UL 790 Class A Fire Resistance.
6. ASTM D3161-03b and ASTM D3161-08b, Class F Wind Resistance (110-mph).
7. ASTM D3161-99a, 110-mph Wind Resistance
8. ASTM D 7158 Class H Wind Resistance
9. UL 2390/ASTM D6381 Class H Wind Resistance

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.2 SHINGLES (ALTERNATE NO. G-11)

A. Three-Tab Type Asphalt Fiberglass Shingles, Faux Slate: Glass fiber mat base, ceramically colored/UV resistant mineral surface granules across

entire face of shingle, algae-resistant, dual self-sealing strips of sealant, designed to resist blow-off in high wind conditions up to 60 mph. Dovetail cut tabs and bold shadow lines to provide a slate appearance. COTR to choose color from Manufacturer's full color line.

1. Weight: 220 lb. per square (100 square feet).
2. Weather Exposure: 5".
3. Algae Resistance: Granules treated to resist algae discoloration.
4. ASTM D3018 and ASTM D3462, Type I.
5. ASTM E108 and UL 790 Class A Fire Resistance.
6. ASTM D3161-03b and ASTM D3161-08b, Class F Wind Resistance.
7. ASTM D3161-99a, Wind Resistance.
8. ASTM D 7158 Class H Wind Resistance.
9. UL 2390/ASTM D6381 Class H Wind Resistance.

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.3 ROOFING NAILS AND ACCESSORIES

A. Roofing Nails: Standard round wire type roofing nails, corrosion resistant; hot dipped zinc coated steel, aluminum, or chromated steel; minimum 3/8 inch (9.5 mm) head diameter; minimum 11 or 12 gauge (2.5 mm) shank diameter; shank to be of sufficient length to penetrate through roof sheathing or 3/4 inch (19 mm) into solid wood, plywood, or non-veneer wood decking.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

B. Felt Underlayment Nails: Hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch (25-mm) minimum diameter.

C. Asphalt Roofing Cement: ASTM D4586, Type II, asbestos free.

2.4 ROOFING FELT

A. Felt: ASTM D226 or ASTM D4869, Type II, asphalt-saturated organic felts, nonperforated.

2.5 SELF-ADHERING SHEET UNDERLAYMENT

A. Self-Adhering Sheet Underlayment, Granular Surfaced: ASTM D 1970, minimum of 55-mil- (1.4-mm-) thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release paper backing; cold applied.

B. Granular-Surfaced Valley Lining: ASTM D 1970, minimum of 55-mil- (1.4-mm-) thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release paper backing; cold applied.

PART 3 EXECUTION

3.1 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.

3.2 LAYING

A. Lay felt under shingles over entire roof.

B. Install asphalt felt underlayment, lapping a minimum of 100 mm (four 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 (five 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.

3.3 SELF-ADHERING SHEET UNDERLAYMENT

A. Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated below, lapped in direction to shed water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.
2. Eaves: Extend from edges of eaves 36 inches (914 mm) beyond interior face of exterior wall.
3. Rakes: Extend from edges of rake 36 inches (914 mm) beyond interior face of exterior wall.
4. Valleys: Extend from lowest to highest point 18 inches (450 mm) on each side.
5. Hips: Extend 18 inches (450 mm) on each side.
6. Ridges: Extend 36 inches (914 mm) on each side without obstructing continuous ridge vent slot.

7. Sidewalls: Extend beyond sidewall 18 inches (450 mm), and return vertically against sidewall not less than 4 inches (100 mm).
8. Dormers, Chimneys, and Other Roof-Penetrating Elements: Extend beyond penetrating element 18 inches (450 mm), and return vertically against penetrating element not less than 4 inches (100 mm).
9. Roof Slope Transitions: Extend 18 inches (450 mm) on each roof slope.
10. Install self-adhering sheet underlayment wherever a condition of valley and hip would result in 18” or less of uncovered area between the two.
11. Install self-adhering sheet underlayment for entire portion of roof area where roof slope is less than or equal to 4:12.

3.4 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 07 60 00 FLASHING AND SHEET METAL.
   1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Apron Flashings: Extend lower flange over and beyond each side of downslope asphalt shingles and up the vertical surface.

C. Step Flashings: Install with a headlap of 2 inches (50 mm) and extend over the underlying asphalt shingle and up the vertical surface. Fasten to roof deck only.

D. Cricket Flashings: Install against the roof-penetrating element extending concealed flange beneath upslope asphalt shingles and beyond each side.

E. Rake Drip Edges: Install rake drip edges made of prefinished aluminum over underlayment and fasten to roof deck.

F. Eave Drip Edges: Install eave drip edges made of prefinished aluminum below underlayment and fasten to roof sheathing.

G. Secure metal drip edges with compatible nails spaced not more than 250 mm (10 inches) on center along the inner edges.

3.5 FLASHINGS

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.

3.6 ASPHALT SHINGLE INSTALLATION

A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Install starter strip along lowest roof edge, consisting of a pre-manufactured starter strip wide with self-sealing strip face up at roof edge.

   1. Extend asphalt shingles 1/2 inch (13 mm) over fasciae at eaves and rakes.
   2. Install starter strip along eaves and rake edges to obtain wind-speed warranty of 110 mph.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Fasten asphalt shingle strips with a minimum of six roofing nails, to obtain wind-speed warranty of 110 mph, located according to manufacturer's written instructions.

   1. When ambient temperature during installation is below 50 deg F (10 deg C), seal asphalt shingles with asphalt roofing cement spots.

E. Closed-Cut Valleys: Extend asphalt shingle strips from one side of valley 12 inches (300 mm) beyond center of valley. Use one-piece shingle strips without joints in valley. Fasten with extra nail in upper end of shingle. Install asphalt shingle courses from other side of valley and cut back to a straight line 2 inches (50 mm) short of valley centerline. Trim upper concealed corners of cut-back shingle strips.

   1. Do not nail asphalt shingles within 6 inches (150 mm) of valley center.
   2. Set trimmed, concealed-corner asphalt shingles in a 3-inch- (75-mm-) wide bed of asphalt roofing cement.

G. Ridge and Hip Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.

3.7 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.

3.8 CONCEALED, CLOSED-CUT VALLEY LINING

A. Comply with NRCA's recommendations. Install a 36-inch- (914-mm-) wide felt underlayment centered in valley. Fasten to roof deck with felt underlayment nails.

1. Lap roof-deck felt underlayment over valley felt underlayment at least 6 inches (150 mm).
2. Install a 36-inch- (914-mm-) wide strip of granular-surfaced valley lining centered in valley, with granular-surface face up. Lap ends of strips at least 12 inches (300 mm) in direction to shed water, and seal with asphalt roofing cement. Fasten to roof deck with roofing nails.

3.9 ROOFING INSTALLER'S WARRANTY

(This warranty shall be transcribed onto Roofing Installer's letterhead in the form as shown below with all required information.)

A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <Insert name of Owner>.
2. Address: <Insert address>.
3. Building Name/Type: <Insert information>.
4. Address: <Insert address>.
5. Area of Work: <Insert information>.
6. Acceptance Date: <Insert date>.
7. Warranty Period: <Insert time>.
8. Expiration Date: <Insert date>.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or

replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
   a. Lightning;
   b. Peak gust wind speed exceeding 110 mph;
   c. Fire;
   d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. Vapor condensation on bottom of roofing; and
   g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.
1. Authorized Signature: <Insert signature>.
2. Name: <Insert name>.
3. Title: <Insert title>.

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SECTION 07 41 13

METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preformed, prefinished metal roofing and flashings.

B. Miscellaneous trim, flashing, closures, drip flashing, and accessories.

C. Fastening devices.

1.02 RELATED SECTIONS

A. Section 06 10 00: Rough Carpentry

B. Section 07 60 00: Flashing and Sheet Metal

C. Section 07 92 00: Sealants

1.03 REFERENCES

A. American Iron & Steel Institute (AISI) Specification for the Design of Coldformed Steel Structural Members.

B. ASTM A-653 & ASTM A924 Steel Sheet, Zinc-Coated (Galvanized)

C. ASTM E-1680-95 (Air Infiltration Test)

D. ASTM E-1646-95 (Water Penetration Test)

E. ASTM E-1592

F. Spec Data Sheet - Galvalume Sheet Metal by Bethlehem Corp.

G. SMACNA - Architectural Sheet Metal Manual.

H. Building Materials Directory - Underwriter's Laboratories, Test Procedure 580.

1.04 ASSEMBLY DESCRIPTION

A. The roofing assembly includes preformed sheet metal panels, related accessories, hips, ridges, eaves, corners, miscellaneous flashing and attaching devices.

1.05 SUBMITTALS

A. Submit detailed drawings showing layout of panels, anchoring details, joint details, trim, flashing, and accessories. Show details of weatherproofing, terminations, and penetrations of metal work.

B. Submit a sample of each type of roof panel, complete with factory finish.

C. Submit results indicating compliance with minimum requirements of the following performance tests:

1. Air Infiltration ASTM E-1680-95

2. Water Infiltration ASTM E-1646-95

3. Wind Uplift - U.L.90

D. Submit calculations with registered engineer seal, verifying roof panel and attachment method resists wind pressures imposed on it pursuant to applicable building codes.

1.06 QUALITY ASSURANCE

A. Manufacturer: Company specializing in Architectural Sheet Metal Products with ten (10) years minimum experience.

B. No product substitutions shall be permitted without meeting specifications.

C. Substitutions shall be submitted 10 Days prior to Bid Date and acceptance put forth in an addendum.

D. No substitutions shall be made after the Bid Date.

1.07 DELIVERY, STORAGE AND HANDLING

A. Upon receipt of panels and other materials, installer shall examine the shipment for damage and completeness.

B. Panels should be stored in a clean, dry place. One end should be elevated to allow moisture to run off.

C. Panels with strippable film must not be stored in the open, exposed to the sun.

D. Stack all materials to prevent damage and to allow for adequate ventilation.

1.08 WARRANTY

A. Paint finish shall have a twenty year guarantee against cracking, peeling and fade (not to exceed 5 N.B.S. units).

B. Galvalume material shall have a twenty year guarantee against failure due to corrosion, rupture or perforation.

C. Applicator shall furnish guarantee covering watertightness of the roofing system for the period of two (2) years from the date of substantial completion.

PART 2 PRODUCT

2.01 MANUFACTURERS

A. Products shall fully comply with specified requirements.

2.02 SHEET MATERIALS

A. Prefinished Metal shall be Hot-Dipped Galvanized - ASTM A446-85 Grade C G90 Coating A525-86 24 Gauge core steel or prefinished Galvalume - ASTM A792-86 AZ-55.

B. Unfinished Metal shall be Grade C Galvalume ASTM 792-86, AZ 55, "Satin Finish".

C. Finish shall be full strength Kynar 500 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500 finish supplier.

D. Strippable film shall be applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. This strippable film must be removed before installation.

2.03 ACCESSORY MATERIALS

A. Fasteners: Galvanized steel with washers where required.

B. Sealant: As specified in Section 07 90 00.

C. Vinyl Weatherseal Insert.

2.04 FABRICATION

A. All exposed adjacent flashing shall be of the same material and finish as the roof panels.

B. Hem all exposed edges of flashing on underside, 1/2 inch.

2.05 CEE-LOCK STANDING SEAM PANEL

A. Panels shall have 1-1/2" high vertical legs, spaced 16-1/2" on center.

B. Standing seam to be of an interlocking, "snap-lock" design.

C. Panels shall be roll-formed in continuous lengths from ridge to eave.

D. Continuous Cee Rib to be 1-3/8" wide and 2-1/8" in height. Rib shall be connected to structure with two #12-14 x 1" self-drilling/tapping fasteners [Cee-Clips at 3'-0" max.].

E. Optional Vinyl Weatherseal (U.S. Patent No. 4641475) to be factory/machine-installed

F. Panel assembly to bear Underwriter's Laboratories Label UL90, pursuant to Construction Number 334 and applicable Fire Ratings.

G. Certification shall be submitted, based on independent testing laboratory, indicating no measurable water penetration or air leakage through the system when tested in accordance with ASTM E-1680-95 and ASTM E-1646-95.

2.06 SNOW GUARDS

A. Seam-mounted, stop-type snow guards: Clear polycarbonate stops designed for attachment to vertical ribs of standing-seam metal roof panels with adhesive, sealant, tape, or stainless-steel set screws.

PART 3 EXECUTION

3.01 INSPECTION

A. Substrate:

1. Examine plywood deck to ensure proper attachment to framing.
2. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves or projections, level to +/- 1/4" in 20', and properly sloped to eaves.
3. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.
4. Verify deck is dry and free of snow or ice. Joints in wood deck to be solidly supported and nailed.

3.02 INSTALLATION

A. Install #30 unperforated asphalt saturated roofing felt underlayment over solid sheathing. Install felt horizontally, starting at eave to ridge with a 6" minimum overlap and 18" endlaps. Ensure that all nail heads are totally flush with the substrate. Nails shall be galvanized roofing nails with coated felt caps.

B. Comply with manufacturers standard instructions and conform to standards set forth in the Architectural Sheet Metal Manual published by SMACNA, in order to achieve a watertight installation.

C. Install panels in such a manner that horizontal lines are true and level and vertical lines are plumb.

D. Install starter and edge trim before installing roof panels.

E. Remove protective strippable film prior to installation of roof panels.

F. Attach panels using manufacturer's standard clips and fasteners, spaced in accordance with approved shop drawings.

G. Install sealants for preformed roofing panels as approved on shop drawings.

H. Do not allow panels or trim to come into contact with dissimilar materials.

I. Do not allow traffic on completed roof. If required, provide cushioned walk boards.

J. Protect installed roof panels and trim from damage caused by adjacent construction until completion of installation.

K. Remove and replace any panels or components which are damaged beyond successful repair.

L. Stop-Type Snow Guards: Attach snow guards to metal roof panels with adhesive, sealant, or adhesive tape, as recommended by manufacturer. Do not use fasteners that will penetrate metal roof panels.

3.03 CLEANING

A. Clean any grease, finger marks or stains from the panels per manufacturer's recommendations.

B. Remove all scrap and construction debris from the site.

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SECTION 07 46 00

SIDING

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. Fiber-cement siding.
2. Fiber-cement soffit.
3. Fiber-cement trim.

B. Related Sections:

1. Section 05 40 00, COLD-FORMED METAL FRAMING
2. Section 06 10 00, ROUGH CARPENTRY
3. Section 07 60 00, FLASHING AND SHEET METAL
4. Section 07 92 00, JOINT SEALANTS

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Initial Selection: For siding, trim, and soffit including related accessories.

C. Samples for Verification: 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.

D. Product Certificates: For each type of siding, trim and soffit, from manufacturer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.

F. Research/Evaluation Reports: For each type of siding required, from the ICC.

G. Maintenance Data: For each type of siding, trim and soffit and related accessories to include in maintenance manuals.

H. Manufacturer's requirements for weather barriers, primer, paint, etc., to be installed by others.

I. Manufacturer's Maintenance and periodic inspection recommendations.

J. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

K. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Installer’s qualification: Provide installer with not less than three years of experience with products similar to those specified.

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 siding, trim, and soffit, including related accessories, from single source from single manufacturer.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings (see elevations).
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a dry, well-ventilated, weathertight place.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with siding installation only if substrate is completely dry and if existing and forecasted weather conditions permit siding to be installed according to manufacturer's written instructions.

1.7 COORDINATION

A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.8 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace siding, trim, 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. Warranty Period: 50 years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish full lengths of siding, trim, and soffit including related accessories, in a quantity equal to 2 percent of amount installed.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT SIDING

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board that does not contain asbestos fibers, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.

1. Surface Burning Characteristics: Flame spread index of 0, smoke developed index of 6, maximum; when tested in accordance with ASTM E 84 (Class I/A).
2. Flammability: Noncombustible, when tested in accordance with ASTM E 136.
3. Flexural Strength: At least 1450 psi (10 MPa) when in equilibrium condition, and at least 1015 psi (7 MPa) when in wet condition, tested in accordance with ASTM C 1185.
4. Coefficient of Thermal Expansion: Less than 1 x 10^-5/inch/inch/degree F (0.5 x 10^-5/degree C), when tested in accordance with ASTM E 228.
5. Water Vapor Transmission: Less than 7.0 perm-inch (10 ng/(Pa s m), when tested in accordance with ASTM E 96.
6. Freeze Thaw Resistance: At least 80 percent flexural strength retained, when tested in accordance with ASTM C 1185.

7. UV Resistance: No cracking, checking, or erosion, when tested for 2000 hours in accordance with ASTM G 26.
8. Water Tightness: No droplets on underside, when tested in accordance with ASTM C 1185.

B. Horizontal Lap Siding at Exterior Wall:
1. Thickness: 5/16 inch (8 mm), nominal.
2. Style: Horizontal lap siding, cedar texture, 6 inches exposure, 12’-0” long.
3. Sealant/Primer: Factory applied Sealant/Primer.
4. Finish: Factory applied solid color (prefinished) – Architect to select from manufacturer’s full line of colors.

C. Ceiling at Porch/Canopy:
1. Thickness: 5/16 inch (8 mm), nominal.
2. Style: Stucco texture panel.
3. Sealant/Primer: Factory applied Sealant/Primer.
4. Finish: Factory applied solid color (prefinished) – Architect to select from manufacturer’s full line of colors.

2.2 FIBER-CEMENT SOFFIT

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board that does not contain asbestos fibers, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
1. Surface Burning Characteristics: Flame spread index of 0, smoke developed index of 6, maximum; when tested in accordance with ASTM E 84 (Class I/A).
2. Flammability: Noncombustible, when tested in accordance with ASTM E 136.
3. Flexural Strength: At least 1450 psi (10 MPa) when in equilibrium condition, and at least 1015 psi (7 MPa) when in wet condition, tested in accordance with ASTM C 1185.
4. Coefficient of Thermal Expansion: Less than 1 x 10^-5/inch/inch/degree F (0.5 x 10^-5/degree C), when tested in accordance with ASTM E 228.
5. Water Vapor Transmission: Less than 7.0 perm-inch (10 ng/(Pa s m), when tested in accordance with ASTM E 96.
6. Freeze Thaw Resistance: At least 80 percent flexural strength retained, when tested in accordance with ASTM C 1185.

7. UV Resistance: No cracking, checking, or erosion, when tested for 2000 hours in accordance with ASTM G 26.
8. Water Tightness: No droplets on underside, when tested in accordance with ASTM C 1185.

B. Fiber-cement Soffit:
1. Thickness: 1/4 inch (6 mm), nominal.
2. Style: Cedar texture.
3. Ventilated and non-ventilated soffit as indicated in drawings.
4. Sealant/Primer: Factory applied Sealant/Primer.
5. Finish: Factory applied solid color (prefinished) – Architect to select from manufacturer's full line of 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 matching color and texture of adjacent siding unless otherwise indicated.
2. Trim Thickness: Provide trim thickness as indicated on drawings.
3. Trim Finish: Factory applied solid color (prefinished) – Architect to select from manufacturer's full line of colors.
4. Trim Size: Provide trim size as indicated on drawings.

B. Flashing: Provide stainless-steel flashing complying with Section 07 60 00, FLASHING AND SHEET METAL at window and door heads and where indicated.

C. Fasteners:
1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1-1/4 inch (32 mm) into substrate.
2. For fastening fiber cement, use hot-dip galvanized fasteners or stainless-steel fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding, trim 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.

3.3 INSTALLATION

A. General: Comply with siding, trim, and soffit manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Do not install damaged components.

B. Install fiber-cement siding, trim, and soffit and related accessories.

1. Install fasteners no more than 24 inches (600 mm) o.c., unless otherwise indicated.
2. Top siding panel shall be installed one piece. Trim top siding panel to fit to soffit. Notify Architect for any discrepancies prior to construction.

C. Fill nail holes and touch-up paint to match pre-finished siding per manufacturer’s written instructions.

D. Install joint sealants as specified in Section 07 92 00, JOINT SEALANTS to produce a weathertight installation.

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

Formed sheet metal work for flashing, gutters, and downspouts.

1.2 RELATED WORK

A. Sealant compound and installation: Section 07 92 00, JOINT SEALANTS.

B. Color of factory coated metal and anodized aluminum: Section 09 06 00, SCHEDULE FOR FINISHES.

C. Paint materials and application: Section 09 91 00, PAINTING.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.

3. Accessories and Miscellaneous Materials: Full-size Sample.

4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

D. Shop Drawings:

Flashings

Gutter, Gutter Cover, and Downspouts

E. Manufacturer's Literature and Data:

Two-piece counterflashing

Thru wall flashing

F. Certificates: Stating that aluminum has been given - specified finish and thickness of anodizing. Coating formulators approvals as specified.

G. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

H. Warranty: Sample of special warranty.

1.5 WARRANTY

A. Flashing and sheet metal shall be subject to the terms of FAR Clause 52.24-21, except that the Warranty period shall be two years in lieu of one year for all items except as noted below.

B. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: 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. Finish Warranty Period: 20 years from date of Substantial Completion.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below for 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):

A167-99(R 2004).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A653/A653M-07.....Steel Sheet Zinc-Coated (Galvanized) or Zinc Alloy Coated (Galvanized) by the Hot- Dip Process

B32-04.....Solder Metal

B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate

D173-03.....Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing

D412-06.....Vulcanized Rubber and Thermoplastic Elastomers-Tension

D1187-97 (R2002).....Asphalt Base Emulsions for Use as Protective Coatings for Metal

D4586-07.....Asphalt Roof Cement, Asbestos Free

C. American National Standards Institute/Single Ply Roofing Institute (ANSI/SPRI):

ES-1-2003.....Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual (2003 Edition).

E. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-505-88.....Metal Finishes Manual

F. American Architectural Manufacturers Association (AAMA):

605-98.....Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions Panels

G. Federal Specification (Fed. Spec):

A-A-1925A.....Shield, Expansion; (Nail Anchors)

UU-B-790A.....Building Paper, Vegetable Fiber

H. International Building Code (IBC):

2007 Edition

1.7 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation. Refer to drawings (elevations) for mock-up locations.

1. Build mockup of typical roof eave, including fascia, fascia trim, apron flashing, approximately 48 inches (1200 mm) long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to sheet metal flashing and trim.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Solder: ASTM B32, Grade Sn60; flux type and alloy composition as required for use with metals to be soldered.

B. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.

C. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

D. 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).

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

F. Fasteners:
1. Use stainless steel for stainless steel and aluminum alloy.
2. Nails:
   a. Minimum diameter for copper nails: 3 mm (0.109 inch).
   b. Minimum diameter for aluminum nails 3 mm (0.105 inch).

c. Minimum diameter for stainless steel nails: 2 mm (0.095 inch) and annular threaded.

d. 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.

G. Sealant: As specified in Section 07 92 00, JOINT SEALANTS for exterior locations.

H. Insect Screening: ASTM D3656, 18 by 18 regular mesh.

I. Roof Cement: ASTM D4586, asbestos free, of consistency required for application.

2.2 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: 0.4 mm (0.016 inch) thick.

C. Thickness of aluminum is specified with each item.

2.3 FABRICATION, GENERAL

A. Jointing:

1. In general, stainless steel joints, except expansion and contraction joints, shall be locked and soldered.

2. Jointing of 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 (one 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 bituminous coated copper, 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 stainless steel,.
b. Treat in accordance with metal producers recommendations other sheet metal required to be soldered.
c. 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 aluminum at intervals not exceeding 5400 mm (18 feet), except do not exceed 3000 mm (10 feet) for gravel stops and fascia-cant systems.
4. Fabricate slip-type or loose locked joints and fill with sealant unless otherwise specified.
5. 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 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 1.6 mm (0.0625 inch) thick aluminum.

E. Drips:
1. Form drips at lower edge of sheet metal counter-flashings (cap flashings), fascias, 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 2003.

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.

2.4 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. Aluminum:
   a. Surface: Smooth, flat.
   b. Exposed Coil-Coated Finishes:
      1) Two-coat Fluoropolymer: AAMA 620. Fluoropolymer finish 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.

c. Color: As selected by Architect from manufacturer's full range.

d. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

2.5 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 (one 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. 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 Stainless steel.
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 0.5 mm (0.018 inch) thick stainless steel.

2. Where shown on drawings as combined counter flashing under threshold, sill plate, door sill, or where subject to foot traffic, use 0.6 mm (0.024 inch) 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.

2.6 HANGING GUTTERS

A. Fabricate gutters of not less than 0.032 inch thick Prefinished Aluminum. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
   1. Gutter Style: SMACNA designation B.
   2. Expansion Joints: Lap Type.
   3. Accessories: Continuous removable leaf screen with sheet metal frame and hardware cloth screen, Wire ball downspout strainer.
   4. Gutters with Girth up to 380 mm (15 inch): Fabricate from the following materials:
      a. Aluminum: 0.81 mm (0.032 inch) thick.
   5. Gutters with Girth up to 410 to 510 mm (16 to 20 inch): Fabricate from the following materials:
      a. Aluminum: 1.02 mm (0.040 inch) thick.
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 (one inch) wide strap and fasten to gutters not over 900 mm (36 inches) on center.
   3. Turn back edge up 25 mm (one 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. Seal aluminum tube to gutter and rivet to gutter.
4. Fabricate basket strainers of same material as gutters.

G. Gutter Brackets:
1. Fabricate of same metal as gutter.
2. Size recommended by SMACNA but not less than twice the gutter thickness.
3. Fabricate to gutter profile.
4. Drill two 5 mm (3/16 inch) diameter holes in anchor leg for countersunk flat head screws.

2.7 DOWNSPOUTS

A. Fabricate conductors of same metal and thickness as gutters in sections approximately 3000 mm (10 feet) long.

B. Fabricate elbows by mitering. 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 (one inch) minimum width. Form to support conductors 25 mm (one inch) from wall surface in accordance with Architectural Sheet Metal Manual Plate 34, Design C for rectangular shapes.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, and Backer Flashing: Fabricate from the following materials:
1. Aluminum: 0.81 mm (0.032 inch) thick.

B. Drip Edges: Fabricate from the following materials:
1. Aluminum: 0.81 mm (0.032 inch) thick.

C. Eave, Rake Flashing: Fabricate from the following materials:
1. Aluminum: 0.81 mm (0.032 inch) thick.

D. Counter Flashing: Fabricate from the following materials:
1. Aluminum: 0.81 mm (0.032 inch) thick.

E. Flashing Receivers: Fabricate from the following materials:
1. Aluminum: 0.81 mm (0.032 inch) thick.

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. 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.
7. 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.
8. Coordinate with roofing work for the installation of metal base flashings and other metal items having roof flanges for anchorage and watertight installation.
9. Nail continuous cleats on 75 mm (3 inch) on centers in two rows in a staggered position.
10. Nail individual cleats with two nails and bend end tab over nail heads. Lock other end of cleat into hemmed edge.
11. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a water tight installation.
12. 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.
13. 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.

14. Paint aluminum in contact with or built into mortar, concrete, plaster, or other masonry materials with a coat of bituminous paint.
15. Paint aluminum in contact with absorptive materials that may become repeatedly wet with two coats of bituminous paint or two coats of aluminum 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.

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 Cavity Wall Construction: Where flashing occurs in cavity walls turn vertical portion up against backup under waterproofing, if any, into mortar joint. Turn up over insulation, if any, and horizontally through insulation into mortar joint.

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 (one 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 (one 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 water proof 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 COUNTERFLASHING

A. General:
1. Install counterflashing over and in conjunction with installation of base flashings, except as otherwise specified or shown.
2. Install counterflashing to lap base flashings not less than 100 mm (4 inch).
3. Install upper edge or top of counterflashing not less than 225 mm (9 inch) above top of the roofing.
4. Lap joints not less than 100 mm (4 inch). Stagger joints with relation to metal base flashing joints.
5. Use surface applied counterflashing on existing surfaces and new work where not possible to integrate into item.
6. When fastening to concrete or masonry, use screws driven in expansion shields set in concrete or masonry. Use screws to wood and sheet metal. Set fasteners in mortar joints of masonry work.

B. One Piece Counterflashing:
1. Where flashing is installed at new masonry, coordinate to ensure proper height, embed in mortar, and end lap.
2. Where flashing is surface mounted on flat surfaces.
   a. When top edge is double folded anchor flat portion below sealant "V" joint with fasteners spaced not over 400 mm (16 inch) on center:

1) Locate fasteners in masonry mortar joints.

2) Use screws to sheet metal or wood.

b. Fill joint at top with sealant.

C. Where vented edge occur install so lower edge of counterflashing is against base flashing.

D. When counter flashing is a component of other flashing install as shown.

3.4 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 (one 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. Anchor gutter spacers to front and back of gutter.

3. For aluminum gutters use aluminum 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. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.

E. Anchor and loosely lock back edge of gutter to continuous cleat.

F. Loosely lock straps to front gutter bead and anchor to roof deck.

G. Gutter Expansion Joint:

1. Locate expansion joints midway between outlet tubes.

2. Provide at least a 25 mm (one 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.

6. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart.

H. Outlet Tubes: Set bracket strainers loosely into gutter outlet tubes.

I. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

3.5 DOWNSPOUTS

A. Set conductors plumb and clear of wall, and anchor to wall with two anchor straps and at approximately 1500 mm (60 inch) o.c. in between, 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.

B. Install elbows, offsets and shoes where shown and required. Slope not less than 45 degrees.

C. Joint sections with 38 mm (1-1/2 inch) telescoping joints.

D. Connect downspouts to underground drainage system as indicated.

- - - E N D - - -

SECTION 07 81 00

APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies spray applied fire resistive material (SFRM) coverings to provide fire resistance to interior structural steel members shown.

1.2 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Manufacturer's complete and detailed application instructions and specifications.
2. Manufacturer's repair and patching instructions.

C. 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.

D. 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 CONTROL

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

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 COTR, 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):

C841-03.....Installation of Interior Lathing and Furring

C847-06.....Metal Lath

E84-08.....Surface Burning Characteristics of Building Materials

E119-08.....Fire Tests of Building Construction and Materials

E605-93 (R2006).....Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members

E736-00.....Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

E759-92 (R2005).....The Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members

E760-92 (R2005).....Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members

E761-92 (R2005).....Compressive Strength of Fire-Resistive Material Applied to Structural Members

E859-93 (R2006).....Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members

E937-93 (R2005).....Corrosion of Steel by Sprayed Fire-Resistive Material Applied to Structural Members

E1042-02.....Acoustically, Absorptive Materials Applied by Trowel or Spray.

G21-96 (R2002).....Determining Resistance of Synthetic Polymeric Materials to Fungi

C. Underwriters Laboratories, Inc. (UL):

Fire Resistance Directory...Latest Edition including Supplements

D. Warnock Hersey (WH):

Certification Listings..Latest Edition

E. Factory Mutual System (FM):

Approval Guide.....Latest Edition including Supplements

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F (7 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to

manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 SPRAYED-ON FIREPROOFING

A. SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application or conveyed in a dry state and mixed with atomized water at place of application, ASTM E1042, Class (a), Category A, Type I, factory mixed cementitious materials with approved aggregate.

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. No evidence of corrosion.
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.
5.	Air Erosion	ASTM E859	Maximum gain weight of the collecting filter $0.27 gm/m^2$ ($0.025 gm/ft^2$).
6.	Compressive Strength	ASTM E761	5.21 lbf/sq. in. (35.9 kPa) minimum. Minimum thickness of SFRM tested shall be 0.75 inch (19 mm) and minimum dry density shall be as specified but not less than 15 lb/cu. ft. (240 kg/cu. m).
7.	Surface Burning	ASTM E84	Flame-Spread Index: 10 or less

	Characteristics with adhesive and sealer to be used		Smoke Developed Index: 0
8.	Fungi Resistance	ASTM G21	Resistance to mold growth when inoculated with aspergillus niger (28 days for general application). Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens

2.2 ADHESIVE

A. Use bonding adhesive as recommended and supplied by the fireproofing material manufacturer.

B. Adhesive may be an integral part of the material or applied separately to surface receiving fireproofing material.

2.3 SEALER

A. Use sealer as recommended and supplied by the fireproofing material manufacturer.

B. Surface burning characteristics as specified for fireproofing material.

C. Fungus resistant.

D. Sealer may be an integral part of the material or applied separately to the exposed surface. When applied separately use contrasting color pigmented sealer, white preferred.

2.4 WATER

A. Clean, fresh, and free from organic and mineral impurities.

B. pH of 6.9 to 7.1.

2.5 MECHANICAL BOND MATERIAL

A. Expanded Metal Lath: ASTM C847, minimum weight of 0.92 kg/m^2 (1.7 pounds per square yard).

B. Fasteners: ASTM C841.

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 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. See design criteria section of the approved assemblies used.
7. 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).

E. Application shall be completed in one area, inspected and approved by the COTR 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. The COTR 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 members, except on following surfaces:

1. Areas used as air handling plenums.
2. Steel to be encased in concrete or designated to receive other type of fireproofing.

B. Type I: Refer to drawings for hour 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.

1. Penetrations for passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire rated vertical barriers (walls and partitions), horizontal beams floor/ceiling assemblies)and vertical service shaft walls and partitions.
2. Openings between structurally separate sections of walls and floors.
3. Gaps between tops of walls and ceiling or roof assemblies.
4. Expansion joints in fire rated walls and floors.
5. Openings and penetrations in fire rated partitions or walls containing fire doors.
6. Openings around structural members which penetrate fire rated floors or walls.

B. Closure of openings in walls against penetration of gases or smoke in smoke partitions.

1.2 RELATED WORK

A. Spray applied fireproofing: Section 07 81 00, APPLIED FIREPROOFING

B. Sealants and application: Section 07 92 00, JOINT SEALANTS.

C. Fire and smoke damper assemblies in ductwork: Section 23 31 00, HVAC DUCTS AND CASINGS and Section 23 37 00, AIR OUTLETS AND INLETS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.

C. List of FM, UL, or WH classification number of systems installed.

D. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

E. Shop Drawings: Submit shop drawings showing layout, profiles and product components. Include UL Systems or other independent laboratory system classification number on shop drawings.

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

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

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):

E84-07.....Surface Burning Characteristics of Building Materials

E814-06.....Fire Tests of Through-Penetration Fire Stops

C. Factory Mutual Engineering and Research Corporation (FM):

Annual Issue Approval Guide Building Materials

D. Underwriters Laboratories, Inc. (UL):

Annual Issue Building Materials Directory

Annual Issue Fire Resistance Directory

1479-03.....Fire Tests of Through-Penetration Firestops

E. Warnock Hersey (WH):

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 m^2 (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

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.

1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
2. Seal all joints to ensure an air and water resistant seal, capable to withstand compression and extension due to thermal, wind or seismic joint movement.
3. Consult with the COTR/architect prior to installation of UL firestopping systems that might hamper the performance of fire dampers as it pertains to duct work.

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 COTR.

C. Clean up spills of liquid type materials.

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SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION:

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. Sealing of site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

B. Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.

C. Firestopping penetrations: Section 07 84 00, FIRESTOPPING.

D. Glazing: Section 08 80 00, GLAZING.

E. Sound rated gypsum partitions/sound sealants: Section 09 29 00, GYPSUM BOARD.

F. Mechanical Work: Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

1.3 QUALITY CONTROL:

A. 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.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
3. Test joint sealants according to SWRI’s Sealant Validation Program for compliance with requirements specified by reference to ASTM C920

for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.

4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates in accordance with sealant manufacturer’s recommendations:

1. Locate test joints where indicated or, if not indicated, as directed by the COTR.
2. Conduct field tests for each application indicated below:
   a. Each type of elastomeric sealant and joint substrate indicated.
   b. Each type of non-elastomeric sealant and joint substrate indicated.
3. Notify the COTR seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint sealant manufacturer’s technical representative present.

E. VOC: Acrylic latex and Silicon sealants shall have less than 20g/l VOC content.

F. 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. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's installation instructions for each product used.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

F. 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 5° C (40° F) or less than 32° C (90° 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):

C509-06.....Elastomeric Cellular Preformed Gasket and Sealing Material.

C612-04.....Mineral Fiber Block and Board Thermal Insulation.

C717-07.....Standard Terminology of Building Seals and Sealants.

C834-05.....Latex Sealants.

C919-02.....Use of Sealants in Acoustical Applications.

C920-05.....Elastomeric Joint Sealants.

C1021-08.....Laboratories Engaged in Testing of Building Sealants.

C1193-05.....Standard Guide for Use of Joint Sealants.

C1330-02 (R2007).....Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.

D1056-07.....Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

E84-08.....Surface Burning Characteristics of Building Materials.

C. Sealant, Waterproofing and Restoration Institute (SWRI).
The Professionals' Guide

PART 2 - PRODUCTS

2.1 SEALANTS:

A. S-2:

1. ASTM C920, polyurethane
2. Type M or S.
3. Class 25.
4. Grade P.
5. Shore A hardness of 30-45.

B. 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. ASTM C1248 Stain Test independent lab results.

C. 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.

D. 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. General: As selected by Architect from manufacturer’s full range.

B. Sealants used with exposed masonry shall match color of mortar joints.

C. Sealants used with unpainted concrete shall match color of adjacent concrete.

D. Coordinate with Architect for color of sealants at all locations.

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. 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.
   e. Fibercement siding.

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° and 100° F).
2. Do not use sealant type listed by manufacture as not suitable for use in locations specified.
3. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
4. Avoid dropping or smearing compound on adjacent surfaces.
5. Fill joints solidly with compound and finish compound smooth.
6. Tool joints to concave surface unless shown or specified otherwise.
7. Finish paving or floor joints flush unless joint is otherwise detailed.
8. Apply compounds with nozzle size to fit joint width.
9. Test sealants for compatibility with each other and substrate. Use only compatible sealant.
10. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

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-6
2. Metal to Masonry or Stone: Type S-6
3. Masonry to Masonry or Stone: Type S-6
4. Cast Stone to Cast Stone: Type S-6
5. Threshold Setting Bed: Type S-6
6. Masonry Expansion and Control Joints: Type S-6
7. Wood to Masonry: 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 and floors to Plumbing Fixtures: Type S-9
2. Counter Tops to Walls: Type S-9
3. Pipe Penetrations: Type S-9
4. Tile control and expansion joints where indicated: Type S-9

D. Horizontal Traffic Joints:

1. Concrete Paving, Unit Pavers: Type S-2
2. Exterior patios: Type S-2

E. High Temperature Joints over 204 degrees C (400 degrees F):

1. Exhaust Pipes, Flues, Breech Stacks: Type S-7 or S-8

F. Interior Caulking:

1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1, 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, C-2
4. Perimeter of Lead Faced Control Windows and Plaster or Gypsum Wallboard Walls: Types C-1, C-2
5. Exposed Isolation Joints at Top of Full Height Walls: Types C-1, C-2
6. Exposed Acoustical Joint at Sound Rated Partitions Type C-2
7. Concealed Acoustic Sealant Type C-1, C-2
8. Isolation joints in cast-in-place concrete slabs: Type S-2
9. Control and expansion joints in tile flooring: Type S-2
10. Tile control and expansion joints (vertical): Type C-1
11. Control and expansion joints on exposed interior surfaces of exterior walls: Type C-1

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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. Frames fabricated of structural steel: Section 05 50 00, METAL FABRICATIONS.

B. Aluminum frames entrance work: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.

C. Door Hardware: Section 08 71 00, DOOR HARDWARE.

D. Glazing: Section 08 80 00, GLAZING.

E. Painting primed doors and frames: Section 09 91 00 PAINTING.

1.3 TESTING

An independent testing laboratory shall perform testing.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturers Literature and Data:

1. Fire rated doors and frames, showing conformance with NFPA 80 and Underwriters Laboratory, Inc. For door assemblies required to be fire-rated and exceeding limitations of labeled assemblies, submit manufacturer’s certification that each door and frame assembly has been constructed to conform to design, materials and construction equivalent to requirements for labeled construction. . Submit proof of temperature rating.
2. Sound rated doors, including test report from Testing Laboratory.
3. Product data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.

C. Shop Drawings showing fabrication and installation of hollow metal doors and frames. Include details of each frame type, elevations of

door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

1. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.
2. Indicate coordinate of glazing frames and stops with glass and glazing requirements.

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. Place units on minimum 4-inches high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide ¼-inches spaces between stacked doors to promote air circulation.

B. Protect from rust and damage during storage and erection until completion.

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. Federal Specifications (Fed. Spec.):

L-S-125B.....Screening, Insect, Nonmetallic

C. Door and Hardware Institute (DHI):

A115 Series.....Steel Door and Frame Preparation for Hardware, Series A115.1 through A115.17 (Dates Vary)

D. Steel Door Institute (SDI):

113-01.....Thermal Transmittance of Steel Door and Frame Assemblies

117-00.....Manufacturing Tolerances for Standard Steel Doors and Frames128-1997 Acoustical Performance for Steel Door and Frame Assemblies

A250.8-03.....Standard Steel Doors and Frames

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

A568/568-M-07.....Steel, Sheet, Carbon, and High-Strength, Low-alloy, Hot-Rolled and Cold-Rolled

A1008-08.....Steel, sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability

E90-04.....Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

F. The National Association Architectural Metal Manufactures (NAAMM):

Metal Finishes Manual (1988 Edition)

G. National Fire Protection Association (NFPA):

80-09.....Fire Doors and Fire Windows

H. Underwriters Laboratories, Inc. (UL):

Fire Resistance Directory

I. Intertek Testing Services (ITS):

Certifications Listings…Latest Edition

J. Factory Mutual System (FM):

Approval Guide

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Steel: ASTM A1008, cold-rolled for panels (face sheets) of doors.

B. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, or drawing quality, ASTM A 642, hot dipped galvanized in accordance with ASTM A 525, with A60 or G60 coating designation, mill phoshatized.

C. Anchors, Fastenings and Accessories: Fastenings anchors, clips connecting members and sleeves from zinc coated steel (hot-dip galvanize).

D. Prime Paint: Paint that meets or exceeds the requirements of A250.8.

1. Shop Applied Paint: Apply after fabrication.

a. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A224.1, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

b. Primer: Refer Section 09 91 00, PAINTING for field applied finishes for primer compatibility.

2.2 FABRICATION GENERAL

A. GENERAL:

1. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, wrap or buckle. Whenever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site. 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 all doors flush as integral part of door construction or by addition of minimum 16-gage inverted steel channels.; seal top edge of exterior doors to prevent water intrusion.
3. When vertical steel stiffeners are used for core construction, fill spaces between stiffeners with mineral fiber insulation.
4. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel.
5. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
6. Thermal- Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to ASTM C 236 or ASTM C 976 on fully operable door assemblies.
   a. Unless otherwise indicated, provide thermal-rated assemblies with U-value of 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K) or better.
7. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 Series specifications for door and frame preparation for hardware.
   a. For concealed overhead door closers, provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.

b. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

B. Heavy Duty Doors: SDI A250.8, Level 2, Model 2, minimum 18-gage cold-rolled sheet steel faces of size and design shown for interior doors. Provide doors with continuously welded seam edges, ground smooth for a seamless appearance. Core construction types a, d, or f, for interior doors.

C. Extra Heavy Duty Doors: SDI A250.8, Level 3, Model 4, insulated, minimum 16-gage galvanized steel faces of size and design shown for exterior doors. Provide doors with continuously welded seam edges, ground smooth for a seamless appearance. Core construction Types b, c, e, or f, for exterior doors.

D. Smoke Doors:

1. Close top and vertical edges flush.
2. Provide seamless vertical edges.
3. Provide clearance at head, jamb and sill as specified in NFPA 80.

E. 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.

2.3 METAL FRAMES

A. General:

1. SDI A250.8, 16-gage thick sheet steel, types and styles as shown or scheduled.
2. Frames for exterior doors: Fabricate from 16-gage galvanized steel conforming to ASTM A525.
3. Frames for labeled fire rated doors.
   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. Provide welded unit type with mitred corners. 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.

C. Terminated Stops: SDI A250.8.

D. Glazed Openings: Minimum 20 gage steel or 0.040-inch- thick aluminum sheet.

a. Integral stop on exterior, corridor, or secure side of door.
b. Design rabbet width and depth to receive glazing material or panel shown or specified.
c. Provide screw-applied, removable, glazing beads on inside of glass, louvers, and other panels in doors.
d. All glazing stops shall be sized so as to be fully flush with the face plane of the opening, be it frame or door.

E. Frame Anchors:

1. Floor anchors:

a. Where floor fills occur, provide extension type floor anchors to compensate for depth of fill.
b. 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.
c. 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.
d. 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 1.52 mm (0.060 inch) or 16 gage (minimum) 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. Provide wood bucks on all 3 sides of frame.
e. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.
F. Door Silencers: Except on weather-stripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames. Note that "stick-on" types are specifically not permitted.

2.4 SHOP PAINTING

A. General: SDI A250.8.
B. Clean, treat and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
   a. Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before application of paint.
   b. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

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. Except for frames located in existing concrete masonry or drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. Remove wood

spreaders and braces only after the walls are built and jamb anchors are secured, leaving surfaces smooth and undamaged.

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.
   a. Locate 3 wall anchors per jamb.
   b. Install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb.
2. Coat frame back with a bituminous coating prior to lining of grout filling in masonry walls.
3. Metal frames in steel stud partitions shall have 16 gage (minimum) jamb anchor clips welded to and completely filling the frame. Locate anchor clips at head; 12” down from head; thence 24” maximum on center to floor; provide floor anchor clip at each jamb, welded to frame. Clips shall have at least two holes for power driven or expansion type attachment to concrete. Jamb anchor clips shall have slots or shoulders to accept steel stud, in accordance with the recommendations of the manufacturer of steel studs actually used. 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.

F. Overhead Bracing (Lead Lined Frames): Where jamb extensions extend to structure above, anchor clip angles with not less than two, 9 mm (3/8 inch) expansion bolts or power actuated drive pins to concrete slab. Weld to steel overhead members.

3.2 INSTALLATION OF DOORS AND APPLICATION OF HARDWARE

Install doors and hardware as specified in Sections Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, Section 08 14 00, WOOD DOORS, and Section 08 71 00, DOOR HARDWARE. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI-250.8.

3.3 ADJUSTING AND CLEAN

A. Prime-Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

B. Protection Removal: Immediately prior to final inspection, remove protective wrappings from prefinished doors.

C. Final Adjustments: Check and readjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

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SECTION 08 14 00

INTERIOR WOOD DOORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies interior flush doors and stile and rail doors with prefinish, prefit option.

B. Section includes fire rated doors, and smoke 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. Card readers and biometric devices: Section 28 13 11, PHYSIAL ACCESS CONTROL SYSTEM (PACS) and Section 28 13 16 ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. 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.

C. Shop Drawings:

1. Show every door in project and schedule location in building.
2. Indicate type, grade, finish and size; include details of glazing, louvers, sound gasketing, core and edge construction and trim for openings and pertinent details.
3. Provide information concerning specific requirements not included in the manufacturer's literature and data submittal.

4. Include factory-finishing specifications.

D. Manufacturer's Literature and Data:

1. Labeled fire rated doors showing fire-protection rating and conformance with NFPA 80.

E. Laboratory Test Reports:

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.

F. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.

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.

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 APPLICABLE PUBLICATIONS

Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

A. Architectural Woodwork Institute (AWI):

AWI-99.....Architectural Woodwork Quality Standards and Quality Certification Program

B. National Fire Protection Association (NFPA):

80-07.....Protection of Buildings from Exterior Fire

252-08.....Fire Tests of Door Assemblies

C. ASTM International (ASTM):

E90-04.....Laboratory Measurements of Airborne Sound Transmission Loss

1.7 QUALITY ASSURANCE

A. Quality Standard: In addition to requirements specified, all interior wood doors shall comply with AWI's "Architectural Woodwork Quality Standards and Quality Certification Program," unless otherwise specified.B. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UBC Standard 7-2 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 FLUSH DOORS

A. General:

1. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
2. Thickness: 45 mm (1-3/4 inches) unless otherwise shown or specified.

B. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde resin.
2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
3. Provide doors with either glued wood stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

C. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

a. Screw Withdrawal, Face: 700 lbf (3100 N).

b. Screw Withdrawal, Edge: 400 lbf (1780 N).

D. Veneered-faced Doors For Transparent Finish:

1. Interior Solid-Core Doors:

a. Grade: Custom (Grade A faces).

b. Species: Birch or Red Oak, COTR approval.

c. Cut: Plain Sliced (flat sliced).

d. Match between Veneer Leaves: Book match.

e. Assembly of Veneer Leaves on Door Faces: Center-balance match.

f. Pair and Set Match: Provide for doors hung in same opening.

g. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet (6 m) or more.

h. Exposed Vertical and Top Edges: Same species as faces.

i. Core: Particleboard. Use either glued wood stave or structural composite lumber for doors indicated to receive exit devices.

j. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.

h. 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.

E. Interior Solid-Core Doors For Opaque Finish:

1. Interior Solid-Core Doors:

a. Grade: Custom.

b. Faces: Poplar or Birch, COTR approval.

c. Exposed Vertical and Top Edges: Poplar.

d. Core: Particleboard. Use either glued wood stave or structural composite lumber for doors indicated to receive exit devices.

e. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.

f. 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.

F. Fire rated wood doors: Manufacturer's standard as allowed by the labeling requirements.

1. Edge Construction: Provide edge construction with intumescent seals

concealed by outer stile. Comply with specified requirements for exposed edges.

2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
3. Fire Rating: As indicated.
4. 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.
5. 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.
6. 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, unless otherwise specified.
   d. Reinforcement blocking in compliance with manufacturer's labeling requirements.
   e. Mineral material similar to core is not acceptable.
7. Other Core Components: Manufacturer's standard as allowed by the labeling requirements.

G. Light Frames:

1. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
   a. Wood Species: Same species as door faces.

b. Profile: Recessed tapered beads.

c. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

2. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

H. Glass: Uncoated, clear, fully tempered float glass, 6.4 mm (¼ inch)thick, complying with Section 08 80 00 GLAZING.

2.2 STILE AND RAIL DOORS

A. Panel Designs: Indicated by Drawings; see detail F6/A003. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

B. Grade: Custom.

C. Finish: Transparent.

D. Wood Species and Cut for Transparent Finish: Red oak, quarter sawed/sliced stiles and rails.

E. Door Construction for Transparent Finish:

1. Stile and Rail Construction: Veneered, structural composite lumber with edges of species indicated. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces. Use veneers not less than 1/16 inch (1.6 mm) thick, unless otherwise specified.

F. Stile and Rail Widths: See detail F6/A003.

G. Molding Profile(Sticking): See detail C8/A004.

H. Glass: Uncoated, clear, fully tempered float glass, 6.4 mm (¼ inch)thick, complying with Section 08 80 00 GLAZING.

2.3 PREFINISH, PREFIT OPTION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting, unless otherwise specified. 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. Openings: Cut and trim openings through doors in factory.
   1. Light Openings: Trim openings with moldings of material and profile indicated.
   2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 GLAZING.
D. Factory sand smooth top and bottom edges of door.
E. Interior Wood Doors to receive transparent finish (in addition to being prefit) shall be factory finished as follows:
   1. Grade: Custom.
   2. Finish: AWI TR-6 catalyzed polyurethane.
   3. Staining: As selected by Architect from manufacturer's full range. Stain is intended to match all interior architectural woodwork.
   4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
   5. Sheen: Satin.

2.4 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.

2.5 SEALING:

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 (two 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. Double egress doors to have rabbeted edges.

I. Glazed Openings: Glaze doors at factory with glass of type and thickness indicated, complying with Section 08 80 00 GLAZING. Install glass using manufacturer's standard elastomeric glazing sealant complying with ASTM C 920. Secure glass in place with removable wood moldings. Miter wood moldings at corner joints.

3.2 INSTALLATION OF DOORS APPLICATION OF HARDWARE

Install doors and hardware as specified in this Section.

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 COTR.

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SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies access doors or panels.

1.2 RELATED WORK:

A. Locations of access doors for duct work cleanouts: Section 23 31 00, HVAC DUCTS AND CASINGS, and Section 23 37 00, AIR OUTLETS AND INLETS.

1.3 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: Access doors, each type, showing construction, location and installation details.

C. Manufacturer's Literature and Data: Access doors, each type.

1.4 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):

A153/A153M - 09... Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware A1008-07 Steel Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy

F2329 - 05.....Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

C. American Welding Society (AWS):

D1.3-98.....Structural Welding Code Sheet Steel

D. National Fire Protection Association (NFPA):

80-06.....Fire Doors and Windows

E. The National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500 Series.....Metal Finishes Manual

F. Underwriters Laboratories, Inc. (UL):

Fire Resistance Directory

1.5 WARRANTY

A. Access Doors and Frames: 2 years from date of substantial completion, unless specified otherwise.

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. 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.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Drywall Beads: Edge trim formed from 0.76 mm (0.0299-inch) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.2 INSULATED FLUSH ACCESS DOORS AND TRIMLESS FRAMES, FIRE RATED:

A. Fabricate from steel (Commercial Steel [CS]) sheet.
   1. Locations: Wall and Ceiling surfaces.
   2. Shall meet requirements for "B" label 1-1/2 hours with maximum temperature rise of 120 degree C (250 degrees F).
   3. Comply with NFPA 80 and have Underwriters Laboratories Inc., or other nationally recognized laboratory label for Class B opening.
   4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.9 mm (0.0359 inch).
   5. Frame: Minimum 1.5 mm (0.0598 inch) thick sheet metal with drywall bead.
   6. Hinges: Continuous piano.
   7. Automatic Closer: Spring type.
   8. Latch: Self-latching bolt operated by Flush Screwdriver with interior release.
   9. Frame Anchors: Same type as door face.

10. Inserts, Bolts and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F2329.

2.3 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. Color as selected by architect from manufacturer's standard available full range.

2.4 SIZE:

As indicated on drawings; see details C4/A701 and E4/A701.

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. See Sheet A241 REFLECTED CEILING PLAN for location of fire rated access doors.

3.2 INSTALLATION, GENERAL:

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

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.

C. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

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SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies aluminum swing doors 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 13.11, LOW ENERGY POWER ASSIST DOOR OPERATORS.

1.3 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: (1/2 full scale) showing construction, anchorage, reinforcement, and installation details.

C. Manufacturer’s Literature and Data:

1. Doors, each type.

D. Samples:

1. Door corner section, 450 mm x 450 mm (18 x 18 inches), of each door type specified, showing vertical and top hinge edges, door closer reinforcement, internal reinforcement.
2. Two samples of anodized aluminum of each color showing finish and maximum shade range.

E. Manufacturer's Certificates:

1. Stating that aluminum has been given specified thickness of anodizing.
2. Indicating manufacturer's qualifications specified.

1.4 QUALITY ASSURANCE:

A. Approval by Contracting Officer is required of products of proposed manufacturer, or supplier, and will be based upon submission by Contractor certification.

B. Certify manufacturer regularly and presently manufactures aluminum entrances as one of their principal products.

1.5 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.

1.6 WARRANTY

Warrant Aluminum-Framed Entrances and Storefronts against malfunctions due to defects in thermal breaks, hardware, materials and workmanship, subject to the terms of Article "WARRANTY OF CONSTRUCTION", FAR clause 52.246-21, except provide 10 year warranty period.

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):

B221-05.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

E283-04.....Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

E331-00.....Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

F468-06.....Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

F593-04.....Stainless Steel Bolts, Hex Cap Screws, and Studs

C. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500 Series.....Metal Finishes Manual

D. American Architectural Manufacturer's Association (AAMA):

2604-05.....High Performance Organic Coatings on Architectural Aluminum Extrusions and Panels

E. American Welding Society (AWS):

D1.2-03.....Structural Welding Code Aluminum

1.8 PERFORMANCE REQUIREMENTS:

A. Shapes and thickness of framing members shall be sufficient to withstand main wind design pressure of 15 PSF. 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, fixed glass and transoms.
2. For color anodized finish, use aluminum alloy as required to produce specified color.

B. Thermal Break: Manufacturer standard low conductive material retarding heat flow in the framework, where insulating glass is scheduled.

C. Fasteners:

1. Zinc plated steel concealed fasteners; Hardened aluminum alloys or AISI 300 series stainless steel exposed fasteners, countersunk, finish to match aluminum color.

D. Sealant: Non-skinning type, AAMA 803.3.

E. Glazing: Setting blocks, edge blocks, and spacers in accordance with ASTM C 864, shore durometer hardness as recommended by manufacturer; Glazing gaskets in accordance with ASTM C 864.

1. Muntins/Grid (between two glass panes): All Units shall be factory glazed.
   a. Pattern: See drawings
   b. Size: 13/16 inch by 3/16 inch
   c. Material: Rolled-formed aluminum
   d. Color: match window

2.2 FABRICATION:

A. Fabricate doors, of extruded aluminum sections not less than 3 mm (0.125 inch) thick. Fabricate glazing beads of aluminum not less than 1.0 mm (0.050 inch) thick.

B. 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.

C. 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. Fabricate and assemble units with joints only at intersection of aluminum members with uniform hairline joints; rigidly secure, and sealed in accordance with manufacturer's recommendations.

D. Make provisions in doors and frames to receive the specified hardware and accessories. Coordinate schedule and template for hardware specified under Section 08 71 00, DOOR HARDWARE. Where concealed closers or other mechanisms are required, provide the necessary space, cutouts, and reinforcement for secure fastening. Reinforce frames and door stiles to receive hardware in accordance with manufacturer's recommendations.

E. 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 doors, frames, mullions, transoms, 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 STILE AND RAIL DOORS:

A. Nominal 45 mm (1-3/4 inch) thick, with stile and head rail 127 mm (5 inches) wide, middle rail 225 mm (9 inches), and bottom rail 300 mm (12 inches) wide.

B. Bevel single-acting doors 3 mm (1/8 inch) at lock, hinge and meeting stile edges. Provide clearances of 2 mm (1/16 inch) at hinge stiles, 3 mm (1/8 inch) at lock stiles and top rails, and 5 mm (3/16 inch) at floors and thresholds. Form glass rebates integrally with stiles and rails.

C. Glazing stops: Provide manufacturer’s standard snap-in glazing stops with EPDM glazing gaskets to prevent water infiltration.

C. Construct doors with a system of welded joints or interlocking dovetail joints between stiles and rails. Clamp door together through top and bottom rails with 9 mm (3/8 inch) primed steel rod extending into the stiles, and having a self-locking nut and washer at each end. Reinforce stiles and rails to prevent door distortion when tie rods are tightened. Provide a compensating spring-type washer under each nut to take up any stresses that may develop. Construct joints between rails and stiles to remain rigid and tight when door is operated.

D. Weather-stripping: Provide manufacturer’s standard pile type in replaceable rabbets for stiles; manufacturer’s standard EPDM bulb type in door frames. Make slots for applying weather-stripping integral with doors and door frame stops. Apply continuous weather-stripping to heads, jambs, bottom, and meeting stiles of doors and frames. Install weather-stripping so doors can swing freely and close positively.

   a. Color: Brown, unless otherwise specified.

2.6 REINFORCEMENT FOR BUILDERS HARDWARE:

A. Fabricate from stainless steel plates.

B. Hinge and pivot reinforcing: 4.55 mm (0.1793 inch) thick.

C. Reinforcing for lock face, flush bolts, concealed holders, concealed or surface mounted closers: 2.66 mm (0.1046 inch) thick.

D. Reinforcing for all other surface mounted hardware: 1.5 mm (0.0598 inch) thick.

2.7 COLUMN COVERS AND TRIM

A. Fabricate column covers and trim shown from 1.5 mm (0.0625 inch) thick sheet aluminum of longest available lengths.

B. Use concealed fasteners, unless otherwise specified.

C. Provide aluminum stiffener and other supporting members shown or as required to maintain the integrity of the components.

2.10 FINISH

A. In accordance with NAAMM AMP 500 series.

B. Anodized Aluminum:

2. Color Finish: Chemically etched medium matte, with integrally colored anodic coating, Class I Architectural, 7 mils thick. More than 50 percent variation of the maximum shade range approved will not be accepted in a single component or in adjacent components, stiles, and rails on a continuous series.

   a. Color: Dark Bronze, unless otherwise specified.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions, and product carton instructions.

B. 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 (eight feet), non-accumulative, is maximum permissible for plumb, level, warp, bow and alignment.

C. 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.

D. Where work is installed within masonry or concrete openings, place no parts other than built-in anchors and provision for operating devices located in the floor, until after the masonry or concrete work is completed.

E. Install hardware specified under Section 08 71 00, DOOR HARDWARE.

F. Install hung door operators specified under Section 08 71 13.11, LOW ENERGY POWER ASSIST DOOR OPERATORS.

G. Shim and brace aluminum system before anchoring to structure.

3.2 ADJUSTING:

After installation of entrance and storefront work is completed, adjust and lubricate operating mechanisms to insure proper performance.

3.3 PROTECTION, CLEANING AND REPAIRING:

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 08 51 13

ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Aluminum windows of type and size shown, complete with hardware, related components and accessories.

B. Types:

1. Hung windows
2. Fixed

1.2 DEFINITIONS

A. Accessories: Mullions, staff beads, casings, closures, trim, moldings, panning systems, sub-sills, clips anchors, fasteners, weather-stripping, insect screens, and other necessary components required for fabrication and installation of window units.

B. Uncontrolled Water: Water not drained to the exterior, or water appearing on the room side of the window.

1.3 RELATED WORK

A. Aluminum swing doors: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.

B. Glazing: Section 08 80 00, GLAZING.

1.4 DELIVERY, STORAGE AND HANDLING

A. Protect windows from damage during handling and construction operations before, during and after installation.

B. Store windows under cover, setting upright.

C. Do not stack windows flat.

D. Do not lay building materials or equipment on windows.

1.5 QUALITY ASSURANCE

A. Approval by COTR is required of products or service of proposed manufacturers and installers.

B. Approval will be based on submission of certification by Contractor that:

1. Manufacturer regularly and presently manufactures the specified windows as one of its principal products.
2. Installer has technical qualifications, experience, trained personnel and facilities to install specified items.

C. Provide each type of window produced from one source of manufacturer.

D. Quality Certified Labels or certificate:

1. Architectural Aluminum Manufacturers Association, "AAMA label" affixed to each window indicating compliance with specification.
2. Certificates in lieu of label with copy of recent test report (not more than 4 years old) from an independent testing laboratory and certificate signed by window manufacturer stating that windows provided comply with specified requirements and AAMA 101/I.S.2 for type of window specified.

1.6 SUBMITTAL

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:
   1. Minimum of 1/2 full scale for all types of windows on project.
   2. Identifying parts of window units by name and kind of metal or material, show construction, locking systems, mechanical operators, trim, installation and anchorages.
   3. Include glazing details and standards for factory glazed units.

C. Manufacturer's Literature and Data:
   Window.
   Sash locks, keepers, and key.

D. Certificates:
   1. Certificates as specified in paragraph QUALITY ASSURANCE.
   2. Indicating manufacturers and installers qualifications.
   3. Manufacturer's Certification that windows delivered to project are identical to windows tested.

E. Test Reports:
   Copies of test reports as specified in paragraph QUALITY ASSURANCE.

F. Samples: Provide 150 mm (six-inch) length samples showing finishes, specified. Physical samples or half size samples of full windows are encouraged if plant site is not easily accessible.

1.7 WARRANTY

Warrant windows against malfunctions due to defects in thermal breaks, hardware, materials and workmanship, subject to the terms of Article "WARRANTY OF CONSTRUCTION", FAR clause 52.246-21, except provide 10 year warranty period.

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 Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

90.1-04.....Energy Standard of Buildings

C. American Architectural Manufacturers Association (AAMA):

101/I.S.2/A440-05.....Windows, Doors, and Unit Skylights

505-98.....Dry Shrinkage and Composite Performance Thermal Cycling Test Procedures

2605-05.....Superior Performing Organic Coatings on Architectural Aluminum Extrusions and Panels

TIR-A8-04.....Structural Performance of Poured and Debridged Framing Systems

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

A653/A653M-07.....Steel Sheet, Zinc Coated (Galvanized), Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-dip Process

E 90-04.....Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

E. National Fenestration Rating Council (NFRC):

NFRC 100-04.....Determining Fenestration Product U-Factors

NFRC 200-04.....Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

F. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500 Series.....Metal Finishes Manual

PART 2- PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions; Sheet and Plate: AAMA 101/I.S.2.

B. Sheet Steel, Galvanized: ASTM A653; G90 galvanized coating.

C. Weather-strips: AAMA 101/I.S.2; except leaf type weather-stripping is not permitted.

D. Insect Screening:

1. Regular mesh, 18 by 18, AAMA 101/I.S.2.
2. Aluminum with dark bronze anodized finish unless specified otherwise.

E. Fasteners: AAMA 101/I.S.2. Screws, bolts, nuts, rivets and other fastening devices to be non-magnetic stainless steel.

1. Fasteners to be concealed when window is closed. Where wall thickness is less than 3 mm (0.125 inch) thick, provide backup plates or similar reinforcements for fasteners.
2. Stainless steel self tapping screws may be used to secure Venetian blind hanger clips, vent guide blocks, friction adjuster, and limit opening device.
3. Attach locking and hold-open devices to windows with concealed fasteners. Provide reinforcing plates where wall thickness is less than 3 mm (0.125 inch) thick.
4. Attach limit stops with tamper proof hardware. Provide sufficient attachment to stops to prevent deflection by sash and from becoming loose. Stops to limit opening from both top and bottom sash direction.

F. Weather-strips: AAMA 101/I.S.2.

G. Hardware:

1. Locks: Two position locking bolts or cam type tamperproof custodial locks with a single point control located not higher than five feet from floor level. Locate locking devices in the vent side rail. Fastenings for locks and keepers shall be concealed or nonremovable.
2. Locking Device Strikes: Locate strikes in frame jamb. Strikes shall be adjustable for locking tension. Fabricate strikes from Type 304 stainless steel or white bronze. Provide sufficient attachment to locking strikes to prevent deflection and from becoming loose.
4. Guide Blocks: Fabricate guide blocks of injection molded nylon. Install guide block fully concealed in vent/frame sill.
5. Hardware for Emergency Ventilation of Windows:
   a. Provide windows with a hold open linkage for emergency ventilation.
   b. Hold open hardware shall provide for maximum six inches of window opening and shall include an adjustable friction shoe to provide resistance when closing the window.
   c. Handles shall be removable.
6. Hardware for Maintenance Opening of Windows: Opening beyond the six inch position shall be accomplished with a window washers key. The release device shall capture the key when window is in the open position.
7. Design operating device to prevent opening with standard tools, coins or bent wire devices.

2.2 THERMAL AND CONDENSATION PERFORMANCE

A. Condensation Resistance Factor (CRF): Minimum CRF of C 50.

B. Thermal Transmittance:

1. Maximum U value class for insulating glass windows: 50 (U=0.50).
2. Maximum U value class for dual glazed windows: 70 (U=0.70), or as required by ASHRAE 90.1.

C. Solar Heat Gain Coefficient (SHGC): SHGC shall comply with State or local energy code requirement.

2.3 FABRICATION

A. Fabrication to exceed or meet requirements of Physical Load Tests, Air Infiltration Test, and Water Resistance Test of AAMA 101/I.S.2.

B. Extrusions: ASTM B221, 6063 temper T5 Aluminum Alloy.

C. Glazing:

1. All units shall be factory glazed with insulating glass; 1" (overall) insulated units. All glass shall be warranted for a period of 10 years.
2. Glaze in accordance with Section 08 80 00, GLAZING.
3. Muntins/Grid (between two glass panes):
   a. Pattern: See drawings
   b. Size: 13/16 inch by 3/16 inch
   c. Material: Rolled-formed aluminum
   d. Color: match window

D. Trim:

1. Trim includes casings, closures, and panning.
2. Fabricate to shapes shown of aluminum not less than (0.080 inch) thick for main frame and (0.094 inch) for frame sill member. The standard tolerances for wall thickness as defined by the Aluminum Association shall apply. The master frame shall be not less than 3 7/8 inches in depth. The inserts shall have hollow extruded horizontal sections and shall have not less than 1 3/8 inches in thickness.
3. Extruded or formed sections, straight, true, and smooth on exposed surfaces.
4. Exposed external corners mitered and internal corners coped; fitted with hairline joints.
5. Reinforce 0.080 inch thick members with not less than 3 mm (1/8-inch) thick aluminum.

6. Except for strap anchors, provide reinforcing for fastening near ends and at intervals not more than 305 mm (12 inches) between ends.
7. Design to allow unrestricted expansion and contraction of members and window frames.
8. Secure to window frames with machine screws or expansion rivets.
9. Exposed screws, fasteners or pop rivets are not acceptable on exterior of the casing or trim cover system.
10. All trim (interior and/or exterior) to be firmly attached to main frame. Attachment by sealants alone is not an approved or acceptable method.

E. Thermal-Break Construction:
1. Manufacturer’s Standard.
2. Low conductance thermal barrier.
3. Capable of structurally holding sash in position and together.
4. All Thermal Break Assemblies (Pour & Debridge, Insulbar or others) shall be tested as per AAMA TIR A8 and AAMA 505 for Dry Shrinkage and Composite Performance.
5. Location of thermal barrier and design of window shall be such that, in closed position, outside air shall not come in direct contact with interior frame of the window.

F. Mullions: AAMA 101.
1. Mullions shall be of extruded aluminum.

G. Subsills and Stools:
1. Fabricate to shapes shown of not less than 2 mm (0.080 inch) thick extruded aluminum.
2. One piece full length of opening with concealed anchors.
3. Sills turned up back edge not less than 6 mm (1/4 inch). Front edge provide with drip.
4. Sill back edge behind face of window frame. Do not extend to interior surface or bridge thermal breaks.
5. Do not perforate for anchorage, clip screws, or other requirements.

H. Insect Screens:
1. AAMA 101/I.S.2.
2. Aluminum screen cloth.
3. Screens shall be of the same quality, material and finish as window units.
4. Screens shall cover the full size of the window and have members matching sight lines of window, including horizontal member aligning

with meeting rail of window. Screening shall be replaceable without damage to items and screens removal from inside of building without removing sash.

2.4 DOUBLE HUNG WINDOWS:

A. AAMA 101/I.S.2. double hung type, H-AW50.

B. AAMA certified product to the AAMA 101/I.S.2.-97 standard.

1. Provide units with "Tilt-in" feature permitting both sides of both sash to be cleaned from interior.
2. Do not tilt-in sash without use of a maintenance only release mechanism and removable locking handle. Finger operated tilt latches not acceptable.

2.10 FINISH

A. In accordance with NAAMM AMP 500 series.

B. Finish exposed aluminum surfaces as follows:

1. Anodized Aluminum:
   a. Finish in accordance with AMP 501 letters and numbers.
   c. Colored anodized Finish: AA-C22A42 (anodized) or AA-C22A44 (electrolytically deposited metallic compound) medium matte, integrally colored coating, Class 1 Architectural, 0.7 mils thick. Color: Dark Bronze, unless otherwise specified.
      1) Dyes not accepted.
      2) Coated Aluminum.
      3) Variation of more than 50 percent of maximum shade range approved will not be accepted in a single window or in adjacent windows and mullions on a continuous series.
         a) AMP 501 and 505.
         d) Stainless steel: AMP 503.
            1. Concealed: 2B or 2D.
            2. Exposed: No. 4 unless specified otherwise.

C. Hardware: Finish hardware exposed when window is in the closed position: Match window color.

PART 3 - EXECUTION

3.1 PROTECTION (DISSIMILAR MATERIALS): AAMA 101/I.S.2.

3.2 INSTALLATION, GENERAL

A. Install window units in accordance with manufacturer's specifications and recommendations for installation of window units, hardware, operators and other components of work.

B. Where type, size or spacing of fastenings for securing window accessories or equipment to building construction is not shown or specified, use expansion or toggle bolts or screws, as best suited to construction material.
   1. Provide bolts or screws minimum 6 mm (1/4-inch) in diameter.
   2. Sized and spaced to resist the tensile and shear loads imposed.
   3. Do not use exposed fasteners on exterior, except when unavoidable for application of hardware.
   4. Provide non-magnetic stainless steel Phillips flat-head machine screws for exposed fasteners, where required, or special tamper-proof fasteners.
   5. Locate fasteners to not disturb the thermal break construction of windows.
C. Set windows plumb, level, true, and in alignment; without warp or rack of frames or sash.
D. Anchor windows on four sides with anchor clips or fin trim.
   1. Do not allow anchor clips to bridge thermal breaks.
   2. Use separate clips for each side of thermal breaks.
   3. Make connections to allow for thermal and other movements.
   4. Do not allow building load to bear on windows.
   5. Use manufacturer's standard clips at corners and not over 600 mm (24 inches) on center.
   6. Where fin trim anchorage is shown build into adjacent construction, anchoring at corners and not over 600 mm (24 inches) on center.
E. Sills and Stools:
   1. Set in bed of mortar or other compound to fully support, true to line shown.
   2. Do not extend sill to inside window surface or past thermal break.
   3. Leave space for sealants at ends and to window frame unless shown otherwise.

3.3 MULLIONS CLOSURES, TRIM, AND PANNING

A. Cut mullion full height of opening and anchor directly to window frame on each side.
B. Closures, Trim, and Panning: External corners mitered and internal corners coped, fitted with hairline, tightly closed joints.
C. Secure to concrete or solid masonry with expansion bolts, expansion rivets, split shank drive bolts, or powder actuated drive pins.
D. Toggle bolt to hollow masonry units. Screwed to wood or metal.

E. Fasten except for strap anchors, near ends and corners and at intervals not more than 300 mm (12 inches) between.

F. Seal units following installation to provide weathertight system.

3.4 ADJUST AND CLEAN

A. Adjust ventilating sash and hardware to provide tight fit at contact points, and at weather-stripping for smooth operation and weathertight closure.

B. Clean aluminum surfaces promptly after installation of windows, exercising care to avoid damage to protective coatings and finishes.

C. Remove excess glazing and sealant compounds, dirt, and other substances.

D. Lubricate hardware and moving parts.

E. Clean glass promptly after installation of windows. Remove glazing and sealant compound, dirt and other substances.

F. Except when a window is being adjusted or tested, keep locked in the closed position during the progress of work on the project.

3.5 OPERATION DEVICES

A. Provide wrenches, keys, or removable locking operating handles, as specified to operate windows.

B. Provide one emergency ventilating operating handle for every four windows.

3.6 PROTECTION, CLEANING AND REPAIRING:

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 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.

B. All door hardware shall be Grade 1, unless otherwise specified.

1.2 RELATED WORK

A. Caulking: Section 07 92 00 JOINT SEALANTS.

B. Application of Hardware: Section 08 14 00, INTERIOR WOOD DOORS, Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS, and Section 08 71 13.11, LOW ENERGY DOOR OPERATORS.

C. Card Readers: Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEMS.

D. Electrical: Division 26, ELECTRICAL.

E. 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, if possible, except as otherwise specified:

1. Cylindrical 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 52.24-21, 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.

1.6 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23 plus 2 copies to the VAMC Locksmith (VISN Locksmith if the VAMC does not have a locksmith).

B. Hardware Schedule: Prepared by or under the supervision of Installer and DHI certified Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware. Prepare and submit hardware schedule using same scheduling sequence and format as shown in Door Hardware Schedule bound separately in the Project Manual.

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. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

1. Contractor(s) to coordinate shop drawing submittal sequence for Door Hardware with Hollow Metal Doors and Frames, Interior Wood Doors, and Aluminum-Framed Entrances and Storefronts, specified in other Division 8 Sections. Submit all the above-mentioned submittals together at one time.

F. Qualification Data: For Architectural Hardware Consultant.

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 COTR for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in COTR's office until all other similar items have been installed in project, at which time the COTR 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. Keying: Coordinate with VAMC for keying system; keying by VAMC. Provide small format interchangeable construction cores for use during construction. Contractor shall provide 2 control keys and 2 master keys for construction cores to VAMC. Cylinders shall be Best 7 pin type; permanent cores shall be installed by the Contractor.

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. 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):

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

A156.15-06.....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

A156.21-09.....Thresholds

A156.22-05.....Door Gasketing and Edge Seal Systems

A156.23-04.....Electromagnetic Locks

A156.25-07 .....Electrified Locking Devices

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. Door and Hardware Institute (DHI).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)

1.11 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer’s responsibilities include supplying and installing door hardware and providing a qualified DHI certified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

PART 2 - PRODUCTS

2.1 BUTT HINGES

A. ANSI A156.1. Provide only full-mortise, five-knuckle, ball bearing hinges. Provide hinges with square corners, unless otherwise specified. 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 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 shall be of stainless steel material.

B. Provide quantity and size of hinges per door leaf as follows:

1. Doors 1210 mm (4 feet) to 2260 mm (7 feet 5 inches) high: 3 hinges minimum.
2. Doors greater than 2260 mm (7 feet 5 inches) high: 4 hinges.
3. 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.
4. 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).
5. 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).
6. Provide heavy-weight hinges where specified.
7. At doors weighing 330 kg (150 lbs.) or more, furnish 127 mm (5 inch) high hinges.
8. Doors over 1210 mm (4 feet), heavy weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).

C. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified.

2.2 DOOR CLOSING DEVICES

A. Closing devices shall be products of one manufacturer, unless otherwise specified.

2.3 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 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.

2.4 COMBINATION CLOSER – HOLDER

A. Conform to ANSI A156.15; combination closer-holder with built-in electronic release.

B. Combination closer-holder shall have the following features:
   1. Control door closing and latching sequence by hydraulic action.
   2. Wiring for 24V DC current. Current draw shall not exceed 0.16 amperes.
   3. Combination closer-holder type:
      a. At doors with 90-110° hold-open point: Single lever arm with slide track closing action, and adjustable hydraulic back-check. Provide tracks with spring-cushion stop assemblies to avoid the necessity of a separate wall or floor stop. Provide with double egress arm where required.

b. At doors with over 110° to 175° hold-open point: Single or double lever arm and adjustable hydraulic back-check. Provide with long arms where required for deep frame reveals.

4. Spring power for closing force shall conform to ANSI A156.4 and have 50% spring power adjustment.
5. Size closers per manufacturer's printed catalog recommendations.
6. Hold open mechanism shall hold door open between 85 degrees and 175 degrees depending on wall and frame conditions. Mount device to provide maximum door opening permitted by building construction or equipment.
7. Electronic release shall release door when signaled by smoke detector. Smoke detectors shall not be incorporated as an integral part of door holders. Smoke detectors are specified in the ELECTRICAL Section.
8. All closers to have full covers.
9. All closers shall have a 1 ½" minimum piston diameter and an adjustable back check position valve.

2.5 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. Provide wall bumpers Type L02251 (rubber pads having concave face) , unless otherwise specified.

D. Provide floor stops Type L02161 where specified, see Door Hardware Schedule. 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. Omit stops where automatic operated doors occur.

F. Provide appropriate roller bumper for each set of doors (except where closet doors occur) where two doors would interfere with each other in swinging.

G. Material of door stop shall be wrought brass or bronze.

2.6 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.

2.7 LOCKS AND LATCHES

A. General: Provide Locks (including electromechanical type), Latches and Dummy Trim and 7-pin cylinders with interchangeable cores from Best Access System, 93K series, unless otherwise specified. See Hardware Schedule.

B. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts. Lock cylinders shall have not less than seven pins. Cylinders shall be furnished with construction removable cores and construction master keys. Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all rim locks, cylindrical locks, and any other type lock included in the Great Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 19 mm (3/4 inch) throw, unless shorter throw allowed by the door manufacturer's fire label. Provide temporary keying device or construction core of allow opening and closing during construction and prior to the installation of final cores.

C. In addition to above requirements, locks and latches shall comply with following requirements:

1. Cylindrical Lock and Latch Sets: Levers shall meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets shall be series 4000 Grade I. 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. Provide lever design to match design selected by Architect. Where two turn pieces are specified for lock F76, turn piece on inside lever shall lock and unlock inside lever, and turn piece on outside lever shall unlock outside lever when inside lever is in the locked position. (This function is intended to allow emergency entry into these rooms without an emergency key or any special tool.)
2. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.5.

2.8 ELECTROMECHANICAL LOCKS

A. ANSI/BHMA A156.25, Grade 1, cylindrical electrically operated lockset. Provide Electrically Unlocked (Fail Secure) option, unless otherwise specified. Crash Bars shall be Von Duprin Model 99.

2.9 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	2 keys each
Control key	2 keys

2.10 ARMOR PLATES, KICK PLATES, AND MOP PLATES

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 1.57 mm (0.062 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.
4. Armor plates for doors are listed under Article "Hardware Sets". Armor plates shall be thickness as noted in the hardware set, 875 mm (35 inches) high and 38 mm (1-1/2 inches) less than width of doors,

except on pairs of metal doors. Provide armor plates beveled on all 4 edges (B4E). Plates on pairs of metal doors shall be 25 mm (1 inch) less than width of each door. Where top of intermediate rail of door is less than 875 mm (35 inches) from door bottom, extend armor plates to within 13 mm (1/2 inch) of top of intermediate rail. On doors equipped with panic devices, extend armor plates to within 13 mm (1/2 inch) of panic bolt push bar.

C. Material of Armor Plates, Kick Plates and Mop Plates shall be brass or bronze. Provide stainless steel, where indicated; see Hardware Schedule.

2.11 EXIT DEVICES

A. General: Provide Exit Devices from Von Duprin, Model 99, unless otherwise specified. See Hardware Schedule.

B. 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 lever handles of design and type similar to locksets, unless otherwise specified. Provide key cylinders for keyed operating trim and, where specified, cylinder dogging.

C. 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, unless otherwise specified.

D. 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.

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.

2.12 FLUSH BOLTS (LEVER EXTENSION)

A. Conform to ANSI A156.16. Flush bolts shall be Type L04251 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. Material of Flush Bolts shall be brass.

2.13 DOOR PULLS (FLUSH PULL)

A. Conform to ANSI A156.6. Metal, Type J403, 2 3/16 inches by 3 ¼ inches, unless otherwise specified. Fasteners concealed in cup.

B. Material of Door Pulls shall be brass or bronze.

2.14 PUSH PLATES

A. Conform to ANSI A156.6. Metal, Type J301, 100 mm (4 inches) wide by 400 mm (16 inches) high.

B. Material of Push Plates shall be brass or bronze.

C. All edges rounded.

2.15 COORDINATORS

A. Conform to ANSI A156.3, Type 21. 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.

2.16 THRESHOLDS

A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified and fabricated to full width of opening indicated. 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. At exterior doors and any interior doors exposed to moisture, provide threshold with non-slip abrasive finish.

C. Provide with miter returns where threshold extends more than 12 mm (0.5 inch) from fame face.

D. Base metal: Aluminum (Alloy=6063, Hardness=T5).

E. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.

2.17 AUTOMATIC DOOR BOTTOM SEAL AND RUBBER GASKET

A. Conform to ANSI A156.22. Provide mortise or under-door type, except where not practical. For mortise automatic door bottoms, provide type specific for door construction (wood or metal).

2.18 WEATHERSTRIPS

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).

2.19 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 Doors: Key cylinders same as entrance doors of area in which door occur, except as otherwise specified. Provide cylinders to operate locking devices where specified for following doors:

1. Swing-up doors.
2. Fire-rated access doors-Engineer's key set.

C. Mutes: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011, depending on frame material, of white or light gray color, on each steel or wood door frame, except at fire-rated frames. Furnish 3 mutes for single doors and 2 mutes for each pair of doors, except double-acting doors.

2.20 FINISHES

A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below.

B. 626: All surfaces on exterior and interior of buildings, except where other finishes are specified.

C. Miscellaneous Finishes:

1. Hinges --630.
2. Door Closers and Concealed Overhead Door Holder/Stop: Factory applied paint finish. Dull or Satin Aluminum color.

3. Thresholds: Mill finish aluminum.

D. Hardware Finishes for Existing Buildings: U.S. Standard finishes shall match finishes of hardware in (similar) existing spaces except where otherwise specified.

E. Special Finish: Exposed surfaces of hardware for dark bronze anodized aluminum doors shall have oxidized oil rubbed bronze finish (dark bronze) finish on door closers shall closely match doors.

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.

2.21 BASE METALS

A. Apply specified U.S. Standard finishes on different base metals as following:

Finish	**Base Metal**
652	Steel
626	Brass or bronze
613	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. Centerline of door pulls to be 1016 mm (40 inches).
5. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
6. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.

7. 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 and away from corridors, except 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)
45 mm (1-3/4 inch)	Over 1200 mm (4 feet)	125 mm (5 inches)

C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim and surrounding conditions.

D. Hinges Required Per Door:

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

E. 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.

F. After locks have been installed; show in presence of COTR 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 COTR 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. The Contractor shall install the lock hardware with Best 7-pin cylinders; Keying by VAMC.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
   1. Configuration: Provide one power supply for each door opening, unless otherwise indicated.

3.3 FINAL INSPECTION

A. Installer to provide letter to COTR 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 COTR.
   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 COTR and VA Locksmith.

3.5 HARDWARE SETS. Door Hardware Schedule is included in the "Schedules" section of the Project Manual.

- - - E N D - - -

SECTION 08 71 13.11

LOW ENERGY POWER ASSIST DOOR OPERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies 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. Sealants; 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. Aluminum frames entrance work; Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.

E. Door hardware; Section 08 71 00, DOOR HARDWARE.

F. Glass and glazing of doors and frames; Section 08 80 00, GLAZING.

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.

1.4 WARRANTY

Power assisted door operators, controls and other related equipment shall be subject to the terms of the "Warranty of Construction", FAR clause 52.246-21, except that the warranty period shall be two years in lieu of one year.

1.5 MAINTENANCE MANUALS

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. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's literature and data describing operators, power units, controls, door hardware and safety devices.

C. Shop Drawings:
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 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):
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):
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 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: Housing shall be 140 mm (5-1/2 inches) wide by 150 mm (6 inches) high aluminum extrusions with enclosed end caps for application to 100 mm (4 inch) 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 which shall include helical gear drive transmission, mechanical spring and bearings, all 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.
6. 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.

2.2 MICROPROCESSOR CONTROLS

A. The system shall include a multi-function microprocessor control providing adjustable hold open time (1 – 30 sec.), LED indications for actual position unknown, system status, open obstruction shutdown, activation signal, safety mat/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

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 anodized/painted to match adjacent storefront/frame finish; color as selected by Architect from manufacturer's full range.

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 or shall be activated by card swipe. Switches shall be installed in a standard 2-gang electrical wall box and placed in a location in compliance with ANSI A117.1. Switches shall be wall mounted; see drawings for locations.

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.

   Total opening time to fully open shall be as in Table II.

E. Closing Time:

   Doors shall be field adjusted to close from 90 degrees to 10 degrees in 3 seconds or longer as required in Table 1.

   1. Doors shall be field adjusted to close from 10 degrees to fully close position in not less than 1.5 seconds.
   2. Doors shall be field adjusted to remain fully open for not less than 5 seconds.
   3. 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
(914) 36	3.0	3.5	3.5	4.0	4.0

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

Provide separate self-contained electric circuits for automatic operators. 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.

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 o£ traffic (pedestrians) 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 COTR.

---- END ----

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies glass 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. Glazing in Section 08 14 00, WOOD DOORS.
2. Mirrors: Section 10 28 00, TOILET, BATH, AND LAUNDRY ACCESSORIES.
3. Section 08 41 43 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS (Swing Doors).
4. Section 08 51 13, ALUMINUM WINDOWS (Double Hung).

1.3 LABELS

A. Temporary labels:

1. Provide temporary label on each light of glass 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 is approved by COTR.

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.

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 applicable code.

2. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
3. Test in accordance with ASTM E 330.
4. Thicknesses listed are minimum. Coordinate thicknesses with framing system manufacturers.

1.5 SUBMITTALS

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

B. 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.

C. Warranty: Submit written guaranty, conforming to General Condition requirements, and to “Warranty of Construction” Article in this Section.

D. Manufacturer's Literature and Data:
1. Glass, each kind required.
2. Insulating glass units.
4. Elastic compound for metal sash glazing.
5. Putty, for wood sash glazing.
6. Glazing cushion.
7. Sealing compound.

E. Samples:
1. Size: 150 mm by 150 mm (6 inches by 6 inches).

F. 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.

1.7 PROJECT CONDITIONS

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 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):

Z97.1-04.....Safety Glazing Material Used in Building - Safety Performance Specifications and Methods of Test.

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

C1363-05.....Thermal Performance of Building Assemblies, by Means of A Hot Box Apparatus

C542-05.....Lock-Strip Gaskets.

C716-06.....Installing Lock-Strip Gaskets and Infill Glazing Materials.

C864-05.....Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

C920-05.....Elastomeric Joint Sealants.

C1036-06.....Flat Glass.

C1048-04.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.

C1349-04.....Architectural Flat Glass Clad Polycarbonate.

C1376-03.....Pyrolytic and Vacuum Deposition Coatings on Flat Glass.

D635-06.....Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastic in a

Horizontal Position.E84-08 Surface Burning Characteristics of Building Materials.

E330-02.....Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

E2190-08.....Insulating Glass Unit

D. Commercial Item Description (CID):

A-A-59502.....Plastic Sheet, Polycarbonate

E. Code of Federal Regulations (CFR):

16 CFR 1201 - Safety Standard for Architectural Glazing Materials; 1977, with 1984 Revision.

F. National Fire Protection Association (NFPA):

80-08.....Fire Doors and Windows.

G. National Fenestration Rating Council (NFRC):

Certified Products Directory (Latest Edition).

H. Safety Glazing Certification Council (SGCC):

Certified Products Directory (Issued Semi-Annually).

I. Underwriters Laboratories, Inc. (UL):

752-06.....Bullet-Resisting Equipment.

J. Unified Facilities Criteria (UFC):

4-010-01-2007.....DOD Minimum Antiterrorism Standards for Buildings

PART 2 - PRODUCT

2.1 GLASS

A. Use thickness stated unless specified otherwise in assemblies.

B. Patterned and Wired Flat Glass:

1. ASTM C1036, Type II, Class 1,Form 1, Pattern Pl, Finish F1, Quality Q6, Mesh m2 .
2. Thickness, 6 mm (1/4 inch), unless otherwise specified.

2.2 HEAT-TREATED GLASS

A. Clear Heat Strengthened Glass:

1. ASTM C1048, Kind HS, Condition A, Type I, Class 1, Quality q3.
2. Thickness, 6 mm (1/4 inch), unless otherwise specified.

B. Clear Tempered Glass:

1. ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.
2. Thickness, 6 mm (1/4 inch), unless otherwise specified.

C. Tempered Patterned Glass (obscure):

1. ASTM C1048, Kind FT, Type II, Class 1, Form 3, Quality q8, Finish f1, Pattern p3.
2. Thickness 16 mm (1/4 inch).

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, 6 mm (1/4 inch), unless otherwise specified.

2.4 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 (Overall Thickness 25 mm [1 inch])
   a. Outboard Lite
      1. Glass type: Low E Tempered
      2. Nominal Thickness: 6 mm (1/4 inch)
      3. Glass Strength: (Fully Tempered)
      4. Coating Orientation: (Surface #2)
   b. Spacer
      1. Nominal Thickness: 13 mm (1/2 inch) wide (air space)
      2. Gas Fill: (Air)
      3. Muntins/Grid (between two glass panes): All Units shall be factory glazed.
         a. Pattern: See drawings
         b. Size: 13/16 inch by 3/16 inch
         c. Material: Rolled-formed aluminum
         d. Color: match window
   c. Inboard Lite
      1. Glass Type: Clear Tempered
      2. Nominal Thickness: 6 mm (1/4 inch)
      3. Glass Strength: (Fully Tempered)
2. Coating Orientation: (N/A)2. Performance Characteristics (Center of Glass)
   a. Visible Transmittance: 70%

b. Visible Reflectance: 11%

c. Winter U-factor (U-value): 0.29

d. Shading Coefficient (SC): 0.44

e. Solar heat Gain Coefficient (SHGC): 0.38

3. Glass shall be annealed, heat strengthened or tempered as required by codes, or as required to meet thermal stress and wind loads.
4. Glass heat-treated by horizontal (roller hearth) process with inherent roller wave distortion parallel to the bottom edge of the glass as installed when specified.

2.5 DECORATIVE GLASS (DG-1)(CHAPEL 204-86)

A. GLASS TYPE :

1. Kind: Kind LT
2. Glass Color: Low iron
3. Glass Thickness: Overall thickness of 9/16” (13mm) comprised of two layers of 1/4” (6mm) glass, permanently bonded together with an interlayer.
4. Interlayer: Clear .060
5. Edgework: Flat polished edges
6. Fabrication: Holes provided as indicated on drawings to comply with ASTM C1048 requirements.
7. Pattern: Manufacturer’s custom ceramic frit pattern imprinted on first and third surfaces of laminated unit and safety tempered in sizes indicated on drawings.
8. Color: Manufacturer’s standard color in multiple tones (Frost).

2.6 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 (two inches) except 100 to 150 mm (four to six 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 (one to three 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. Glazing Clips: Galvanized steel spring wire designed to hold glass in position in rabbeted sash without stops.
F. Glazing Gaskets: ASTM C864:
   1. Firm dense wedge shape for locking in sash.
   2. Soft, closed cell with locking key for sash key.
   3. Flanges may terminate above the glazing-beads or terminate flush with top of beads.
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.
J. Neoprene or EPDM 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.
K. 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.

L. 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. Patterned Glass:

1. Install units with one patterned surface with smooth surface on the weather side.
2. Install units in interior partitions with pattern in same direction in all openings.

G. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.

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.

3.4 INSTALLATION - DRY METHOD (TAPE AND GASKET SPLINE GLAZING)

A. Cut glazing spline 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 - WET/DRY METHOD (PREFORMED TAPE AND SEALANT)

A. Cut glazing tape to length and set against permanent stops, 5 mm (3/16 inch) below sight line. Seal corners by butting tape and dabbing with butyl sealant.

B. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.

C. Place setting blocks at 1/4 points with edge block no more than 150 mm (6 inches) from corners.

D. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to achieve full contact at perimeter of pane or glass unit.

E. Install removable stops, with spacer strips inserted between glazing and applied stops, 6 mm (1/4 inch) below sight line. Place glazing tape on glazing pane or unit with tape flush with sight line.

F. Fill gap between glazing and stop with manufacturer's recommended sealant, unless otherwise specified, to depth equal to bite of frame on glazing, but not more than 9 mm (3/8 inch) below sight line.

G. Apply cap bead of manufacturer's recommended sealant, unless otherwise specified, along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.6 REPLACEMENT AND CLEANING

A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by COTR.

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

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 tempered wire glass in interior fire rated or labeled doors and windows.
2. Install clear tempered wire glass in exterior windows and doors indicated to receive wire glass.

B. Tempered Glass:

1. Install in full and half glazed doors unless indicated otherwise.
2. Install in door sidelights adjacent to doors.
3. Use clear tempered glass on interior borrowed lights and doors, unless otherwise indicated or specified.
4. Use SEU Low E tempered and clear insulating glass, G-41, on storefront and sidelights.

5. Use clear tempered glass in exterior and interior panes unless specified otherwise at insulating glass units adjacent to door.

C. Insulating Glass:

1. Install SEU Low E tempered and clear tempered glass in aluminum framed entrances and storefronts (swing doors) and aluminum windows.

- - - E N D - - -

SECTION 08 90 00

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies fixed louvers and vents.

1.2 RELATED WORK

A. Joint Sealant system in Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:
Each type, showing material, finish, size of members, method of assembly, and installation and anchorage details.

C. Manufacturer's Literature and Data:
Each type of louver and vent.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on main wind design pressure of 15 lbf/sq. ft., acting inward or outward.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

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. The Master Painters Institute (MPI):
Approved Product List – November 2007

C. American Society for Testing and Materials (ASTM):
B209/B209M-07.....Aluminum and Aluminum Alloy, Sheet and Plate
B221-06.....Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
B221M-07.....Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Shapes, and Tubes

D. National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500-505 (1988).....Metal Finishes Manual

E. National Fire Protection Association (NFPA):
90A-02.....Installation of Air Conditioning and Ventilating Systems

G. American Architectural Manufacturers Association (AAMA):
605-98.....High Performance Organic Coatings on Architectural Extrusions and Panels

H. Air Movement and Control Association, Inc. (AMCA):
500-L-99.....Testing Louvers

I. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
Architectural Sheet Metal Manual for fabrication, construction details, and installation procedures.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum, Extruded: ASTM B221/B221M, Alloy 6063-T5 or T-52.

B. Aluminum, Plate and Sheet: ASTM B209/B209M, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

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: See Louver Schedule at end of PART 3.

1. Provide fixed extruded aluminum 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.
5. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
6. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
7. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
   a. Frame Type: Channel, unless otherwise indicated.
      1) Frame around louver shall be 2” maximum. Notify prior to ordering and installation of louvers and vents.
8. Include supports, anchorages, and accessories required for complete assembly.
9. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.
   a. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
10. Provide extended sills for recessed louvers.
11. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

B. Performance Characteristics:

1. Horizontal, Drainable-Blade Louver LV-1, LV-2, & LV-3:
   a. Louver Depth: 50.8 mm (2 inch).
   b. Frame and Blade Nominal Thickness: Not less than 1.60 mm (0.063 inch) for blades and 1.60 mm (0.063 inch)for frames.
   c. Mullion Type: Exposed.
   d. Free Area: Not less than 9.04 sq. ft. (0.840 sq. m) for 48-inch-1220-mm-) wide by 48-inch- (1220-mm-) high louver.
   e. Point of Beginning Water Penetration: Not less than 886 fpm 4.50 m/s).
   f. Air Performance: Not more than 0.10-inch wg (0.025-kPa) static pressure drop at 886-fpm (4.5-m/s) free-area velocity.
   g. Percent free area: 57
2. Horizontal, Drainable-Blade Louver LV-4 and LV-5:
   a. Louver Depth: 150 mm (6 inch).
   b. Frame and Blade Nominal Thickness: Not less than 2.06 mm (0.081 inch) for blades and 2.06 mm (0.081 inch)for frames.
   c. Mullion Type: Exposed.
   d. Free Area: Not less than 9.41 sq. ft. (0.88 sq. m) for 48-inch-1220-mm-) wide by 48-inch- (1220-mm-) high louver.
   e. Point of Beginning Water Penetration: Not less than 1077 fpm 5.47 m/s).
   f. Air Performance: Not more than 0.15-inch wg (0.037kPa) static pressure drop at 1077-fpm (5.47-m/s) free-area velocity.
   g. Percent free area: 57
3. Louvers shall bear AMCA certified rating seals for air performance and water penetration ratings.

C. Aluminum Louvers:
   1. Blades shall be 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 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicate.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Non-rewirable, U-shaped frames.
   a. Frame width 2 inch max. on all sides. Notify Architect for any discrepancies prior to ordering and construction of louvers.
4. Louver Screening for Aluminum Louvers:
   a. Bird Screening: Aluminum, 13 mm (1/2 inch) square mesh, 1.60 mm (0.063 inch) wire.

2.5 BLANK-OFF PANELS

A. Uninsulated, Blank-Off Panels: Metal sheet attached to back of louver.

1. Aluminum sheet for aluminum louvers, not less than 0.050-inch (1.27-mm) nominal thickness.
2. Panel Finish: Same type of finish applied to louvers, but black color.
3. Attach blank-off panels with stainless steel, sheet metal screws.

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.

2.6 FINISH

A. In accordance with NAAMM Metal Finishes Manual: AMP 500-505

B. Aluminum Louvers :

1. Organic Finish: AAMA 605 (Fluorocarbon coating).

2.7 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 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 in masonry walls during progress of the work. If wall louvers 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.

3.3 LOUVER SCHEDULE

Louver Type	Size*	Shape

LV-1	1’-0”(W) x 2’-1” (H) height to top of arch.	Arched Top
LV-2	1’-4” (W) x 3’-0” (H) height to top of arch.	Arched Top
LV-3	3’-2” (W) x 3’-6” (H) height to top of arch.	Arched Top
LV-4	6’-3” (W) x 2’-0” (H)	Rectangular
LV-5	6’-0” (W) x 6’-0” (H)	Square

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SECTION 09 06 00

SCHEDULE FOR FINISHES

SECTION 09 06 00-SCHEDULE FOR FINISHES

VAMC: Carl Vinson VA Medical Center

Location: Dublin, Georgia

VA Project no. and Name: 557-CSI-375 New Hospice Care Unit

Matrix Project No.: 09104

Construction Bid Documents

Date: 09/09/2010

SECTION 09 06 00

SCHEDULE FOR FINISHES

PART I – GENERAL

1.1 DESCRIPTION

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

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 COTR for finish requirements.

1.3 SUBMITALS

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.

1.4 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.

PART 2- PRODUCTS

2.1 DIVISION 06 – WOOD AND PLASTICS

A. SECTION 06 06 60, TRANSLUCENT RESIN PANELS

Glazing Type	Manufacturer	Mfg. Color Name/No.
TRP-1	Lumicor Lumiclear R4™,	Natural Leaves

2.2 DIVISION 07 - THERMAL AND MOISTURE PROTECTION

A. SECTION 07 31 13, ASPHALT SHINGLES

	Size	Shape	Manufacturer	Mfg Color Name/No.
Base Bid	12”x18” with 8” exposure, 50 shingles per square	Rectangular tabs, 4 tabs per shingle, faux slate look	Certainteed Corporation	Hatteras, Architect shall select color from manufacturer’s full range of colors
Alternate No. G-11	12”x36” with 5” exposure, 80 shingles per square	Rectangular tabs, 3 tabs per shingle, faux slate look	Certainteed Corporation	XT25, Architect shall select color from manufacturer’s full range of colors

2.3 DIVISION 08 - OPENINGS

V. SECTION 08 80 00, GLAZING

Glazing Type	Manufacturer	Mfg. Color Name/No.
DG-1	Goldray Industries Ltd	

	4605 52 Ave. SE Calgary, AB, Canada, T2C 4N7 800-640-3709/403-236-1333 www.goldrayindustries.com	

2.4 DIVISION 09 - FINISHES

A. SECTION 09 30 13, CERAMIC TILING

1. SECTION 09 30 13, CERAMIC TILING

Finish Code	Manufacturer	Mfg. Color Name/No
CT-1 (13x13)	Daltile	Pietre Vecchie; Champagne/PV02
CT-2 (12x12)	Daltile	Villa Valleta; Sun Valley/VV03
CT-3 (1x1)	American Olean	Cappuccino/A78
CT-4 (1x1)	American Olean	Willow/A91
CT-5 (1x1)	American Olean	Artichoke/A63
CT-6 (1x1)	American Olean	Almond/A24
CT-7 (6x6)	Daltile	Stratford Place; Willow Branch/SD92
CT-8 (6x6)	Daltile	Stratford Place; Truffle Field/SD93
CT-9 (6x6)	American Olean	Matte; Almond/0087
CT-10 (6x6)	American Olean	Matte; Cappuccino/0009
CT-11 (2x2)	Not Used	Not Used
CT-12 (2x2)	Daltile	Gold Rush; Goldust/5202
CT-13 (1x1)	Daltile	Sonterra; Terra Cotta/SR58
CT-14 (1x1)	Not Used	Not Used
CT-15 (6x6)	Daltile	Fidenza; Bianco/FD01
CT-16 (1x1)	American Olean	Nutmeg/A37

CT-17	Not Used	Not Used
CT-18	Not Used	Not Used
CT-19	Not Used	Not Used
CT-20 (6x6)	American Olean	Cove Base/Matte; Nutmeg 0039
CT-21 (6x6)	American Olean	Bullnose/Matte; Nutmeg 0039
CT-22 (6x6)	American Olean	Cove Base/Matte; Almond 0087
CT-23 (6x6)	American Olean	Bullnose/Matte; Almond 0087
CT-24 (6x6)	American Olean	Cove Base/Matte; Cappuccino 0009
CT-25 (6x6)	American Olean	Bullnose/Matte; Cappuccino 009

2. GROUT (GRT)

Finish Code	Manufacturer	Mfg. Color Name/No
GRT-1	Custom Building Products	Haystack/380
GRT-2	Custom Building Products	Light Smoke/145
GRT-3	Hydroment	Woodlands/H194

B. SECTION 09 51 00, ACOUSTICAL CEILINGS

Finish Code	Component	Color Pattern	Manufacturer	Mfg Name/No.
AC-1	Acoustical Ceiling Tile	White	Armstrong	#1734, Fine Fissured, 2’x2’x5/8”, Beveled Tegular
	Exposed Suspension System for AC-1	White	Armstrong	Suprafine XL Exposed Tee System, 9/16”
AC-2	Acoustical Ceiling	White	Armstrong	#1733, Fine

	Tile			Fissured, 2’x4’x5/8”, Angled Tegular
	Exposed Suspension System for AC-2	White	Armstrong	Prelude XL Exposed Tee System, 15/16”
AC-3	Acoustical Ceiling Tile	White	Armstrong	#1729, Fine Fissured, 2’x4’x5/8”, Square Lay-in
	Exposed Suspension System for AC-3	White	Armstrong	Prelude XL Exposed Tee System, 15/16”
AC-4	Acoustical Ceiling Tile	White	Armstrong	#870, Clean Room VL Unperforated, 2’x4’x5/8”
	Exposed Suspension System for AC-4	White	Armstrong	Prelude Plus XL Fire Guard Environmental Tee System, 15/16”

C. SECTION 09 65 19, RESILIENT TILE FLOORING (VCT)

Finish Code	Size	Material/Component	Manufacturer	Mfg Name/No.
VCT-1	12x12	VCT	Mannington Commercial	Almondine/133
VCT-2	12x12	VCT	Armstrong	Excelon Stonetex Clay Red/52157
VCT-3	12x12	VCT	Armstrong	Excelon Stonetex Leaf Green/52154

VCT-4	12x12	VCT	Armstrong	Excelon Stonetex Forest Moss/52155

D. SECTION 09 65 16, VINYL PLANKS (VP)

Finish Code	Pattern name	Manufacturer	Mfg. Color Name/No.
VP-1 (6”)	Nature’s Path	Mannington Commercial	Windsor Oak – Gunstock/12115
VP-2 (6”)	Nature’s Path	Mannington Commercial	Windsor Oak – Golden/12114
VP-3 (3”)	Nature’s Path	Mannington Commercial	Windsor Oak – Gunstock/12115
VP-4 (6”)	Nature’s Path	Mannington Commercial	Windsor Oak - Gunstock/12116

E. SECTION 09 65 16, VINYL SHEET FLOORING (VS)

Finish Code	Pattern name	Manufacturer	Mfg. Color Name/No.
VS-1	BioSpec	Mannington Commercial	15167 Olivia

F. SECTION 09 65 13, RESILIENT BASE AND ACCESSORIES

Finish Code	Item	Height	Manufacturer	Mfg Name/No.
RB-1	Rubber Base (RB)	4” Millwork – Ambassador Profile	Johnsonite	Coronado 65
RB-2	Rubber Base (RB)	4”	Johnsonite	Flaxen 57
RB-3	Rubber Base (RB)	4” Millwork – Ambassador Profile	Johnsonite	Mystical 276
RB-4	Rubber Base (RB)	4”	Johnsonite	Coronado 65

G. SECTION 09 91 00, PAINT AND COATINGS

1. Paint code	Gloss	Manufacturer	Mfg. Color Name/No.
PT-1	See Specifications	Sherwin Williams	SW7557 Summer White
PT-2	See Specifications	Sherwin Williams	SW6134 Netsuke
PT-3	See Specifications	Sherwin Williams	SW7688 Sundew
PT-4	See Specifications	Sherwin Williams	SW6133 Muslin
PT-5	See Specifications	Sherwin Williams	SW7697 Safari
PT-6	See Specifications	Valspar	Brilliant Metals EE2067 Silver Jade

H. SECTION 09 72 16, VINYL COATED FABRIC WALLCOVERING (WC)

Finish Code	Manufacturer	Mfg. Color Name/No.
WC-1	Wolf Gordon	Summer/752.08
WC-2	Not Used	Not Used
WC-3	Not Used	Not Used
WC-4	Colour & Design	Laurel Leaf; Taupe/CD2-LLT-04
WC-5	Colour & Design	Laurel Leaf; Sisal/CD2-LAL-05
WC-6	Command Wallcovering/Naturale	Bali; Butter/NT02-7022
WC-7	Command Wallcovering/Naturale	Bali; Chiffon/NT02-7016

2.5 DIVISION 10 - SPECIALTIES

A. SECTION 10 26 00, WALL GUARDS AND CORNER GUARDS

Item	Material	Manufacturer	Mfg. Color Name/No.
Corner Guards	Wood Grain Polymer	Kwalu	Northern Cherry
Wall Guards and Handrail	Wood Grain Polymer	Kwalu	Northern Cherry/Round

B. SECTION 10 60 00, TOILET PARTITIONS

Item	Material	Manufacturer	Mfg. Color Name/No.
Men's/Women's Toilet Partitions	Metal	Hadrian	Bronze Metallic/815

2.6 DIVISION 11 – EQUIPMENT

2.7 DIVISION 12- FURNISHINGS

A. SECTION 12 32 00, WOOD CASEWORK and SECTION 12 36 00, COUNTERTOPS AND ACCESSORIES

Item Type	Location	Finish/Color
SS-1	Solid Surface; Lobby Reception Desk Countertop	Zodiaq; Giallo Michelangelo
SS-2	Solid Surface; Men's / Women's Restroom Countertops	Corian; Raffia
LAM-1	Plastic Laminate; Base and Wall Cabinets	Wilsonart; Zanzibar/7957K-78
LAM-2	Plastic Laminate; Countertops	Wilsonart; Sandy Topaz 4862K-07
LAM-3	Plastic Laminate; Countertops	Wilsonart; Luna Glow 1851K-35
LAM-4	Plastic Laminate; Countertops	Wilsonart; Willowstone 4791K-52
LAM-5	Plastic Laminate; Countertops	Formica; MDF Solidz 7812-58
LAM-6	Plastic Laminate; Base and Wall Cabinets	Formica; Cardboard/7813-SP
LAM-7	Plastic Laminate; Countertops	Formica; Organic Green 6904-MC

PART III EXECUTION

3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS

Term	Abbreviation
Acoustical Ceiling	AC

Bead Board(Wood) Ceiling	BB
Ceramic Tile	CT
Concrete Masonry Unit	CMU
Exterior	EXT
Grout	GRT
Gypsum Wallboard	GWB
Material	MAT
Paint	PT
Plastic Lamimate	LAM
Rubber Base	RB
Sealed Concrete	SC
Solid Surface	SS
Stain	ST
Translucent Resin Panel	TRP
Vinyl Coated Fabric Wallcovering	WC
Vinyl Composition Tile	VCT
Vinyl Plank	VP
Vinyl Sheet Flooring	VS
Wood	WD

3.3 ROOM FINISH SCHEDULE

A. Match adjoining or existing similar surfaces colors, textures or patterns where disturbed or damaged by alterations or new work when not scheduled.

B. ROOM FINISH SCHEDULE

1. Room Finish Schedule is included in the "Schedules" section of the Project Manual.

--- E N D---

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies steel stud wall systems, ceiling or soffit suspended or furred framing, fasteners, and accessories for the screw attachment of gypsum board, 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. Wood blocking and nailers installed with non-structural steel framing: Section 06 10 00, ROUGH CARPENTRY.

D. Head-of-wall joint systems installed with non-structural steel framing: Section 07 84 00, FIRESTOPPING.

E. Ceiling suspension systems for acoustical tile or panels: Section 09 51 00, ACOUSTICAL CEILINGS andSection 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. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. 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.

C. Shop Drawings:

1. Typical ceiling suspension system.

2. Typical metal stud and furring construction system including details around openings and corner details.
3. Typical fire rated assembly and column fireproofing showing details of construction same as that used in fire rating test.

D. Test Results: Fire rating test designation, each fire rating required for each assembly.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

In accordance with the requirements of ASTM C754.

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 Society For Testing And Materials (ASTM)

A123-09.....Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

A653/A653M-09.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process

A641-09.....Zinc-Coated (Galvanized) Carbon Steel Wire

C11-09.....Terminology Relating to Gypsum and Related Building Materials and Systems

C635-07.....Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings

C636-08.....Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

C645-08.....Non-Structural Steel Framing Members

C754-08.....Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

C841-03(R2008).....Installation of Interior Lathing and Furring

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

C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

E580-08.....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

Galvanize steel studs, runners (track), rigid (hat section) 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 as shown.
   1. Use ASTM A525 steel, 0.9 mm (0.0359-inch) thick bare metal (20 gauge).
   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. Slip-Type Head Joints: Where indicated, provide the following:
   1. Double-Runner Deflection Track System: ASTM C645 top runners, inside runner with 51 mm (2-inch) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

D. Doubled studs for openings and studs for supporting concrete backer-board.

E. Studs 3600 mm (12 feet) or less in length shall be in one piece.

2.3 FURRING CHANNELS

A. General: Conform to UL Design Numbers, see drawings for wall types and roof assembly.

B. Rigid furring channels (hat shape): ASTM C645.

C. 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.

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. Tie Wire and Hanger Wire:

1. ASTM A641, soft temper, Class 1 coating.
2. Gauge (diameter) as specified in ASTM C754 or ASTM C841.

F. Powder 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 406 mm (16 inches) on center, unless otherwise indicated.

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 all partitions, unless otherwise indicated.

F. Openings:

1. Frame jambs of openings in stud partitions and furring with two studs placed back to back or as shown. Provide continuous wood bucks around jambs of openings as shown on drawings.
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 600 mm (24 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 92 mm (3-5/8 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 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.

3.4 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 unless otherwise noted on drawings.
   2. Space resilient furring channels on underside of wood trusses as shown on drawings.

B. 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.

C. 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.

D. 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.

3.5 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

This section specifies installation and finishing of gypsum board and tile backing panels.

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. Acoustical Sealants: Section 07 92 00, JOINT SEALANTS.

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. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Cornerbead and edge trim.
2. Finishing materials.
3. Gypsum board, each type.

C. 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 fire rated assembly and column fireproofing, indicating details of construction same as that used in fire rating test.

D. Samples:

1. Cornerbead.
2. Edge trim.

3. Control joints.

E. Test Results:

1. Fire rating test, each fire rating required for each assembly.
2. Sound rating test.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

In accordance with the requirements of ASTM C840.

1.6 ENVIRONMENTAL CONDITIONS

In accordance with the requirements of ASTM C840.

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):

C11-08.....Terminology Relating to Gypsum and Related Building Materials and Systems

C475-02.....Joint Compound and Joint Tape for Finishing Gypsum Board

C840-08.....Application and Finishing of Gypsum Board

C919-08.....Sealants in Acoustical Applications

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. (2.84mm) in thickness

C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

C1047-05.....Accessories for Gypsum Wallboard and Gypsum Veneer Base

C1177-06.....Glass Mat Gypsum Substrate for Use as Sheathing

C1658-06.....Glass Mat Gypsum Panels

C1396-06.....Gypsum Board

E84-08.....Surface Burning Characteristics of Building Materials

C. Underwriters Laboratories Inc. (UL):

Latest Edition.....Fire Resistance Directory

D. Inchcape Testing Services (ITS):

Latest Editions.....Certification Listings

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

A. Gypsum Board: ASTM C1396, Type X, 16 mm (5/8 inch) thick with long edges tapered unless shown otherwise. Shall contain a minimum of 20 percent recycled gypsum.

B. Moisture and Mold Resistant Gypsum Board: ASTM C1396/C1396M. With moisture and mold resistant core and paper surfaces, Type X, 16 mm (5/8 inch) thick with long edges tapered. Mold resistance: ASTM D3273, score of 10.

C. Tile Backing Units:

1. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or 1325, with manufacturer’s standard edges.
2. Thickness: 16 mm (5/8 inch).
3. Mold Resistance: ASTM D3273, score of 10.

2.2 GYPSUM SHEATHING BOARD

A. ASTM C1396, Type X, water-resistant core, 16 mm (5/8 inch) thick.

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

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 all partitions and furring, unless shown otherwise.

1. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of structure overhead, unless shown otherwise.

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 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:

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.
5. No offset in exposed face of walls and partitions will be permitted because of multi-ply application requirements. See drawings for shear wall locations requiring extra layer of plywood under gypsum board.
6. 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.

d. Install control joints in specific locations approved by Architect for visual effect.

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 value 45, unless otherwise specified.

I. 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. Unless otherwise noted, 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 INSTALLING TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 FINISHING OF GYPSUM BOARD

A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840.

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, smoke barrier, 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 smoke barrier, fire rated and sound rated construction. Sanding is not required of non decorated surfaces. Seal all penetrations above ceilings around pipes, conduits, ducts, and wires 1/8” thick and larger.

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 5: On all exposed walls and ceilings.

D. Cementitious Backer Units: Finish according to manufacturer’s written instructions.

3.6 REPAIRS

A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces. All surfaces shall have a level five finish.

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 inch) 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 smoke tight construction, fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet or moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but not limited to, fuzzy or splotchy surface contamination and discoloration.

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SECTION 09 30 13

CERAMIC/PORCELAIN TILING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies ceramic tile, waterproofing membranes for thin-set and thick-set applications, and crack isolation membranes.

1.2 RELATED WORK

A. Sealing of joints where specified: Section 07 92 00, JOINT SEALANTS.

B. 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.

C. Resilient edge strips at joints with new resilient flooring,: Section 09 65 19, RESILIENT TILE FLOORING.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

B. 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. Ceramic 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.

C. Product Data:

1. Ceramic tile, marked to show each type, size, and shape required.
2. Chemical resistant mortar and grout (Epoxy and Furan).
3. Cementitious backer unit.
4. Dry-set Portland cement mortar and grout.
5. Divider strip.
6. Elastomeric membrane and bond coat.
7. Reinforcing tape.
8. Leveling compound.

9. Latex-Portland cement mortar and grout.
10. Commercial Portland cement grout.
11. Organic adhesive.
12. Slip resistant tile.
13. Waterproofing isolation membrane.
14. Fasteners.

D. Certification:
1. Master grade, ANSI A137.1.
2. Manufacturer's certificates indicating that the following materials comply with specification requirements:
a. Chemical resistant mortar and grout (epoxy and furan).
b. Modified epoxy emulsion.
c. Commercial Portland cement grout.
d. Cementitious backer unit.
e. Dry-set Portland cement mortar and grout.
f. Elastomeric membrane and bond coat.
g. Reinforcing tape.
h. Latex-Portland cement mortar and grout.
i. Leveling compound.
j. Organic adhesive.
k. Waterproof isolation membrane.
l. Factory mounted tile suitability for application in wet area specified under 2.1, A, 3 with list of successful in-service performance locations.

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 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
1. Level Surfaces: Minimum 0.6.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:

1. Waterproof membrane.
2. Crack isolation membrane.
3. Joint sealants.

1.7 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):

A10.20-05.....Safety Requirements for Ceramic Tile, Terrazzo, and Marble Works

A108.1A-05.....Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar

A108.1B-05.....Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with dry-Set or latex-Portland Cement Mortar

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

A108.02.....General Requirements: Materials, Environmental and Workmanship

A108.4-05.....Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesives

A108.5-05.....Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar

A108.6-05.....Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy

A108.8-05.....Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout

A108.10-05.....Installation of Grout in Tilework

A108.11-05.....Interior Installation of Cementitious Backer Units

A108.13-05.....Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone

A118.1-05.....Dry-Set Portland Cement Mortar

A118.3-05.....Chemical Resistant, Water Cleanable Tile-Setting Epoxy and Water Cleanable Tile-Setting and Grouting Epoxy Adhesive

A118.4-05.....Latex-Portland Cement Mortar

A118.5-05.....Chemical Resistant Furan Mortars and Grouts for Tile Installation

A118.6-05.....Standard Cement Grouts for Tile Installation

A118.9-05.....Cementitious Backer Units

A118.10-05.....Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation

A136.1-05.....Organic Adhesives for Installation of Ceramic Tile

A137.1-88.....Ceramic Tile

C. American Society For Testing And Materials (ASTM):

A185-07.....Steel Welded Wire Fabric, Plain, for Concrete Reinforcing

C109/C109M-07.....Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch. or [50-mm] Cube Specimens)

C241-90 (R2005).....Abrasion Resistance of Stone Subjected to Foot Traffic

C348-02.....Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars

C627-93(R2007).....Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester

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 mm) in thickness

C979-05.....Pigments for Integrally Colored Concrete

C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Panel Products

C1027-99(R2004).....Determining "Visible Abrasion Resistance on Glazed Ceramic Tile"

C1028-07.....Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull Meter Method

C1127-01.....Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface

C1178/C1178M-06.....Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel

D4397-02.....Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

D5109-99(R2004).....Standard Test Methods for Copper-Clad Thermosetting Laminates for Printed Wiring Boards

D. Tile Council of America, Inc. (TCA):

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 0.8 on ramps for wet and dry conditions.
3) Not less than 0.6, except 0.8 on ramps as stated above, for wet and dry conditions for other areas.

b. Tile Having Abrasive Grains:

4. Do not use back mounted tiles in showers and whirlpool baths, unless certified by manufacturer as noted in paragraph 1.3.D.
5. 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.
6. Factory-Applied Temporary Protective Coating:
   a. Protect exposed face surfaces (top surface) of tile against adherence of mortar and grout by pre-coating with a continuous film of petroleum paraffin wax, applied hot.
   b. Do not coat unexposed tile surfaces.

B. Trim Shapes:

1. Conform to applicable requirements of adjoining floor and wall tile.
2. Use slip resistant trim shapes for horizontal surfaces of showers, therapeutic pool, overflow ledges, recessed steps, shower curbs, drying area curbs, and seats.
3. Use trim shapes sizes conforming to size of adjoining field wall tile unless detailed or specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
4. Wall Base: Use cove base conforming to size and color of adjoining field tile unless detailed or specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
5. Internal and External Corners:
   a. Square internal and external corner joints are not acceptable.
   b. External corners including edges: Use bullnose shapes.
   c. Internal corners: Use cove shapes.
   d. Base to floor internal corners: Use special shapes providing integral cove vertical and horizontal joint.
   e. Base to floor external corners: Use special shapes providing bullnose vertical edge with integral cove horizontal joint. Use stop at bottom of openings having bullnose return to wall.
   f. Wall top edge internal corners: Use special shapes providing integral cove vertical joint with bullnose top edge.

g. Wall top edge external corners: Use special shapes providing bullnose vertical and horizontal joint edge.

h. For matte glazed wall tile installed in Portland cement mortar setting bed, use cove and bullnose shapes as applicable. When matte glazed wall and base tile is required, use C Series cove and bullnose shapes.

i. For ceramic matte glazed wall tile installed in dry-set Portland cement mortar, latex-Portland cement mortar, and organic adhesive (thin set methods), use cove and surface bullnose shapes as applicable.

j. Provide cove and bullnose shapes where 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) wide. 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

Confirm to ASTM C1178/C1178M, Optional System for Cementious Backer Units.

2.6 SETTING MATERIALS OR BOND COATS

A. Conform to TCA Handbook for Ceramic Tile Installation.

B. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.2.

1. Cleavage Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.
2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

C. Latex-Portland Cement Mortar (Thin Set): 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, redispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.

D. Dry-Set Portland Cement Mortar: ANSI A118.1. For wall applications, provide non-sagging, latex-Portland cement mortar complying with ANSI A118.4.

E. Organic Adhesives: ANSI A136.1, Type 1.

F. Chemical-Resistant Bond Coat:

1. Epoxy Resin Type: ANSI A118.3.
2. Furan Resin Type: ANSI A118.5.

G. Waterproofing AND ANTI-FRACTURE 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 (CM) 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. 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.8. Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
9. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.

2.7 GROUTING MATERIALS

A. Coloring Pigments:
   1. Pure mineral pigments, limeproof and nonfading, 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. White Portland Cement Grout:
   1. ANSI A118.6.
   2. Use one part white Portland cement to one part white sand passing a number 30 screen.
   3. Color additive not permitted.

C. Commercial Portland Cement Grout: ANSI A118.6 color as specified.

D. Dry-Set Grout: ANSI A118.6 color as specified.

E. 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.

F. Chemical-Resistant Grout:

1. Epoxy grout, ANSI A118.3.
2. Furan grout, ANSI A118.5.

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 WATER

Clean, potable and free from salts and other injurious elements to mortar and grout materials.

2.10 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.

2.11 FLOOR MORTAR BED REINFORCING

ASTM A185 welded wire fabric without backing, MW3 x MW3 (2 x 2-W0.5 x W0.5).

2.12 POLYETHYLENE SHEET

A. Polyethylene sheet conforming to ASTM D4397.

B. Nominal thickness: 0.15 mm (six mils).

C. Use sheet width to minimize joints.

2.13 GROUT SEALANT

A. Low-odor, water-based, non-flammable, low VOC formula which complies with EPA and CARB VOC requirements.

B. Stain resistance.

C. Non-darkening.

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.
   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), unless otherwise specified.
3. Allow not less than 50 mm (2 inch) depression at edge of depressed slab, unless otherwise specified.
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 CEMENTITIOUS BACKER UNITS

A. Remove polyethylene wrapping from cementitious backer units and separate to allow for air circulation. Allow moisture content of backer units to dry down to a maximum of 35 percent before applying joint treatment and tile.

B. Install in accordance with ANSI A108.11 except as specified otherwise.

C. Install units horizontally or vertically to minimize joints with end joints over framing members. Units with rounded edges; face rounded edge away from studs to form a V joint for joint treatment.

D. Secure cementitious backer units to each framing member with screws spaced not more than 200 mm (eight inches) on center and not closer than 13 mm (1/2 inch) from the edge of the backer unit or as

recommended by backer unit manufacturer. Install screws so that the screw heads are flush with the surface of the backer unit.

E. Where backer unit joins shower pans or waterproofing, lap backer unit over turned up waterproof system. Install fasteners only through top one-inch of turned up waterproof systems.

F. Do not install joint treatment for seven days after installation of cementitious backer unit.

G. Joint Treatment:

1. Fill horizontal and vertical joints and corners with latex-Portland cement mortar. Apply fiberglass tape over joints and corners and embed with same mortar.
2. Leave 6 mm (1/4 inch) space for sealant at lips of tubs, sinks, or other plumbing receptors.

3.5 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.

3.6 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, unless otherwise specified.
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 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.

E. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
   1. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
F. Install anti-fracture membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
   1. Do not install tile or setting materials over anti-fracture membrane until membrane has cured.
G. 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. Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Provide uniform joint widths unless otherwise indicated
   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 and furred areas, from floor to nominal wainscot heights shown with tile, unless otherwise specified.

b. Finish reveals of openings with tile, 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.

c. Make joints in Paver tile, porcelain type; maximum 3 mm (1/8 inch) wide.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, whirlpool room, equipment clean-up, and laundries.

b. Tile installed with chemical-resistant mortars and grouts.

c. Tile wall installations composed of tiles 200 by 200 mm (8 by 8 inches or larger.

3.7 CERAMIC TILE INSTALLED WITH PORTLAND CEMENT MORTAR

A. Mortar Mixes for Floor, Wall And Base Tile (including Showers): ANSI A108.1.except specified otherwise.

B. Installing Wall and Base Tile: ANSI A108.1, except specified otherwise.

C. Installing Floor Tile: ANSI A108.1, except as specified otherwise. Slope mortar beds to floor drains a minimum of 1 in 100 (1/8 inch per foot).

3.8 CERAMIC TILE INSTALLED WITH LATEX PORTLAND CEMENT BONDONG MORTAR

Due to the denseness of ceramic 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.

3.9 THIN SET CERAMIC 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).

3.10 THIN SET CERAMIC TILE INSTALLED WITH ORGANIC ADHESIVE

Installation of Tile: ANSI A108.4.

3.11 GROUTING

A. Grout Type and Location:

1. Grout for glazed wall and base tile, Portland cement grout, latex-Portland cement grout, dry-set grout, or commercial Portland cement grout.
2. Grout for tile of whirlpool room: 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, tub, service sink, 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 GROUT SEALANT

A. Allow grout to cure 72 hours before applications. Test in a hidden area to ensure desirable results.

B. Apply in accordance with manufacturer's instructions.

C. Conduct a test to see if surface is completely sealed after 2 hours by apply drops of water on the surface. If it penetrates immediately, apply an additional coat.

3.15 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.

3.16 TESTING FINISH FLOOR

A. Test floors in accordance with ASTM C627 to show compliance with codes 1 through 10.

B. Test storage rooms.

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SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1- GENERAL

1.1 DESCRIPTION

A. Metal ceiling suspension system for acoustical ceilings.

B. Acoustical units.

1.2 RELATED WORK

A. Color, pattern, and location of each type of acoustical unit: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTAL

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples:

1. Acoustical units, each type, with label indicating conformance to specification requirements.
2. Colored markers for units providing access.

C. Manufacturer's Literature and Data:

1. Ceiling suspension system, each type, showing complete details of installation.
2. Acoustical units, each type

D. 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 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):

A641/A641M-03.....Zinc-coated (Galvanized) Carbon Steel Wire

A653/A653M-07.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process

C423-07.....Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

C634-02 (E2007).....Standard Terminology Relating to Environmental Acoustics

C635-04.....Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

C636-06.....Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

E84-07.....Surface Burning Characteristics of Building Materials

E119-07.....Fire Tests of Building Construction and Materials

E413-04.....Classification for Rating Sound Insulation.

E580-06.....Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint

E1264-(R2005).....Classification for Acoustical Ceiling Products

PART 2- PRODUCTS

2.1 METAL SUSPENSION SYSTEM (AC-1)

A. Narrow Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A653/A653M, not less than G30 (Z90) coating designation; with prefinished 9/16 inch (15 mm) wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Steel cold-rolled sheet.
5. Cap Finish: Painted, for color refer to 09 06 00, schedule for finish.

B. 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.
2. Use same construction for cross runners as main runners. Use of lighter-duty sections for cross runners is not acceptable.

C. Exposed grid suspension system for support of lay-in panels:

1. 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 METAL SUSPENSION SYSTEM (AC-2,AC-3)

A. Wide face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A653/A653M, not less than G30 (Z90) coating designation; with prefinished 15/16 inch (24 mm) wide metal caps on flanges.
   1. Structural Classification: Heavy-duty system.
   2. End Condition of Cross Runners: Override (stepped) type.
   3. Face Design: Flat, flush.
   4. Cap Material: Steel cold-rolled sheet.
   5. Cap Finish: Painted, for color refer to 09 06 00, schedule for finish.
B. 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.
C. Exposed grid suspension system for support of lay-in panels:
   1. 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.

2.3 METAL SUSPENSION SYSTEM (AC-4)

A. Wide face, Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A653/A653M, G60 (Z180) coating designation; with prefinished, cold-rolled, 15/16 inch (24 mm) wide caps on flanges.
   1. Structural Classification: Heavy-duty system.
   2. Face Design: Flat, flush.
   3. Face Finish: Painted, for color refer to 09 06 00, schedule for finish.

2.4 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.

2.5 WIRE

A. Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.

B. Size: Select wire diameter so its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 inch (2.69 mm) diameter wire.

2.6 ANCHORS AND INSERTS

A. Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Hanger Inserts:

1. Fabricate inserts from steel, zinc-coated (galvanized after fabrication).

C. Clips:

1. Galvanized steel.
2. Designed to clamp to steel beam or bar joists, or secure framing member together.
3. Designed to rigidly secure framing members together.
4. Designed to sustain five times the loads imposed by hangers or items supported.

D. Tile Splines: ASTM C635.

2.7 CARRYING CHANNELS FOR SECONDARY FRAMING

A. Fabricate from cold-rolled or hot-rolled steel, black asphaltic paint finish, free of rust.

B. Weighing not less than the following, per 300 m (per thousand linear feet):

Size mm	Size Inches	Cold-rolled Kg	Pound	
38	1 1/2	215.4	475	
50	2	267.6	590	

2.8 ACOUSTICAL PANELS(AC-1)

A. General:

1. Class A Flame Spread: ASTM 84.

B. Classification: Provide panels complying with ASTM E1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
2. Pattern: CE (perforated, small holes and lightly textured).

C. Color: For color refer to 09 06 00, schedule for finish.

D. Light Reflectance (LR): Not less than 0.85.

E. Noise Reduction Coefficient (NRC): Not less than 0.55.

F. Ceiling Attenuation Class (CAC): Not less than 33.

G. Edge/Joint Detail: Beveled tegular

H. Thickness: 5/8 inch (15 mm).

I. Modular Size: 24 by 24 inches (610 by 610 mm).

J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273 and evaluated according to ASTM D3274 or ASTM G21.

2.9 ACOUSTICAL PANELS (AC-2)

A. General:

1. Class A Flame Spread: ASTM 84

B. Classification: Provide panels complying with ASTM E1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.

2. Pattern: CE (perforated, small holes and lightly textured).

C. Color: For color refer to 09 06 00, schedule for finish.

D. Light Reflectance (LR): Not less than 0.85.

E. Noise Reduction Coefficient (NRC): Not less than 0.55.

F. Ceiling Attenuation Class (CAC): Not less than 35.

G. Edge/Joint Detail: Angled tegular

H. Thickness: 5/8 inch (15 mm).

I. Modular Size: 24 by 48 inches (610 by 1220 mm).

J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273 and evaluated according to ASTM D3274 or ASTM G21.

2.10 ACOUSTICAL PANELS (AC-3)

A. General:

1. Class A Flame Spread: ASTM 84

B. Classification: Provide panels complying with ASTM E1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.

2. Pattern: CE (perforated, small holes and lightly textured).

C. Color: For color refer to 09 06 00, schedule for finish.

D. Light Reflectance (LR): Not less than 0.85.

E. Noise Reduction Coefficient (NRC): Not less than 0.55.

F. Ceiling Attenuation Class (CAC): Not less than 35.

G. Edge/Joint Detail: Square.

H. Thickness: 5/8 inch (15 mm).

I. Modular Size: 24 by 48 inches (610 by 1220 mm).

J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273 and evaluated according to ASTM D3274 or ASTM G21.

2.11 ACOUSTICAL PANELS (AC-4)

A. General:

1. Class A Flame Spread: ASTM 84

B. Classification: Provide panels complying with ASTM E1264 for type, form, and pattern as follows:

1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay on face.

2. Pattern: E (lightly textured).

C. Color: For color refer to 09 06 00, schedule for finish.

D. Light Reflectance (LR): Not less than 0.80.

E. Ceiling Attenuation Class (CAC): Not less than 40.

F. Edge/Joint Detail: Square.

G. Thickness: 5/8 inch (15 mm).

H. Modular Size: 24 by 48 inches (610 by 1220 mm).

I. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273 and evaluated according to ASTM D3274 or ASTM G21.

2.12 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

Red.....Sprinkler System: Valves and Controls

Green.....Domestic Water: Valves and Controls

Yellow.....Chilled Water and Heating Water

Orange.....Ductwork: Fire Dampers

Blue.....Ductwork: Dampers and Controls

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 m^2 (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 so 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 more than 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. Indirect Hung Suspension System:

1. As illustrated in ASTM C635.
2. Space carrying channels for indirect hung suspension system not more than 1200 mm (4 feet) on center. Space hangers for carrying channels not more than 2400 mm (8 feet) on center or for carrying channels less than 1200 mm (4 feet) or center so that specified requirements are not exceeded.
3. Support main runners by specially designed clips attached to carrying channels.

E. Seismic Ceiling Bracing System:

1. Construct system is 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

This section specifies the installation of resilient base and resilient molding accessories.

1.2 RELATED WORK

A. Color and texture: Section 09 06 00, SCHEDULE FOR FINISHESS.

B. Integral base with sheet flooring: Section 09 65 16, RESILIENT SHEET FLOORING.

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. Description of each product.
2. Base manufacturer's recommendations for adhesives.
3. Application and installation instructions.

C. Samples:

1. Base: 150 mm (6 inches) long, each type and color.
2. Adhesive: Literature indicating each type.

D. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

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 weather tight and dry storage facility.

B. Protect material from damage by handling and construction operations before, during, and after installation.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

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):

F1344-04.....Rubber Floor Tile

F1859-04.....Rubber Sheet Floor Covering without Backing

F1860-04.....Rubber Sheet Floor Covering with Backing

F1861-02.....Resilient Wall Base

C. Federal Specifications (Fed. Spec.):

RR-T-650E.....Treads, Metallic and Non-Metallic, Nonskid

PART 2 - PRODUCTS

2.1 GENERAL

Use only products by the same manufacturer and from the same production run.

2.2 RESILIENT BASE

A. Resilient Base Standard: ASTM F1861

1. Material Requirement: Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe).

B. Use only one type of base throughout.

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer’s standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Finish: Matte.

2.3 RESILIENT MOLDING ACCESSORIES

A. Description: Reducer strip for resilient floor covering, Joiner for tile and carpet, and Transition strips.

B. Material: Rubber.

C. Profile and Dimensions: As indicated on drawings and as required to create level installation for materials of dissimilar heights.

D. Colors and Patterns: As selected by Architect from full range of industry colors.

2.4 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.

D. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

E. Install resilient products after other finishing operations, including painting, have been completed.

3.2 INSTALLATION REQUIREMENTS

A. The respective manufacturer's instructions for application and installation will be considered for use when approved by the COTRCOTR.

B. Submit proposed installation deviation from this specification to the COTR COTRindicating the differences in the method of installation.

C. The COTR COTRreserves 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.

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.
2. Refer to finish and color schedule for resilient base locations.

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 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 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 as recommended by manufacturer's written instructions.

COTRE. 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 16

RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the installation of sheet flooring with backing and integral cove base.

B. Grades of resilient sheet vinyl floor covering without backing having vinyl plastic wearlayer with backing.

C. Installation of sheet flooring including following:

1. Heat welded seams.
2. Integral cove base: Installed at intersection of floor and vertical surfaces.

1.2 RELATED WORK

A. Concrete floors: Section 03 30 00, CAST-IN-PLACE CONCRETE.

B. Color, pattern and texture: Section 09 06 00, SCHEDULE FOR FINISHES.

D. Resilient base over base of lockers, equipment and casework: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

E. Unbacked vinyl (homogenous) sheet flooring with welded seams: Section 09 65 16, RESILIENT SHEET FLOORING.

1.3 QUALITY CONTROL-QUALIFICATIONS:

A. The COTR shall approve products or service of proposed manufacturer, suppliers, and installers, and the Contractor shall submit certification that:

1. Heat welded seaming is manufacturer's prescribed method of installation.
2. Installer is approved by manufacturer of materials and has technical qualifications, experience, trained personnel, and facilities to install specified items.
3. Manufacturer's product submitted has been in satisfactory operation, on three installations similar and equivalent in size to this project for three years. Submit list of installations.

B. The sheet vinyl floor coverings shall meet fire performance characteristics as determined by testing products, per ASTM test method, indicated below by Underwriters Laboratories, Inc. (UL) or another recognized testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 watts per sq. cm or more, Class I, per ASTM E648.
2. Smoke Density: Less than 450 per ASTM E662.

C. The floor covering manufacturer shall certify that products supplied for installation comply with local regulations controlling use of volatile organic compounds (VOC's).

1.4 SUBMITTALS

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

B. Manufacturer's Literature and Data:

1. Description of resilient material and accessories to be provided.
2. Resilient material manufacturer's recommendations for adhesives, weld rods, sealants, and underlayment.
3. Application and installation instructions.

C. Samples:

1. Sheet material, 38 mm by 300 mm (1-1/2 inch by 12 inch), of each color and pattern with a welded seam using proposed welding rod.
2. Cap strip and fillet strip, 300 mm (12 inches) for integral base.
3. Shop Drawings and Certificates: Layout of joints showing patterns where joints are expressed, and type and location of obscure type joints. Indicate orientation of directional patterns.
4. Certificates: Quality Control Certificate Submittals and lists specified in paragraph, QUALIFICATIONS.
5. Edge strips: 150 mm (6 inches) long each type.
6. Adhesive, underlayment and primer: Pint container, each type.
7. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.

1.5 PROJECT CONDITIONS

A. Maintain temperature of floor materials and room, where work occurs, above 18 ° C (65 °F) and below 38 °C (100 °F) for 48 hours before, during and for 48 hours after installation. After above period, room temperature shall not fall below 13 °C (55 °F).

B. Construction in or near areas to receive flooring work shall be complete, dry and cured. Do not install resilient flooring over slabs until they have been cured and are sufficiently dry to achieve a bond with adhesive. Follow flooring manufacturer's recommendations for bond and moisture testing.

C. Building shall be permanently enclosed. Schedule construction so that floor receives no construction traffic when completed.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site in original sealed packages or containers; labeled for identification with manufacturer's name and brand.

B. Deliver sheet flooring full width roll, completely enclosed in factory wrap, clearly marked with the manufacturer's number, type and color, production run number and manufacture date.

C. Store materials in weathertight and dry storage facility. Protect from damage due to handling, weather, and construction operations before, during and after installation. Store sheet flooring on end with ambient temperatures maintained as recommended by manufacturer.

D. Store sheet flooring on end.

E. Move sheet vinyl floor coverings and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

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 Society For Testing Materials (ASTM):

E648-06.....Critical Radiant Flux of Floor-Covering Systems Using a Radiant Energy Source.

E662-06.....Specific Optical Density of Smoke Generated by Solid Materials.

E1907-06.....Evaluating Moisture Conditions of Concrete Floors to Receive Resilient Floor Coverings

F710-05.....Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.

F1303-04.....Sheet Vinyl Floor Covering with Backing.

F1913-04.....Sheet Vinyl Flooring without Backing

C. Resilient Floor Covering Institute (RFCI):

Recommended Work Practices for Removal of Resilient Floor Coverings.

1.8 SCHEDULING

Interior finish work such as plastering, drywall finishing, concrete, terrazzo, ceiling work, and painting work shall be complete and dry before installation. Mechanical, electrical, and other work above

ceiling line shall be completed. Heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

1.9 WARRANTY:

Submit written warranty, in accordance with FAR clause 52.246-21, Warranty of Construction requirements except that warranty period shall be extended to include two (2) years.

PART 2 - PRODUCTS

2.1 SHEET VINYL FLOOR COVERINGS

A. Sheet Vinyl Floor Coverings: Smooth face, minimum thickness nominal 2 mm (0.08 inch). Sheet flooring shall conform to ASTM F1913 and material requirements specified in ASTM F1303, Type II, Grade 1, backing classification not applicable. Foam backed sheet flooring is not acceptable.

B. Size: Provide maximum size sheet vinyl material produced by manufacturer to provide minimum number of joints. Minimum size width acceptable - 1200 mm (48 inches).

C. Each color and pattern of sheet flooring shall be of same production run.

D. Wearing Surface: Embossed.

2.2 WELDING ROD:

Product of floor covering manufacturer in color shall match field color of sheet vinyl covering.

2.3 APPLICATION MATERIALS AND ACCESSORIES

A. Floor and Base Adhesive: Type recommended by sheet flooring material manufacturer for conditions of use.

B. Mastic Underlayment (for concrete floors): Provide products with latex or polyvinyl acetate resins in mix. Condition to be corrected shall determine type of underlayment selected for use.

C. Base Accessories:

1. Fillet Strip: 19 mm (3/4 inch) radius fillet strip compatible with resilient sheet material.
2. Cap Strip: Extruded flanged zero edge vinyl reducer strip approximately 25 mm (one inch) exposed height with 13 mm (1/2 inch) flange.

2.4 SHEET FLOORING

A. ASTM F1303, Type II, Grade 1, except for backing requirements. Foam backed sheet flooring is not acceptable.

B. Minimum nominal thickness 2 mm (0.08 inch); 1800 mm (6 ft) minimum width.

C. Critical Radiant Flux: 0.45 watts per sq.cm or more, Class I, per ASTM E648.

D. Smoke density: less than 450 per ASTM E662.

E. Color and pattern of sheet flooring of the same production run.

2.5 ADHESIVES

Water resistant type recommended by the sheet flooring manufacturer for the conditions of use.

2.6 BASE CAP STRIP AND COVE STRIP

A. Extruded vinyl compatible with the sheet flooring.

B. Cap strip "J" shape with feathered edge flange approximately 25 mm (one inch) wide; top designed to receive sheet flooring with 13 mm (1/2 inch) flange lapping top of flooring

C. Cove strip 70 mm (2-3/4 inch) radius.

2.7 LEVELING COMPOUND (FOR CONCRETE FLOORS)

Provide cementitious products with latex or polyvinyl acetate resins in the mix.

2.8 PRIMER (FOR CONCRETE SUBFLOORS)

As recommended by the adhesive or sheet flooring manufacturer.

2.9 EDGE STRIPS

A. Extruded aluminum, mill finish, mechanically cleaned.

B. 28 mm (1-l/8 inch) wide, 6 mm (1/4 inch) thick, bevel one edge to 3 mm (1/8 inch) thick.

C. Drill and counter sink edge strips for flat head screws. Space holes near ends and approximately 225 mm (9 inches) on center in between.

2.10 SEALANT

A. As specified in Section 07 92 00, JOINT SEALANTS.

B. Compatible with sheet flooring.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

A. Maintain temperature of sheet flooring above 36 °C (65 °F), for 48 hours before installation.

B. Maintain temperature of rooms where sheet flooring work occurs above 36 °C (65 °F), for 48 hours, before installation and during installation.

C. After installation, maintain temperature at or above 36 °C (65 °F.)

D. Building is permanently enclosed.

E. Wet construction in or near areas to receive sheet flooring is complete, dry and cured.

3.2 SUBFLOOR PREPARATION

A. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710.

1. Installer shall examine surfaces on which resilient sheet flooring is to be installed, and shall advise Contractor, in writing, of areas which are unacceptable for installation of flooring material. Installer shall advise Contractor which methods are to be used to correct conditions that will impair proper installation. Installation shall not proceed until unsatisfactory conditions have been corrected.
2. Slab substrates dry, free of curing compounds, sealers, hardeners, and other materials which would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by Resilient Floor Covering Institute recommendations in manual RFCI-MRP.

B. Broom or vacuum clean substrates to be covered by sheet vinyl floor coverings immediately before installation. Following cleaning, examine substrates to determine if there is visually any evidence of moisture, alkaline salts, carbonation, or dust.

C. Primer: If recommended by flooring manufacturer, prior to application of adhesive, apply concrete slab primer in accordance with manufacturer’s directions.

D. Correct conditions which will impair proper installation, including trowel marks, pits, dents, protrusions, cracks or joints.

E. 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.

F. Clean floor of oil, paint, dust and deleterious substances. Leave floor dry and cured free of residue from existing curing or cleaning agents.

G. Concrete Subfloor Testing:

Determine adhesion and dryness of the floor by bond and moisture tests as recommended by RFCI manual MPR.

3.2 INSTALLATION OF FLOORING

A. Install work in strict compliance with manufacturer's instructions and approved layout drawings.

B. Maintain uniformity of sheet vinyl floor covering direction and avoid cross seams.

C. Arrange for a minimum number of seams and place them in inconspicuous and low traffic areas, but in no case less than 150 mm (6 inches) away from parallel joints in flooring substrates.

D. Match edges of resilient floor coverings for color shading and pattern at seams.

E. Where resilient sheet flooring abuts other flooring material floors shall finish level.

F. Extend sheet vinyl floor coverings into toe spaces, door reveals, closets, and similar openings.

G. Inform the COTR of conflicts between this section and the manufacturer's instructions or recommendations for auxiliary materials, or installation methods, before proceeding.

H. Install sheet in full coverage adhesives.

   1. Air pockets or loose edges will not be accepted.
   2. Trim sheet materials to touch in the length of intersection at pipes and vertical projections; seal joints at pipe with waterproof cement or sealant.

I. Keep joints to a minimum; avoid small filler pieces or strips.

J. Follow manufacturer’s recommendations for seams at butt joints. Do not leave any open joints that would be readily visible from a standing position.

K. Follow manufacturer’s recommendations regarding pattern match, if applicable.

L. Installation of Edge Strips:

   1. Locate edge strips under center lines of doors unless otherwise indicated.
   2. Set aluminum strips in adhesive, anchor with lead anchors and stainless steel Phillips screws.

M. Integral Cove Base Installation:

   1. Set preformed fillet strip to receive base.
   2. Install the base with adhesive, terminate expose edge with the cap strip.

3. Form internal and external corners to the geometric shape generated by the cove at either straight or radius corners.
4. Solvent weld joints as specified for the flooring. Seal cap strip to wall with an adhesive type sealant.
5. Unless otherwise specified or shown where sheet flooring is scheduled, provide integral base at intersection of floor and vertical surfaces. Provide sheet flooring and base scheduled for room on floors and walls under and behind areas where casework, laboratory and pharmacy furniture and other equipment occurs, except where mounted in wall recesses.

N. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

3.3 INSTALLATION OF INTEGRAL COVED BASE

A. Set preformed cove to receive base. Install base material with adhesive and terminate exposed edge with cap strip. Integral base shall be 150 mm (6 inches) high, unless otherwise specified.

B. Internal and external corners shall be formed to geometric shape generated by cove at either square or radius corners.

1. Corners: Metal inside and outside corners and end stops provided or approved by manufacturer.

3.4 WELDING

A. Heat weld all joints of flooring and base using equipment and procedures recommended by flooring manufacturer.

B. Welding shall consist of routing joint, inserting a welding rod into routed space, and terminally fusing into a homogeneous joint.

C. Upon completion of welding, surface across joint shall finish flush, free from voids, and recessed or raised areas.

D. Fusion of Material: Joint shall be fused a minimum of 65 percent through thickness of material, and after welding shall meet specified characteristics for flooring.

3.5 CLEANING

A. Clean small adhesive marks during application of sheet flooring and base before adhesive sets, excessive adhesive smearing will not be accepted.

B. Remove visible adhesive and other surface blemishes using methods and cleaner recommended by floor covering manufacturers.

C. Clean and polish materials per flooring manufacturer’s written recommendations.

D. Vacuum floor thoroughly.

E. Do not wash floor until after period recommended by floor covering manufacturer and then prepare in accordance with manufacturer’s recommendations.

F. Upon completion, COTR shall inspect floor and base to ascertain that work was done in accordance with manufacturer's printed instructions.

G. Perform initial maintenance according to flooring manufacturer’s written recommendations, including protective coating/wax.

3.6 PROTECTION:

A. Protect installed flooring as recommended by flooring manufacturer against damage from rolling loads, other trades, or placement of fixtures and furnishings.

B. Keep traffic off sheet flooring for 24 hours after installation.

C. Where construction traffic is anticipated, cover sheet flooring with reinforced kraft paper properly secured and maintained until removal is authorized by the COTR.

D. Where protective materials are removed and immediately prior to acceptance, repair any damage, re-clean sheet flooring, lightly re-apply polish and buff floor.

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SECTION 09 65 19

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the installation of vinyl composition 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. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. 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.

C. 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.

D. 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.

E. 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 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 weathertight and dry storage facility.

B. Protect from damage from handling, water, and temperature.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.

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):

D4078-02.....Water Emulsion Floor Finish

E648-08.....Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source

E662-06.....Specific Optical Density of Smoke Generated by Solid Materials

E1155-96 (R2008).....Determining Floor Flatness and Floor Levelness Numbers

F510-93 (R 2004).....Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Method

F710-08.....Preparing Concrete Floors to Receive Resilient Flooring

F1066-04.....Vinyl Composition Floor Tile

C. Resilient Floor Covering Institute (RFCI):

IP #2.....Installation Practice for Vinyl Composition Tile (VCT)

D. Federal Specifications (Fed. Spec.):

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 VINYL COMPOSITION TILE

A. ASTM F1066, Composition 1, Class 2 (through pattern), 300 mm (12 inches) square, 3 mm (1/8 inch) thick.

B. Color and pattern uniformly distributed throughout thickness, see drawings.

2.3 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.

2.4 PRIMER (FOR CONCRETE SUBFLOORS)

As recommended by the adhesive and tile manufacturer.

2.5 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.

2.6 POLISH AND CLEANERS

A. Cleaners RFCI CL-1.

B. Polish: ASTM D4078.

2.7 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.

2.8 SCREWS

Stainless steel flat head screw.

2.9 FEATURE STRIPS

A. Use same material as floor tile.

B. Sizes and shapes as shown.

2.10 FINISH COAT/WAX

A. Manufacturer recommended finish coat or wax is required.

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:

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:

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. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

D. 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. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern). E. 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 COTR 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. Apply two coat(s).

D. When construction traffic occurs over tile, cover resilient materials with reinforced kraft paper properly secured and maintained until removal is directed by COTR. 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 COTR. Cover floor tile until Substantial Completion.

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.

3.6 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 72 16
VINYL-COATED FABRIC WALL COVERINGS

PART 1 - GENERAL

1.1 DESCRIPTION

Section specifies vinyl coated fabric wallcovering and installation.

1.2 RELATED WORK

A. Color, pattern, type, direction of hanging and areas to receive wallcovering: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples:

1. Each type and pattern as specified in Section 09 06 00, SCHEDULE FOR FINISHES.
2. Size: Full width of mill run.

C. Manufacturer's Certificates:

1. Compliance with CFFA W-101D.
2. Wallcovering manufacturer's approval of adhesive.

D. Manufacturer's Literature and Data:

1. Primer and adhesive.
2. Installation instructions.
3. Maintenance instructions, including recommended materials and methods for maintaining wallcovering with precautions in use of cleaning material.

1.4 QUALITY ASSURANCE

A. Finish one complete space with each type (color and pattern) of wallcovering showing specified colors and patterns.

B. Use approved sample spaces as a standard for work throughout the project.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver in original unopened containers bearing the manufacturer's name, brand name, and product designation.

B. Store in accordance with manufacturer's instructions.

C. Handle to prevent damage to material.

1.6 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. Chemical Fabrics and Film Association, Inc., (CFFA):
Document 2575-96.....Vinyl Coated Fabric Wallcovering

C. American Society for Testing and Materials (ASTM)
G21-96 (R2002).....Determining Resistance of Synthetic Polymeric Materials to Fungi

PART 2 - PRODUCTS

2.1 VINYL COATED FABRIC WALLCOVERING

A. Comply with CFFA-2575.

B. Fungi Resistance: ASTM G21, rating of 0.

C. Factory-applied clear delustered polyvinyl-fluoride (PVF) coating:

1. Minimum 0.0125 mm (1/2 mil) thickness.
2. Do not include PVF coating weight in minimum total weight.
3. Fire hazard classification with PVF coating: Class A unless specified otherwise.
   a. Surface-Burning Characteristics: As follows, per ASTM E 84.
      1) Flame-Spread Index: 25 or less.
      2) Smoke-Developed Index: 450 or less.D. Type III (Heavy Duty).

2.2 ADHESIVE

A. Use only water-based adhesive having volatile organic compounds not more than 50 g/l.

B. Vermin and mildew resistant.

C. Primer/Sealer: Mildew-resistant primer/sealer as recommended in writing by wall-covering manufacturer for intended substrate, unless specified otherwise.

D. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall-covering manufacturer.

E. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. Temperatures:

1. Do not perform work until surfaces and materials have been maintained at minimum of 60 °F. for three days before work begins.
2. Maintain minimum temperatures of 60 °F. until adhesives are dried or cured.

B. Lighting:
   1. Do not proceed unless a minimum lighting level of 15 candlepower per square foot occurs.
   2. Measure light level at mid-height of wall.
C. Ventilation:
   1. Provide uniform continuous ventilation in space.
   2. Ventilate for a time for not less than complete drying or curing of adhesive.
D. Protect other surfaces from damage which may be caused by this work.
E. Remove waste from building daily.

3.2 SURFACE CONDITION

A. Inspect surfaces to receive wallcoverings to assure that:
   1. Patches and repairs are completed.
   2. Surface are clean, smooth and prime painted.
B. Do not proceed until discovered defects have been corrected by other trades and surfaces are ready to receive wallcovering.
C. Carefully remove electrical outlet and switch plates, mechanical diffusers, escutcheons, registers, surface hardware, fittings and fastenings, prior to starting work.
D. Carefully store items for reinstallation.
E. Comply with manufacturer's written instructions for surface preparation.
F. Clean substrates of substances that could impair wall covering's bond, including mold, mildew, oil, grease, incompatible primers, dirt, and dust.
G. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
   1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
   2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity.
   3. Delete first subparagraph below if priming of gypsum-board surfaces is performed under another Section.
   4. Gypsum Board: Prime with primer recommended by wall-covering manufacturer.
   5. Painted Surfaces: Treat areas susceptible to pigment bleeding.

H. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.

I. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

J. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

3.3 APPLICATION OF ADHESIVE

A. Mix and apply adhesives in accordance with manufacturer's directions.

B. Prevent adhesive from getting on face of wallcovering.

C. Apply adhesive to wallcovering back.

3.4 WALLCOVERING INSTALLATION

A. Use wallcovering of same batch or run or dye lot in an area. Use fabric rolls in consecutive numerical sequence of manufacturer.

B. Install material completely adhered, smooth, clean, without wrinkles, air pockets, gaps or overlaps.

C. Extend wallcovering continuous behind non-built-in casework and other items which are close to but not bolted to or touching the walls.

D. Install wallcovering before installation of resilient base. Extend wallcovering not more than 6 mm (1/4 inch) below top of resilient base.

E. Install panels consecutively in order in which they are cut from the roll including filling spaces above or below windows, doors, or similar penetrations.

F. Do not install horizontal seams.

G. Except on match patterns, hang fabric by reversing alternate strips, except as recommended by the manufacturer.

H. Cutting:

1. Cut on a work table with a straight edge.
2. Joints or seams that are not cut clean are unacceptable.
3. Trim additional selvage to achieve a color and pattern match at seams. Overlapped seams are not allowed.
4. Do not double cut seams on wall unless specified.
5. If double cutting on the wall is necessary, place a three inch strip of Type I wallcovering under pasted edge.
   a. Do not cut into wall surface.
   b. After cutting, remove strip and excess adhesive from seam before proceeding to next seam.

c. Smooth down seam in adhesive for tight bond and joint.

I. Trim strip-matched patterns, which are not factory pre-trimmed.

J. Inside Corners:

1. Wrap wallcovering around corner.
2. Do not seam within 50 mm (2 inches) of inside corners.
3. Double cut seam.

K. Outside Corners:

1. Wrap wallcovering around corner.
2. Do not seam within 150 mm (6 inches) of outside corners.
3. Double cut seam.

L. Match pattern 72 inches (1830 mm) above the finish floor.

3.5 PATCHING

A. Replace surface damaged wallcovering in a space as specified for new work:

1. Replace full height of surface.
2. Replace from break in plane to break in plane when same batch or run is not used. Double cut seams.
3. Adjoining differential colors from separate batches or runs are not acceptable.

B. Correct loose or raised seams with adhesives to lay flat with tight bonded joint as specified for new work.

3.6 CLEANING AND INSTALLING TEMPORARY REMOVED ITEMS

A. Remove adhesive from wallcovering as work proceeds.

B. Remove adhesives where spilled, splashed or splattered on wallcoverings or adjacent surfaces in a manner not to damage surface from which it is removed.

C. Reinstall previously removed electrical outlet and switch plates, mechanical diffusers, escutcheons, registers, surface hardware, fittings and fastenings.

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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 13 – SPECIAL CONSTRUCTION, 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.

G. For Interior Painting, See Specification Section 09 91 13.

H. For Exterior Painting, See Specification Section 09 91 23.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:
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.

C. 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.

D. Sample of identity markers if used.

E. 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 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).

1.5 MOCK-UP PANEL

A. Before starting application of water paint mixtures, apply paint as specified to an area, not to exceed 9 m^2 (100 ft^2), selected by COTR.

B. Finish and texture approved by COTR will be used as a standard of quality for remainder of work.

1.6 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):
   ACGIH TLV-BKLT-1992.....Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
   ACGIH TLV-DOC.....Documentation of Threshold Limit Values and Biological Exposure Indices, (Sixth Edition)

C. American National Standards Institute (ANSI):
   A13.1-96.....Scheme for the Identification of Piping Systems

D. American Society for Testing and Materials (ASTM):
   D260-86.....Boiled Linseed Oil

E. Commercial Item Description (CID):

A-A-1555.....Water Paint, Powder (Cementitious, White and Colors) (WPC) (cancelled)

A-A-3120.....Paint, For Swimming Pools (RF) (cancelled)

F. Federal Specifications (Fed Spec):

TT-P-1411A.....Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)

G. Master Painters Institute (MPI):

No. 1-06.....Aluminum Paint (AP)

No. 4-06.....Interior/ Exterior Latex Block Filler

No. 5-06.....Exterior Alkyd Wood Primer

No. 7-06.....Exterior Oil Wood Primer

No. 8-06.....Exterior Alkyd, Flat MPI Gloss Level 1 (EO)

No. 9-06.....Exterior Alkyd Enamel MPI Gloss Level 6 (EO)

No. 10-06.....Exterior Latex, Flat (AE)

No. 11-06.....Exterior Latex, Semi-Gloss (AE)

No. 18-06.....Organic Zinc Rich Primer

No. 22-06.....Aluminum Paint, High Heat (up to 590% - 1100F) (HR)

No. 26-06.....Cementitious Galvanized Metal Primer

No. 27-06.....Exterior / Interior Alkyd Floor Enamel, Gloss (FE)

No. 31-06.....Polyurethane, Moisture Cured, Clear Gloss (PV)

No. 36-06.....Knot Sealer

No. 43-06.....Interior Satin Latex, MPI Gloss Level 4

No. 44-06.....Interior Low Sheen Latex, MPI Gloss Level 2

No. 45-06.....Interior Primer Sealer

No. 46-06.....Interior Enamel Undercoat

No. 47-06.....Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 (AK)

No. 48-06.....Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)

No. 49-06.....Interior Alkyd, Flat, MPI Gloss Level 1 (AK)

No. 50-06.....Interior Latex Primer Sealer

No. 51-06.....Interior Alkyd, Eggshell, MPI Gloss Level 3

No. 52-06.....Interior Latex, MPI Gloss Level 3 (LE)

No. 53-06.....Interior Latex, Flat, MPI Gloss Level 1 (LE)

No. 54-06.....Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)

No. 59-06.....Interior/Exterior Alkyd Porch & Floor Enamel, Low Gloss (FE)

No. 60-06.....Interior/Exterior Latex Porch & Floor Paint, Low Gloss

No. 66-06.....Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved) (FC)

No. 67-06.....Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR)

No. 68-06.....Interior/ Exterior Latex Porch & Floor Paint, Gloss

No. 71-06.....Polyurethane, Moisture Cured, Clear, Flat (PV)

No. 74-06.....Interior Alkyd Varnish, Semi-Gloss

No. 77-06.....Epoxy Cold Cured, Gloss (EC)

No. 79-06.....Marine Alkyd Metal Primer

No. 90-06.....Interior Wood Stain, Semi-Transparent (WS)

No. 91-06.....Wood Filler Paste

No. 94-06.....Exterior Alkyd, Semi-Gloss (EO)

No. 95-06.....Fast Drying Metal Primer

No. 98-06.....High Build Epoxy Coating

No. 101-06.....Epoxy Anti-Corrosive Metal Primer

No. 108-06.....High Build Epoxy Coating, Low Gloss (EC)

No. 114-06.....Interior Latex, Gloss (LE) and (LG)

No. 119-06.....Exterior Latex, High Gloss (acrylic) (AE)

No. 135-06.....Non-Cementitious Galvanized Primer

No. 138-06.....Interior High Performance Latex, MPI Gloss Level 2 (LF)

No. 139-06.....Interior High Performance Latex, MPI Gloss Level 3 (LL)

No. 140-06.....Interior High Performance Latex, MPI Gloss Level 4

No. 141-06.....Interior High Performance Latex (SG) MPI Gloss Level 5

H. Steel Structures Painting Council (SSPC):

SSPC SP 1-00 (R2004)....Solvent Cleaning

SSPC SP 2-00 (R2004)....Hand Tool Cleaning

SSPC SP 3-00 (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. Plastic Tape:

1. Pigmented vinyl plastic film in colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES or specified.
2. Pressure sensitive adhesive back.
3. Widths as shown.

D. Identity markers options:

1. Pressure sensitive vinyl markers.
2. Snap-on coil plastic markers.

E. Aluminum Paint (AP): MPI 1.

F. Exterior Alkyd, Flat (EO): MPI 8.

G. Exterior Alkyd Enamel (EO): MPI 9.

H. Exterior Latex, Flat (AE): MPI 10.

I. Organic Zinc rich Coating (HR): MPI 22.

J. High Heat Resistant Coating (HR): MPI 22.

K. Cementitious Galvanized Metal Primer: MPI 26.

L. Exterior/ interior Alkyd Floor Enamel, Gloss (FE): MPI 27.

M. Interior Satin Latex: MPI 43.

N. Interior Low Sheen Latex: MPI 44.

O. Interior Primer Sealer: MPI 45.

P. Interior Enamel Undercoat: MPI 47.

Q. Interior Latex Primer Sealer: MPI 50.

R. Interior Latex, MPI Gloss Level 3 (LE): MPI 52.

S. Interior Latex, Flat, MPI Gloss Level 1 (LE): MPI 53.

T. Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE): MPI 54.

U. Epoxy Cold Cured, Gloss (EC): MPI 77.

V. Fast Drying Metal Primer: MPI 95.

W. Epoxy Anti-Corrosive Metal Primer: MPI 101.

X. Interior latex, Gloss (LE) and (LG): MPI 114.

Y. Exterior Latex, High Gloss (acrylic) (AE): MPI 119.

Z. Waterborne Galvanized Primer: MPI 134.

AA. Non-Cementitious Galvanized Primer: MPI 135.

BB. Interior High Performance Latex, MPI Gloss Level 2(LF): MPI 138.

CC. Interior High Performance Latex, MPI Gloss Level 3 (LL): MPI 139.

DD. Interior High Performance Latex, MPI Gloss Level 4: MPI 140.

EE. Interior High Performance 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. Lead-Base Paint:
   a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
   b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
   c. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
3. Asbestos: Materials shall not contain asbestos.
4. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
6. Use high performance acrylic paints in place of alkyd paints, where possible.

7. 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, Cement Board, Cement Plaster and Stucco:

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. 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 Plaster and 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 [Plaster, 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 COTR.
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 COTR, 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 95 (Fast Drying Metal Primer). 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. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel (EO)).

5. Asphalt coated metal: MPI 1 (Aluminum Paint (AP)).

6. 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 and Hardboard:

1. Surfaces scheduled to have MPI 10 (Exterior Latex, Flat (AE))or or MPI 53 (Interior Latex, Flat), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)).

2. Primer: MPI 50(Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer) MPI 46 (Interior Enamel Undercoat) in shower and bathrooms.
3. Use MPI 101 (Cold Curing Epoxy Primer) for surfaces scheduled to receive MPI 77 (Epoxy Cold Cured, Gloss (EC)).

H. Concrete Floors: MPI 68 (Interior/ Exterior Latex Porch & Floor Paint, Gloss).

3.6 EXTERIOR FINISHES

A. Apply following finish coats where specified in Section 09 06 00, SCHEDULE FOR FINISHES.

B. See Specification 09 91 13 for details and requirements.

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. See Specification 09 91 23 for detais and requirements.

3.8 REFINISHING EXISTING PAINTED SURFACES

A. Clean, patch and repair existing surfaces as specified under surface preparation.

B. Remove and reinstall items as specified under surface preparation.

C. Remove existing finishes or apply separation coats to prevent non compatible coatings from having contact.

D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.

E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.

F. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one coat of MPI 31 (Polyurethane, Moisture Cured, Clear Gloss) or MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV))to match existing finishes.

G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.

H. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.

I. Sand or dull glossy surfaces prior to painting.

J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.9 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.

3.10 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 94 (Exterior Alkyd, Semi-gloss (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 11 (Exterior Latex, Semi Gloss (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.
   c. Apply one coat of MPI 50 (Interior Latex Primer Sealer) and one coat of MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)) 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 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 ofMPI 10 (Exterior Latex, Flat (AE)).

3.11 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 and existing 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. 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. Gaskets.

8. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundations walls and interior walls in pipe basements.
9. Face brick.
10. Structural steel encased in concrete, masonry, or other enclosure.
11. Structural steel to receive sprayed-on fire proofing.

3.12 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 12 000 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 BACKGROUND	COLOR OF LETTERS	LEGEND BBREVIATIONS
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		Yellow	Black	Alk
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	Red	White	Auto Spr
Standpipe	Red	Red	White	Stand
Sprinkler		Red	White	Drain

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.
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. Dental compressed air lines: Section 22 61 13.74, DENTAL COMPRESSED-AIR PIPING / Section 22 61 19.74, DENTAL COMPRESSED-AIR EQUIPMENT.
   c. Laboratory gas and vacuum lines: Section 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES / Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES.
   d. Oral evacuation lines: Section 22 62 19.74, DENTAL VACUUM AND EVACUATION EQUIPMENT.
   e. Medical Gases and vacuum lines: Section 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES / Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES.
   f. 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 PARTITION" or, "FIRE PARTITION" 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.

3.13 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.

- - - E N D - - -

SECTION 09 91 13

EXTERIOR PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Concrete masonry units (CMU).
2. Steel.
3. Galvanized metal.
4. Aluminum (not anodized or otherwise coated).

B. Related Requirements:

1. Division 06 Sections for shop priming carpentry with primers specified in this Section.
2. Division 08 Sections for factory priming windows and doors with primers specified in this Section.
3. Division 09 painting Sections for special-use coatings.
4. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
5. Division 09 Section "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on exterior wood substrates.
6. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.
7. Asphalt and concrete pavement marking: Section 32 17 23, PAVEMENT MARKINGS.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:
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.

C. 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.

D. Sample of identity markers if used.

E. 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 MOCK-UP PANEL

A. Before starting application of paint, apply paint as specified to an area, not to exceed 9 m^2 (100 ft^2), selected by COTR. Coordinate with COTR/Architect for location of mock-up panel.

B. Finish and texture approved by COTR will be used as a standard of quality for remainder of work.

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.6 DELIVERY, STORAGE, AND HANDLING

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.

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):

ACGIH TLV-BKLT-2008.....Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)

ACGIH TLV-DOC-2008.....Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)

C. American National Standards Institute (ANSI):

A13.1-07.....Scheme for the Identification of Piping Systems

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

D260-86.....Boiled Linseed Oil

E. Federal Specifications (Fed Spec):

TT-P-1411A.....Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)

F. Painting Council (SSPC):

SSPC SP 1-04 (R2004)....Solvent Cleaning

SSPC SP 2-04 (R2004)....Hand Tool Cleaning

SSPC SP 3-04 (R2004)……..Power Tool Cleaning

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

C. Colors: Section 09 06 00, SCHEDULE FOR FINISHES.

2.2 BLOCK FILLERS

A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.

1. MPI#4 Block Filler, Latex, Interior/Exterior

2.3 PRIMERS/SEALERS

A. Exterior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex primer for exterior application.

1. MPI#3 Primer, Alkali Resistant, Water Based

2.4 METAL PRIMER

A. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.

1. MPI#107 Primer, Rust Inhibitive, Water Based.

B. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.

1. MPI#107 Primer, Rust Inhibitive, Water Based.

2.5 WATER-BASED PAINTS

A. Exterior Semigloss Acrylic Enamel: Factory-formulated semigloss waterborne acrylic-latex enamel for exterior application over zinc-coated or ferrous metals.

1. MPI#163 Exterior Light Industrial Coating, Water Based, semi-gloss.

2.6 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Contractor’s testing agency will perform tests for compliance with product requirements.
2. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

2.7 **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): As specified.
2. Lead-Base Paint:

a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
c. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.

3. Asbestos: Materials shall not contain asbestos.
4. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
6. Use high performance acrylic paints in place of alkyd paints, where possible.
7. VOC content for solvent-based paints shall not exceed 250g/l, unless otherwise specified and shall not be formulated with more than one percent aromatic hydro carbons by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Masonry (Clay and CMU): 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

A. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

B. Application Procedures: Apply paints and coatings by brush or roller according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: The use of spray application is prohibited on this project.

C. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

D. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

E. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

F. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

G. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

H. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work; coordinate work with COTR:
   1. Paint the following work where exposed to view:
      a. Equipment, including panelboards and switch gear.
      b. Uninsulated metal piping.
      c. Uninsulated plastic piping.
      d. Pipe hangers and supports.
      e. Metal conduit.
      f. Plastic conduit.
      g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.

1. Semigloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.
   a. Primer: Exterior ferrous-metal primer.
   b. Finish Coats: Exterior semigloss acrylic enamel.

B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:

1. Semigloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.
   a. Primer: Exterior galvanized metal primer.
   b. Finish Coats: Exterior semigloss acrylic enamel.

- - - END - - -

SECTION 09 91 23

INTERIOR PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Steel.
2. Galvanized metal.
3. Wood.
4. Gypsum board.

B. Related Requirements:

1. Division 06 Sections for shop priming carpentry with primers specified in this Section.
2. Division 08 Sections for factory priming windows and doors with primers specified in this Section.
3. Division 09 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
4. Division 09 Section "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.
5. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.
6. Asphalt and concrete pavement marking: Section 32 17 23, PAVEMENT MARKINGS.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:
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.

C. 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.

D. Sample of identity markers if used.

E. 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 DELIVERY, STORAGE, AND HANDLING

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.

1.5 MOCK-UP PANEL

A. Before starting application of paint, apply paint as specified to an area, not to exceed 9 m^2 (100 ft^2), selected by COTR. Coordinate with COTR/Architect for location of mock-up panel.

B. Finish and texture approved by COTR will be used as a standard of quality for remainder of work.

C. 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 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

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):

ACGIH TLV-BKLT-2008.....Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)

ACGIH TLV-DOC-2008.....Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)

C. American National Standards Institute (ANSI):

A13.1-07.....Scheme for the Identification of Piping Systems

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

D260-86.....Boiled Linseed Oil

F. Federal Specifications (Fed Spec):

TT-P-1411A.....Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)

G. Painting Council (SSPC):

SSPC SP 1-04 (R2004)....Solvent Cleaning

SSPC SP 2-04 (R2004)....Hand Tool Cleaning

SSPC SP 3-04 (R2004)....Power Tool Cleaning

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants

added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

C. Colors: Section 09 06 00, SCHEDULE FOR FINISHES.

2.2 PRIMERS/SEALERS

A. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.

1. MPI#50 Primer/Sealer, Latex, Interior

B. Interior Wood Primer for Acrylic-Enamel and Semi-gloss Alkyd-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex-based interior wood primer.

1. MPI#39 Primer, Latex, for Interior Wood

2.3 METAL PRIMERS

A. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.

1. MPI #107 Primer, Rust Inhibitive, Water Based

B. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.

1. MPI #107 Primer, Rust Inhibitive, Water Based

2.4 LATEX PAINTS

A. Interior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application.

1. MPI # 53 Latex, Interior, Flat

B. Interior Flat Latex-Emulsion Size: Factory-formulated flat latex-based interior paint.

1. MPI # 53 Latex, Interior, Flat

C. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.

1. MPI# 44 Latex, Interior (MPI Gloss Level 2)

D. Interior Semi-gloss Acrylic Enamel: Factory-formulated semi-gloss acrylic-latex enamel for interior application.

1. MPI# 153 Light Industrial Coating, Water Based, Semi-Gloss

E. Interior Semi-gloss Epoxy: Factory-formulated semi-gloss acrylic-latex enamel for interior application.

1. MPI# 215 Epoxy Modified Latex, Interior, Semi-Gloss

2.5 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Contractor's testing agency will perform tests for compliance with product requirements.
2. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

2.6 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): As specified.
2. Lead-Base Paint:
   a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
   b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
   c. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
3. Asbestos: Materials shall not contain asbestos.

4. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
6. Use high performance acrylic paints in place of alkyd paints, where possible.
7. VOC content for solvent-based paints shall not exceed 250g/l, unless otherwise specified and shall not be formulated with more than one percent aromatic hydro carbons by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Wood: 15 percent.
2. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

G. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
5. Coordinate with COTR regarding mechanical and electrical piping painting schedule.

B. Application Procedures: Apply paints and coatings by brush or roller according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: The use of spray application is prohibited on this project.

C. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

D. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

E. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

F. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

G. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

H. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
   a. Equipment, including panelboards and switch gear.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Tanks that do not have factory-applied final finishes.
   h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
2. Paint the following work where exposed in occupied spaces:
   a. Equipment, including panelboards.

b. Uninsulated metal piping.

c. Uninsulated plastic piping.

d. Pipe hangers and supports.

e. Metal conduit.

f. Plastic conduit.

g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.

2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Flat Acrylic Finish (Ceiling): Two finish coats over a primer.

a. Primer: Interior gypsum board primer.

b. Finish Coats: Interior flat acrylic paint.

2. Egg-shell Low-Luster Acrylic-Enamel Finish (Walls): Two finish coats over a primer.

a. Primer: Interior gypsum board primer.

b. Finish Coats: Egg-shell interior low-luster acrylic enamel.

3. Interior Semi-gloss Epoxy Finish: Two finish coats over a primer.

a. Primer: Interior gypsum board primer.

b. Finish Coats: Interior semi-gloss epoxy.

B. Wood: Provide the following paint finish systems over new interior wood surfaces:

1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Interior wood primer for acrylic-enamel and semi-gloss alkyd-enamel finishes.

b. Finish Coats: Interior low-luster acrylic enamel.

C. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semi-gloss Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Interior ferrous-metal primer.

b. Finish Coats: Interior semi-gloss acrylic enamel.

D. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:

1. Flat Acrylic Finish: Two finish coats. Add fungicidal agent to render fabric mildew proof.

a. Finish Coats: Interior flat latex-emulsion size.

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SECTION 09 93 00

STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes surface preparation and application of wood finishes on the following substrates:

1. Exterior Substrates:
   a. Exposed dimension lumber (rough carpentry).
   b. Dressed lumber (finish carpentry).
2. Interior Substrates:
   a. Dressed lumber (finish carpentry).
   b. Exposed wood panel products.

B. Related Requirements:

1. Division 09 wood flooring Sections for stains and transparent finishes applied to wood flooring.
2. Division 09 Section "Exterior Painting" for standard paint systems on exterior substrates.
3. Division 09 Section "Interior Painting" for stains and transparent finishes on concrete floors.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer’s Literature and Product Data: 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.

C. 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.

D. Sample of identity markers if used.

E. Product List: For each product indicated, include the following:

1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.
3. VOC content.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior stains and finishes applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
2. Shellacs, Clear: VOC not more than 730 g/L.
3. Stains: VOC not more than 250 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.

D. Stain Colors: As indicated in a color schedule.

2.2 INTERIOR WOOD STAINS AND VARNISHES

A. Open-Grain Wood Filler: Factory-formulated paste wood filler applied at spreading rate recommended by manufacturer.

1. MPI#91 Paste, Wood Filler.

B. Interior Wood Stain: Factory-formulated alkyd-based penetrating wood stain for interior

1. MAI#90 Stain, Semi-transparent.

C. Interior Alkyd- or Polyurethane-Based Clear Satin Varnish: Factory-formulated alkyd- or polyurethane-based clear varnish.

1. MPI#57 Varnish, Interior, Polyurethane, Oil Modified, Satin.

2.3 EXTERIOR WOOD STAIN PRODUCTS

A. Solid-Color Water Based Stain: Factory-formulated water based solid-color stain applied at spreading rate recommended by manufacturer.

1. MPI#16 Stain, Exterior, Water Based, Solid Hide.

2.4 SOURCE QUALITYCONTROL

A. Testing of Materials: COTR reserves the right to invoke the following procedure:

1. Contractor's testing agency will perform tests for compliance with product requirements.
2. COTR may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: 13 percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

D. Exterior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Prime edges, ends, faces, undersides, and backsides of wood.
   a. For solid hide stained wood, stain edges and ends after priming.
   b. For varnish coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.
3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

E. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.

2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
3. Sand surfaces that will be exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
   1. Use applicators and techniques suited for finish and substrate indicated.
   2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
   3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD STAIN SCHEDULE

A. Exterior Wood Fencing: Provide the following stain systems on exterior wood fencing:
   1. Solid-Color Water Based Finish: Two stain coats over a primer as recommended by manufacturer.
      a. Primer Coat: As recommended by manufacturer.
      b. Stain Coats: Solid-color water based stain.

3.6 INTERIOR STAIN AND NATURAL-FINISH WOODWORK SCHEDULE

A. Stained Woodwork: Provide the following stained finishes over new interior woodwork:

1. Alkyd-Based Stain Satin-Varnish Finish: Two finish coats of alkyd-based clear satin varnish over a sealer coat and interior wood stain. Wipe wood filler before applying stain.

   a. Filler Coat: Open-grain wood filler.

   b. Stain Coat: Interior wood stain.

   c. Sealer Coat: Clear sanding sealer.

   d. Finish Coats: Interior alkyd- or polyurethane-based clear satin varnish.

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SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies interior signage for room numbers, directional signs, code required signs, telephone identification signs and temporary interior signs.

B. This section also specifies exterior medical center identification signs, building identification signs, parking and traffic signs.

C. Installation of Government furnished dedication plaque and VA seal.

D. Installation of signage is part of the scope of this project.

1.2 RELATED WORK

A. Electrical: Related Electrical Specification Sections.

B. Lighted EXIT signs for egress purposes are specified under Division 26, ELECTRICAL.

1.3 MANUFACTURER'S QUALIFICATIONS

Sign manufacturer shall provide evidence that they regularly and presently manufactures signs similar to those specified in this section as one of their principal products.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Samples: Sign panels and frames, with letters and symbols, each type. Submit 2 sets. One set of samples will be retained by COTR, other returned to Contractor.

1. Sign Panel, 200 mm x 250 mm (8 inches x 10 inches), with letters.
2. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches. Show anticipated range of color and texture.
3. Sample of typeface, arrow and symbols in a typical full size layout.

C. Manufacturer's Literature:

1. Showing the methods and procedures proposed for the concealed anchorage of the signage system to each surface type.
2. Manufacturer’s printed specifications, anchorage details, installation and maintenance instructions.

D. Samples: Sign location plan, showing location, type and total number of signs required.

E. Shop Drawings: Scaled for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.

F. Full size layout patterns for dimensional letters.

1.5 DELIVERY AND STORAGE

A. Deliver materials to job in manufacturer's original sealed containers with brand name marked thereon. Protect materials from damage.

B. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.

C. Deliver signs only when the site and mounting services are ready for installation work to proceed.

D. Store products in dry condition inside enclosed facilities.

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 Society for Testing and Materials (ASTM):

B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate

B221-06.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and tubes.

C. Federal Specifications (Fed Spec):

MIL-PRF-8184F.....Plastic Sheet, Acrylic, Modified.

MIL-P-46144C.....Plastic Sheet, Polycarbonate

1.7 MINIMUM SIGN REQUIREMENTS

A. Permanent Rooms and Spaces:

1. Tactile and Braille Characters, raised minimum 0.793 mm (1/32 in). Characters shall be accompanied by Grade 2 Braille.
2. Type Styles: Characters shall be uppercase, Helvetica Medium, Helvetica Medium Condensed and Helvetica Regular.
3. Character Height: Minimum 16 mm (5/8 in) high, Maximum 50 mm (2 in).
4. Symbols (Pictograms): Equivalent written description shall be placed directly below symbol, outside of symbol's background field. Border dimensions of symbol background shall be minimum 150 mm (6 in) high.
5. Finish and Contrast: Characters and background shall be eggshell, matte or other non-glare finish with adequate contrast with background.

6. Mounting Location and Height: Match existing, unless otherwise specified. Coordinate mounting location and height with COTR prior to mounting. Mount signs on wall adjacent to the latch side of the door and to avoid door swing and protruding objects.

1.8 COLORS AND FINISHES:

PMS #547U Blue B/G w/White Copy.

PART 2 - PRODUCTS

2.1 GENERAL

A. Signs of type, size and design to match existing, unless otherwise specified. Coordinate with VAMC regarding the content of the sign including room numbering system.

B. Signs complete with lettering, framing and related components for a complete installation.

C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.

D. Do not scale drawings for dimensions. Contractor to verify and be responsible for all dimensions and conditions shown by these drawings. COTR to be notified of any discrepancy in drawing, in field directions or conditions, and/or of any changes required for all such construction details.

E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. The Contractor shall further warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

F. Quantity: Provide and install sign on wall adjacent to each interior door in the building, unless otherwise specified.

2.2 PRODUCTS

A. Electrical Signs:

1. General: Furnish and install all lighting, electrical components, fixtures and lamps ready for use in accordance with the sign type drawings, details and specifications.
2. Refer to Electrical Specifications Section, Division 26, ELECTRICAL, to verify line voltages for sign locations that require electrical signs.

3. Quality Control: Installed electrical components and sign installations are to bear the label and certification of Underwriter's Laboratories, Inc., and are to comply with National Electrical Code as well as applicable federal, state and local codes for installation techniques, fabrication methods and general product safety.
4. Ballast and Lighting Fixtures: See Electrical Specifications.

2.3 SIGN STANDARDS

A. General: Match existing. Coordinate with VAMC.

2.4 SIGN TYPES

A. General: All Framed Signs shall have magnetic inserts.
   1. Frame: #640 Radius Corner Satin Silver
   2. Insert Type: Clear Acrylic w/Applied Vinyl Copy
   3. Font Style: Times New Roman
B. Temporary Interior Signs:
   1. Fabricated from 50 kg (110 pound) matte finished white paper cut to 100 mm (4 inch) wide by 300 mm (12 inch) long. Punched 3 mm (.125 inch) hole with edge of hole spaced 13 mm (.5 inch) in from edge and centered on 100 mm (4 inch) side. Reinforce hole on both sides with suitable material that prevents tie form pulling through hole. Ties are steel wire 0.3 mm (0.120 inch) thick attached to tag with twist leaving 150 mm (6 inch) long free ends.
   2. Mark architectural room number on sign, with broad felt marker in clearly legible numbers or letters that identify room, corridor or space as shown on floor plans.
   3. Install temporary signs to all rooms that have a room, corridor or space number. Attach to door frame, door knob or door pull.
      a. Doors that do not require signs are: corridor doors in corridor with same number, folding doors or partitions, toilet doors, bathroom doors within and between rooms, closet doors within rooms, communicating doors in partitions between rooms with corridor entrance doors.
      b. Replace and missing damaged or illegible signs.

2.5 FABRICATION

A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.

B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.
D. Contact surfaces of connected members be true. Assembled so joints will be tight and practically unnoticeable, without use of filling compound.
E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces be smooth flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.
F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth su1rfaces.
G. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.
H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.
I. Finish hollow signs with matching material on all faces, tops, bottoms and ends. Edge joints tightly mitered to give appearance of solid material.
J. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.
K. Movable parts, including hardware, are be cleaned and adjusted to operate as designed without binding of deformation of members. Doors and covers centered in opening or frame. All contact surfaces fit tight and even without forcing or warping components.
L. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
M. No signs are to be manufactured until final sign message schedule and location review has been completed by the COTR & forwarded to contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Protect products against damage during field handling and installation. Protect adjacent existing and newly placed construction, landscaping and finishes as necessary to prevent damage during installation. Paint and touch up any exposed fasteners and connecting hardware to match color and finish of surrounding surface.

B. Mount signs in proper alignment, level and plumb according to the sign location plan and the dimensions given on elevation and sign location drawings. Where otherwise not dimensioned, signs shall be installed where best suited to provide a consistent appearance throughout the project. When exact position, angle, height or location is in doubt, contact COTR for clarification.

C. Contractor shall be responsible for all signs that are damaged, lost or stolen while materials are on the job site and up until the completion and final acceptance of the job.

D. Remove or correct signs or installation work COTR determines as unsafe or as an unsafe condition.

E. At completion of sign installation, clean exposed sign surfaces. Clean and repair any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.

F. Certain signs may be installed on glass. A blank glass back up is required to be placed on opposite side of glass exactly behind sign being installed. This blank glass back up is to be the same size as sign being installed.

G. Contractor will be responsible for verifying that behind each sign location there are no utility lines that will be affected by installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.

H. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.

3.2 INTERIOR SIGNAGE SCHEDULE

A. Before ordering, verify signage schedule with COTR. Do not order signage until COTR has approved room names, numbers, and types.

ROOM		ROOM

NO.	NAME		NO.	NAME
103-86	Hospice Coordinator		177-86	Inpatient Equipment Storage
104-86	Team Report / Conference		178-86	IT Room
105-86	Nurse Manager		179-86	Family Laundry
107-86	Team Breakroom		182-86	Team Station (2 signs)
108-86	Swing Office		183-86	Dictation
109-86	Ante Room / Bariatric Isolation Room		184-86	Office Supply Storage
115-86	Patient Room		185-86	Team Copy / Work Room
119-86	Patient Room		186-86	Conference / Counseling
122-86	Family Lounge		187-86	Nourishment (2 signs)
123-86	Screened Porch		188-86	Med Prep
126-86	Patient Room		189-86	Staff Toilet
131-86	Patient Room		190-86	Office / Storage
136-86	Patient Room		191-86	Central Supply
138-86	Vending / Kitchenette		192-86	Electrical Room
139-86	Family Shower		193-86	Electrical Room
141-86	Housekeeping		194-86	Children's Counseling
142-86	Family Lounge		195-86	Equipment Clean-Up
143-86	Porch		196-86	Biohazard Storage
144-86	Oxygen Storage		201-86	Men's Toilet
145-86	Soiled Utility		202-86	Women's Toilet
146-86	Clean Linen		203-86	Medical Director
147-86	Patient Gurney Shower		204-86	Chapel
149-86	Patient Room		205-86	Mechanical Room
154-86	Patient Room		207-86	Patient Drop-Off / Pick-Up
158-86	Patient Room		208-86	Connector
162-86	Screened Porch			
163-86	Family Lounge		301-86	Porch
165-86	Patient Room		302-86	Porch
169-86	Patient Room		303-86	Patient Drop-Off / Pick-Up
174-86	Ante Room / Isolation Room		304-86	Connector

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SECTION 10 21 13

TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies metal toilet partitions and entrance screens.

1.2 RELATED WORK

A. Overhead structural steel supports for ceiling hung pilasters: Section 05 50 00, METAL FABRICATIONS.

B. Grab bars and toilet tissue holders: Section 10 28 00, TOILET, BATH, AND LAUNDRY ACCESSORIES.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples: Prime coat of paint on 150 mm (six-inch) square of metal panel with baked enamel finish coat over half of panel.

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.

E. Manufacturer's certificate, attesting that zinc-coatings conform to specified requirements.

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. Federal Specifications (Fed. Spec.):

FF-B-575C.....Bolt, Hexagon and Square

C. Code of Federal Regulations (CFR):

40 CFR 247.....Comprehensive Procurement Guidelines for Products Containing Recovered Materials

D. Commercial Item Descriptions (CID):

A-A-1925.....Shield, Expansion (Nail Anchors)

A-A-60003.....Partitions, Toilet, Complete

E. **American Society for Testing and Materials** (ASTM):

ASTM A666 – 03.....Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

ASTM A743/A743M – 06....Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application

ASTM A879/A879M – 06....Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

PART 2 - PRODUCTS

2.1 FABRICATION

A. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.

1. Electrolytically Zinc Coated: ASTM A879/A 879M, 01Z (03G).

B. Stainless-Steel Sheet: ASTM A666, Type 304, stretcher-leveled standard of flatness.

C. Stainless-Steel Castings: ASTM A743/A 743M.

D. Conform to Fed. CID A-A-60003, except as modified herein.

E. Fabricate to dimensions shown or specified.

F. Toilet Enclosures:

1. Type 1, Style B (Ceiling hung).
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.
   b. Combined with rubber bumper stop.
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 (baked enamel) on steel doors, pilasters, and enclosure panels except those adjacent to urinals and as specified.

1) Color: As selected by Architect from manufacturer's full range.

G. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Provide with no-sightline system. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 25 mm (1 inch)for doors and panels and 32 mm (1-1/4 inches) for pilasters.

2. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

H. Facing Sheets and Closures: Electrolytically coated steel sheet with nominal base-metal (uncoated) thicknesses as follows:

1. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 1.21 mm (0.048 inch).

2. Panels: Manufacturer's standard thickness, but not less than 0.91 mm

(0.036 inch).

3. Doors: Manufacturer's standard thickness, but not less than 0.76 mm (0.030 inch).

I. Pilaster Sleeves (Caps): Stainless-steel sheet, not less than 0.79 MM (0.031 inch)nominal thickness and 76 MM (3 inches) high, finished to match hardware.

J. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets; stainless steel.

K. Ceiling-Hung Units: Provide manufacturer’s standard corrosion-resistant anchoring assemblies with leveling adjustments nuts at pilasters for connection to structural support above finished ceiling. Provide

assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

L. Door Size and Swings: Unless otherwise indicated, provide 610 mm (24 inch) wide, inswining doors for standard toilet compartments and 914mm (36 inch) wide, outswinging doors with a minimum 813 mm (32 inch) wide, clear opening for compartments designated as accessible.

M. Room Entrance Screens:

1. Type II, Style B, (ceiling hung.
2. Self-closing doors swinging into the toilet room.
3. Provide door pull on pull side and flat stainless steel push plate 250 mm by 70 mm (10 inches by 2-3/4 inches) with beveled ground edges, locate 1200 mm (four feet) above floor.
4. Provide door stop with rubber bumper on pilaster opposite pull.
5. Where doors open against wall, provide rubber tipped bumpers having a three inch projection, at point of contact of top edge of door.
6. Finish the same as toilet enclosures.

2.2 FASTENERS

A. Use stainless steel fasteners, unless otherwise specified.

B. Partition Fasteners: CID A-A-60003.

C. Use expansion bolts, CID A-A-60003, for anchoring to solid masonry or concrete.

D. Use toggle bolts, CID A-A-60003, for anchoring to hollow masonry or stud framed walls.

E. Use steel bolts FS-B-575, for anchoring pilasters to overhead steel supports.

2.3 ACCESSORIES

A. Hinges: Manufacturer’s standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.

B. Coat Hook: Manufacturer’s standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.

C. Door Bumper: Manufacturer’s standard rubber-tipped bumper at out-swinging doors.

D. Door Pull: Manufacturer’s standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

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.
6. Maximum Clearances:
   a. Pilasters and Panels: 13 mm (1/2inch).
   b. Panels and Walls: 25 mm (1 inhc).

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.

C. Ceiling-Hung Units: Secure pialsters to supporting structure and level, plumb, and tighten. Hand doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer’s written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

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SECTION 10 21 23

CUBICLE CURTAIN TRACKS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies cubicle curtain track (C.C.T.).

1.2 RELATED WORK

Steel shapes for suspending track assembly: Section 09 51 00, ACOUSTICAL CEILINGS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples:

One 300 mm (12 inch) long piece of cubicle curtain track with carrier access and end stop.

One clip anchor for fastening track to grid system of acoustical ceilings. One curtain carrier.

C. Shop Drawings: Showing layout of tracks and method of anchorage.

D. Manufacturer's Literature and Data:

Cubicle curtain track.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver material in original package marked to identify the contents, brand name, and the name of the manufacturer or supplier.

B. Store in dry and protected location. Store so as to not bend or warp the tracks.

C. Do not open packages until contents are needed for installation, unless verification inspection is required.

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):

B221-06.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

B456-03.....Electrodeposited Coatings for Copper Plus Nickel Plus Chromium and Nickel Plus Chromium

C. The National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500 Series.....Metal Finishes Manual

PART 2 - PRODUCTS

2.1 CUBICLE CURTAIN TRACKS

A. Surface mounted :

1. Channel Tracks (Surface Mounted Type): Extruded aluminum, ASTM B221, alloy 6063, temper T5 or T6, channel shaped, with smooth inside raceway for curtain carriers.

B. Curtain Carriers: Nylon carriers, with either nylon wheels on metal, nylon axles. Equip each carrier with either stainless steel, chromium plated brass or steel hooks with swivel, or nickel chromium plated brass or stainless steel bead chain and hook assembly. Hook for bead chain may be the same material and finish as the bead chain or may be chromium plated steel. Provide 2.2 carriers for every 300 mm (onefoot) of each section of each track length, plus one additional carrier.

C. End Stop Connectors, Ceiling Flanges and Other Accessories: Fabricate from the same material with the same finish as the tracks or from nylon.

D. Hangers and Fittings: Fabricate from the same material with the same finish as the tracks. Hangers may be round or square for channel tracks. Design fittings to be compatible with design of tracks and to safely transmit the track load to the hangers.

E. At end of each section of track, make provision for insertion and removal of carriers. Design to prevent accidental removal of carrier. Any operating mechanism shall be removable with common tools.

2.3 FASTENERS

A. Exposed Fasteners, Screws and Bolts: Stainless steel or chromium/nickel plated brass.

B. Concealed Fasteners, Screws and Bolts: Hot-dip galvanized (except in high moisture areas use stainless steel).

C. Metal Clips: Anchor curtain tracks to exposed grid of lay-in acoustical tile ceilings, with concealed metal (butterfly) type or two piece snap locking type ceiling clip of high strength spring steel. When it is not possible to install the metal ceiling clip, the cubicle curtain track may be screwed to the ceiling grid.

2.4 FINISHES

A. Aluminum: Chemically etched medium matte, with clear anodic coating, Class II Architectural, 0.4 mils thick.

B. Chrome/Nickel Plating: Satin or polished finish as specified, ASTM B546, minimum thickness of chromium plate as follows:

1. 0.2 mil on copper alloys.
2. 0.4 mil on steel.

C. Stainless Steel: No. 4 in accordance with NAAMM Metal Finishes Manual.

2.5 FABRICATION

A. Weld and grind smooth joints of fabricated components.

B. Form tracks and bends of lengths that will produce the minimum number of joints. Make track sections up to 4800 mm (16 feet) without joints. Form corner bend on a 300 mm (12 inch) radius.

C. Provide steel anchor plates, supports, and anchors for securing components to building construction.

D. Form flat surface without distortion.

E. Shop assemble components and package complete with anchors and fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install tracks after finish painting and ceiling finishing operations are complete.

B. Install track level and hangers plumb and securely anchor to the ceiling or suspend from above to form a rigid installation.

C. Anchor surface mounted curtain tracks directly to exposed grid of lay-in acoustical tile ceilings with suitable fasteners, spaced approximately 600 mm (24 inches) on center.

D. Anchor surface mounted curtain tracks to concrete, plaster and gypsum board ceilings with a minimum of 3 mm (1/8-inch) diameter fastenings or concealed clips spaced not more than 900 mm (three feet) on center.

E. Securely fasten end stop caps to prevent their being forced out by the striking weight of carriers.

F. Remove damaged or defective components and replace with new components or repair to the original condition.

3.2 ACCEPTANCE

A. Track shall be installed neat, rigid, plumb, level and true, and securely anchored to the overhead construction.

B. Carrier units shall operate smoothly and easily over the full range of travel.

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SECTION 10 26 00

WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies wall guards (crash rails or bumper guards), handrails, and corner guards.

1.2 RELATED WORK

A. Armor plates and kick plates not specified in this section: Section 08 71 00, DOOR HARDWARE.

B. Color and texture of aluminum and resilient material: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: Show design and installation details.

C. Manufacturer's Literature and Data:

1. Handrail/Wall Guard Combinations.
2. Wall Guards.
3. Corner Guards.

D. Test Report: Showing that resilient material complies with specified fire and safety code requirements.

1.4 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.

1.5 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 Society for Testing and Materials (ASTM):

A167-99(R2004).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

B221-07.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

D256-06.....Impact Resistance of Plastics

D543-06.....Standard Practices for Evaluating the Resistance of Plastics to Chemical ReagentsD635-06 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

E84-07.....Surface Burning Characteristics of Building Materials

G 21-09 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to FungiC. The National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500 Series.....Metal Finishes Manual

D. National Fire Protection Association (NFPA):

80-06.....Standard for Fire Doors and Windows

E. Society of American Automotive Engineers (SAE):

J 1545-05.....Instrumental Color Difference Measurement for Exterior Finishes.

F. Underwriters Laboratories Inc. (UL):

Annual Issue.....Building Materials Directory

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide wall and door protection system components with UL label indicating that they are identical to those tested in accordance with ASTM E84 for Class 1 characteristics listed below.

1. Flame Spread: 25 or less.
2. Smoke developed: 450 or less.

B. Stainless Steel: ASTM A167, Type 302B.

C. Aluminum Extruded: ASTM B221, Alloy 6063, Temper T5 or T6. Aluminum alloy used for colored anodizing coating shall be as required to produce specified color.

D. Resilient Material:

1. Extruded and injection molded acrylic vinyl or extruded polyvinyl chloride meeting following requirements:

a. Minimum impact resistance of 1197 ps (25 ft lbs per sq.ft) when tested in accordance with ASTM D256 (Izod impact, ft.lbs. per inch notch).

b. Class 1 fire rating when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less.
c. Rated self extinguishing when tested in accordance with ASTM D635.
d. Material shall be labeled and tested by Underwriters Laboratories or other approved independent testing laboratory.
e. Integral color with all colored components matched in accordance with SAE J 1545 to within plus or minus 1.0 on the CIE-LCH scales.
f. Same finish on exposed surfaces.

E. Provide wall and door protection system that do not support fungal or bacterial growth as tested in accordance with ASTM G-21.

F. Provide wall and door protection system with self-extinguishing characteristics tested in accordance with ASTM D-635.

2.2 CORNER GUARDS

A. Resilient, Shock-Absorbing Corner Guards: Surface mounted type of 6 mm 1/4-inch corner. Color as selected by the Architect from manufacturer's full range.

1. Vinyl/Acrylic: Extruded material shall be high impact resistant, stain and chemical resistant with pebblette grain texture, normal 1.98 mm (0.78 inch) thick. Surface mounted guards consisting of a continuous extruded aluminum retainer with snap-on cover. Color matched end caps to be provided for partial height application. Attachment hardware shall be appropriate for wall construction.
2. Aluminum Retainers: Extruded aluminum retainers shall be 6063-T6 Alloy, nominal 1.57mm (0.062 inch) thick. Minimum strength and durability properties as specified in ASTM B221.
3. Fasteners: Non-corrosive and compatible with aluminum retainers and supplied by the manufacturer.

2.3 BUMPER GUARDS

A. Vinyl/Acrylic: Extruded material shall be high impact resistant, stain and chemical resistant with pebblette grain texture, normal 1.98 mm (0.78 inch) thick. Vinyl/Acrylic guard shall be securely snapped in place over the continuous aluminum retainer mounted on bumper cushions. End caps shall be mechanically fastened with concealed fasteners. Color matched end caps and corners to be removable for ease of

replacement. Attachment hardware shall be appropriate for wall construction.

B. Aluminum Retainers: Extruded aluminum retainers shall be 6063-T6 Alloy, nominal 1.83mm (0.072 inch) thick. Minimum strength and durability properties as specified in ASTM B221.

C. Fasteners: Non-corrosive and compatible with aluminum retainers and supplied by the manufacturer.

D. Color as selected by the Architect from manufacturer’s full range.

2.4 HANDRAILS

A. Vinyl/Acrylic: Extruded material shall be high impact resistant, stain and chemical resistant with a simulated wood grain. The surface finish shall be repairable in the field following manufacturer’s repair procedures so that there is no discernible damage. Vinyl film wraps and surface printing methods strictly prohibited. Handrail to be round Round Style with 1 3/8 inch diameter polymer extrusions.

1. Wood Grain Pattern/color: As selected by the Architect from manufacturer’s full range.
2. Mounting brackets to be manufactured with wood grained polymer to match rail.
3. Thickness: 1.98 mm (0.98 inch) thick.

B. Fasteners: Non-corrosive and compatible with rail and supplied by the manufacturer.

2.6 FASTENERS AND ANCHORS

A. Provide fasteners and anchors as required for each specific type of installation.

B. Where type, size, spacing or method of fastening is not shown or specified, submit shop drawings showing proposed installation details.

2.7 FINISH

A. In accordance with NAAMM AMP 500 series.

B. Resilient Material: Embossed texture and color in accordance with SAE J 1545, unless otherwise specified.

PART 3 - INSTALLATION

3.1 CORNER GUARDS

A. Install corner guards on walls in accordance with manufacturer's instructions.

B. Where corner guards are installed on gypsum board, clean surface and anchor guards with a neoprene solvent-type contact adhesive specifically manufactured for use on gypsum board construction. Remove

excess adhesive from around edge of guard and allow to cure undisturbed for 24 hours.

3.3 HANDRAIL AND BUMPER GUARDS

A. During frame up, install backer in framing for handrail and bumper guards to secure to.

B. Secure guards to walls with mounting cushions or brackets and fasteners in accordance with manufacturer's details and instructions.

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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 toilets, baths, locker rooms and at sinks in related spaces. See drawings for locations.

B. Items Specified:

TA1 Surface Mounted Paper Towel Dispenser.

TA1A Surface Mounted Paper Towel Dispenser.

TA2 Surface Mounted Waste Receptacle.

TA3 Recessed Paper Towel Dispenser and Waste Receptacle Combination Unit.

TA4 Recessed Paper Towel Dispenser and Waste Receptacle Combination Unit.

TA4A Semi-recessed Paper Towel Dispenser and Waste Receptacle Combination Unit.

TA15 Recessed Multi-Roll Toilet Tissue Dispenser.

TA20 Stainless Steel Framed Mirror.

TA21 Surface Mounted Soap Dispenser.

TA23 Lavatory Mounted Soap Dispenser.

TA27 Heavy Duty Stainless Steel Shower Curtain Rod.

TA27A Vinyl Shower Curtain.

TA27B Vinyl Shower Curtain.

TA28 Stainless Steel Shower Curtain Hooks.

TA31 Custodial Shelf with Mop & Broom Holders and Rag Hook.

TA33B 24 inch Towel Bar.

TA34 Lavatory Mounted Soap Dispenser.

TA36 IV Prep Hook.

TA50 Infant Changing Station.

TA52 Partition Mounted Dual Napkin Disposal and Roll toilet Tissue Dispenser.

TA53 Recessed Sanitary Napkin Disposal and Toilet Tissue Dispenser.

1. TA56 Heavy Duty Robe Hook.

C. Grab Bar Legend:

GB3 24 inch length

GB5 36 inch length

GB6 42 inch length

GB7 48 inch length

1.2 RELATED WORK

A. Furring, blocking, and shims required for installing metal lockers and concealed within other construction before toilet and bath accessory installation: Section 06 10 00, ROUGH CARPENTRY

B. Color of finishes: Section 09 06 00, SCHEDULE FOR FINISHES

C. Shower curtain break away pendant chain hooks: Section 10 21 23, CUBICLE CURTAIN TRACKS.

D. Color of vinyl fabric: Section 09 06 00, SCHEDULE FOR FINISHES.

E. Manufactured toilet and bath accessories: Section 10 28 00, TOILET, BATH, AND LAUNDRY ACCESSORIES.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:

1. Each product specified.
2. Paper towel dispenser and combination dispenser and disposal units.
3. Metal framed mirrors, showing 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.

C. Samples:

1. One of each type of accessory specified.
2. After approval, samples may be used in the work.

D. Manufacturer's Literature and Data:

1. All accessories specified.
2. Show type of material, gauges 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.

E. 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.

1.4 QUALITY ASSURANCE

A. 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.

B. Each accessory type shall be the same and be made by the same manufacturer.

C. Each accessory shall be assembled to the greatest extent possible before delivery to the site.

D. 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 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

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. American Society for Testing and Materials (ASTM):

A167-99(R2004).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

A176-99(R2004).....Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip

A269-07.....Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A312/A312M-06.....Seamless and Welded Austenitic Stainless Steel Pipes

A653/A653M-07.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

B456-03.....Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium

C1036-06.....Flat Glass

C1048-04.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass

F446-85 (R2004).....Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area.

A269-07.....Seamless and Welded Austenitic Stainless Steel Tubing for General Service

C. The National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500 Series.....Metal Finishes Manual

AMP 500-505-88.....Metal Finishes Manual and Finishes for Stainless Steel

D. American Welding Society (AWS):

D10.4-86 (R2000).....Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing

E. Federal Specifications (Fed. Specs.):

A-A-3002.....Mirrors, Glass

FF-S-107C (2).....Screw, Tapping and Drive

FF-S-107C.....Screw, Tapping and Drive.

WW-P-541E(1).....Plumbing Fixtures (Accessories, Land Use) Detail Specification

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel:

1. Plate or sheet: ASTM A167, Type 304, 0.0312-inch (22 guage) thick unless otherwise specified.
2. Tube: ASTM A269, Alloy Type 304.

B. Stainless Steel Tubing: ASTM A269, Grade 304, seamless or welded.

C. Stainless Steel Pipe: ASTM A312; Grade TP 304.

D. Steel Sheet: ASTM A653, zinc-coated (galvanized) coating designation G90.

E. Glass:

1. ASTM C1036, Type 1, Class 1, Quality q2, for mirrors.

F. Foam Rubber: ASTM D3453, Grade BD, Type 2.

G. Plywood: PS1, Grade CD.

2.2 FASTENERS

A. Exposed Fasteners: Stainless steel or chromium plated brass, finish to match adjacent surface.

B. Concealed Fasteners: Steel, hot-dip galvanized (except in high moisture areas such as showers or bath tubs use stainless steel).

C. Toggle Bolts: For use in hollow masonry or frame construction.

D. Hex bolts: For through bolting on thin panels.

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 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. Hot-dip galvanized steel, except stainless steel, anchors and fastening devices.

G. Shop assemble accessories and package with all components, anchors, fittings, fasteners and keys.

H. Key items alike.

I. Provide templates and rough-in measurements as required.

J. Round and deburr edges of sheets to remove sharp edges.

K. General: Only an unobtrusive stamped logo of manufacturer, as approved by Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by means of either a printed, water

proof label or a stamped nameplate, indicating manufacturer’s name and product model number.

L. General: No names or labels are permitted on exposed faces or toilet and bath accessory units. On either interior surface not exposed to view or on back surface, provide identification of each accessory item by either a printed, waterproof label or a stamped nameplate indicating manufacturer’s name and product model number.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before starting work notify the COTR in writing of any conflicts detrimental to installation or operation of units.

B. Verify with the COTR the exact location of accessories.

C. Before ordering accessories, especially paper towel and soap dispenser, check with COTR for items that work with facility’s EMS supply.

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.

3.3 SCHEDULE OF ACCESSORIES

TA1 Surface Mounted Paper Towel Dispenser:

Constructed of 22 gauge, type 304 stainless steel with satin finish. Dispenser shall provide a capacity of 400 C – fold or 525 multi-fold paper towels without adjustments or adapters. Door

shall have full length stainless steel piano hinge and tumbler lock. Unit to be 10 ¾" wide by 14" high by 4" deep.

TA1A Surface Mounted Paper Towel Dispenser:

Constructed of 22 gauge, type 304 stainless steel with satin finish. Dispenser shall provide a capacity of 200 C – fold or 275 multi-fold paper towels without adjustments or adapters. Door shall have full length stainless steel piano hinge and tumbler lock. Unit to be 10¾" wide 7 1/8" high, 4" deep. Verify with COTR before purchase.

TA2 Surface Mounted Waste Receptacle:

Constructed of 22 gauge, type 304 stainless steel with satin finish and with a capacity of 20-gal (75.7 l). Receptacle shall be equipped with four interior hooks, have reinforced mounting screw holes, and shall be furnished with a removable heavy-guage vinyl liner.

TA3 Recessed Paper Towel Dispenser and Waste Receptacle Combination Unit:

Constructed of 22 gauge, type 304 stainless steel with satin finish. Dispenser shall provide a capacity of 600 C – fold or 800 multi – fold paper towels without adjustments or adapters. Doors to have full length stainless steel piano hinges and tumbler lock. Removable stainless steel waste receptacle shall have bottom edges hemmed and shall be locked into the cabinet with tumbler lock, and have a minimum capacity of 12 gal. (45.5 L). Unit shall fit rough wall opening of 4" deep. Unit to be 17 3/16" wide by 56" high by 3/16" deep. Verify with COTR before purchase.

TA4 Recessed Paper Towel Dispenser and Waste Receptacle Combination Unit:

Constructed of 22 gauge type 304 stainless steel with satin finish. Dispenser shall provide a capacity of 350 C-fold or 475 multi-fold towels. Doors to have full-length stainless steel piano-hinge, and equipped with a knob latch. Removable stainless steel waste receptacle shall be retained in cabinet by a friction catch, have top edges hemmed for safe handling, and shall have a minimum capacity of 2 gal. Unit shall fit rough wall opening of 4" deep. Unit to be 14" wide by 28" high by 3/16" deep. Verify with COTR before purchase

TA4A Semi-recessed Paper Towel Dispenser and Waste Receptacle Combination Unit:

Constructed of 22 gauge type 304 stainless steel with satin finish. Dispenser shall provide a capacity of 350 C-fold or 475 multi-fold towels. Doors to have full-length stainless steel piano-hinge, and equipped with a knob latch. Removable stainless steel waste receptacle shall be retained in cabinet by a friction catch, have top edges hemmed for safe handling, and shall have a minimum capacity of 2 gal. Unit shall fit rough wall opening of 4” deep. Unit to be 14” wide by 28” high by 3/16” deep. Unit to be semi-recessed into wall by using manufacturer’s compatible 2” skirt. Verify with COTR before purchase.

TA15 Recessed Multi-Roll Toilet Tissue Dispenser:

Constructed of 22 gauge, type 304 stainless steel, welded construction, with exposed surfaces stain finished. Doors shall have tumbler lock. Flanges shall be one-piece seamless construction. Unit shall dispense 2 standard toilet tissue rolls, up to 5 ¼” diameter, (1800 sheets). Spare roll shall automatically drop into place after bottom roll is used up. Unit to be 6 1/16” wide by 12 ½” high by 2 ¾” deep overall.

TA20 Stainless Steel Framed Mirror:

Sizes as indicated. Mirror shall be framed with one-piece stainless steel channel (1/2” x 1/2" x 3/8”) with 90 degree mitered corners. All exposed surfaces shall have polished finish. No. 1 quality ¼” (6 mm) float/plate glass mirror shall be guaranteed 10 years against silver spoilage. Edges and back shall be protected by shock-absorbing padding. Galvanized steel back shall have integral horizontal hanging brackets for mounting on concealed wall hanger(s), and be secured with concealed Phillips head screws in lower frame.

TA21 Surface Mounted Soap Dispenser:

Container body and back constructed of type 304 stainless steel, satin finish. To dispense lotion soaps, synthetic detergents and antiseptic solutions. Capacity 40 oz., with unbreakable refill window, concealed wall fastening, large locked hinged stainless steel filler top. Unit to be vandal resistant. Unit to be 8 1/8” wide by 4 3/4" high by 3 1/2” deep overall. Verify with COTR before purchase.

TA23 Lavatory Mounted Soap Dispenser:

Dispenser shall dispense synthetic detergents, viscous lotion soaps, antiseptic solutions and vegetable oil base liquid soaps. Piston and 4” spout assembly shall be 300 series stainless steel. 6” spout shall route 360 degrees without damage to valve mechanism. Cover shall lock to body with concealed locking mechanism opened only with a special key provided. Piston, 6” spout and supply tube assembly shall be removable from top for top filling and maintenance. Valve shall have ABS cylinder and Buna N O-ring seals and duckbills. Shank shall accommodate mounting thickness up to 4”. Translucent, unbreakable polyethylene container shall have a capacity of 20 fl. oz. Verify with COTR before purchase.

TA27 Heavy Duty Stainless Steel Shower Curtain Rod:

Provide with rod 20 gauge, 1” diameter type 304 stainless steel, satin finish, with matching flange. Length as required.

TA27 A Vinyl Shower Curtain:

Opaque, matte white vinyl .008” (0.2mm) thick with nickel-plated brass grommets along top, one every 6”. Bottom and sides shall be hemmed.

TA27B Vinyl Shower Curtain:

Opaque, matte white vinyl .008” (0.2mm) thick with nickel-brass grommets along top, one every 6”. Bottom and sides shall be hemmed.

TA31 Custodial Shelf with Mop and Broom Holders and Rag Hooks:

Constructed of type 304 stainless steel with satin finish. The shelf shall be 18 gauge stainless steel, with 1 ½” return edges and front edge shall be hemmed. Mounting brackets, welded to shelf, shall be 18 gauge stainless steel with satin finish. Unit shall be 36” in length, 8” deep, with 4 spring-loaded, rubber cam holders, 3 rag hooks.

TA33B 24 inch Towel Bar:

Stainless steel towel bar. 1” diameter bar, 18 gauge, type 304 stainless steel, satin finish, concealed mounting plate. 24 inch length.

TA34 Lavatory Mounted Soap Dispenser:

With 4” spout. Corrosion resistant valve dispenses liquid soaps, lotions, and detergents. Valve operates with less than 5lb of

force, spout rotates 360 degrees without damage to valve mechanism, cover locks to body with concealed locking mechanism opened only with special key provided. Piston spout and supply tube assembly removable after unlocking for top filling and maintenance. Type 304 stainless steel. 34oz. polyethylene container with molded plastic shank for 4” or 1” maximum mounting thickness (as needed for installation location), 4” spout length.

TA36 IV Prep Hook:

Double wardrobe hook. Compact durable hook. Chromium Plated cast brass 1 1/3”H x 1 ¼ W x 1” projection. Packed with screws. Finish: BHMA 626.

TA50 Infant Changing Station:

Material: FDA approved, high impact polyethylene with Microban Antimicrobial additive & with heavy duty nylon safety straps.

Signage: Graphic step-by step safety instructions. Door display stickers.

Operation: Easily opened and closed with one hand. No sharp corners. Easily cleaned with standard commercial cleaners. Accessible from three sides.

Construction: 11 gauge steel mounting plates. Gas shock mechanism for safe open/close motions. Complies with ASTM Static load performance when properly installed. Concealed, reinforced, full-length. Steel-on-steel hinges. Optional lock. 36”W x 20”H x 4” extension.

Dispenser: sanitary liner dispenser, built-in.

TA52 Partition Mounted Dual Napkin Disposal and Roll Toilet Tissue Dispenser:

Constructed of 18-8, type 304, 22 gauge stainless steel, welded construction, with exposed surfaces satin finished. Door shall have tumbler lock. Flanges shall be on-piece seamless construction. Unit shall dispense 4 standard toilet tissue rolls, two for each compartments. Unit shall mount in toilet partitions and serve two toilet compartments. Napkin disposal shall have self-closing push doors attached to cabinet with full length welded stainless steel piano hinges. Toilet tissue spindles to be theft resistant. Unit to be 17 1/8” wide by 20” high by 4 1/4" deep overall.

TA53 Recessed Sanitary Napkin Disposal and Toilet Tissue Dispenser:

Constructed of 22 gauge, type 304 stainless steel, welded construction, with exposed surfaces satin finished. Doors shall have tumbler lock. Flanges shall be one-piece seamless construction. Unit shall dispense 2 standard toilet tissue rolls, up to 5 ¼" diameter, (1800 sheets). Toilet tissue spindles to be theft-resistant. Spare roll shall automatically drop into place after bottom roll is used up. Unit to be 17 3/16" wide by 12 ¾" high by 4 ¼" deep overall.

TA56 Surface Mounted Robe Hook: Type-304 stainless steel with satin finish. Flange and support arm shall be 22 gauge (0.8mm) and equipped with a concealed, 18-gauge (1.2mm) mounting bracket that is secured to a concealed, 19-gauge (1.0mm) wall plate with a stainless steel setscrew. Cap shall be 14 gauge (2.0mm), welded to the support arm. Manufacturer's service and parts manual shall be provided to the building owner upon completion of project.

3.4 GRAB BAR DATA

PART 4 - A. Length and style as indicated, constructed of type 304 satin finish stainless steel with peened gripping surface. It shall have wall thickness of 18 gauge and outside diameter of 1 ½-inch. Distance from inside of grab bar to finished wall shall be 1 ½-inch. Flanges shall be 22 gauge stainless steel, 3 ¼-inch diameter and each shall have 4 stainless steel set screws. Ends of grab bar shall pass thru concealed mounting flanges and be heliarc welded to form one structural unit.

3.5 CLEANING

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

This section covers semi-recessed fire extinguisher cabinets.

1.2 RELATED WORK

A. Glazing: Section 08 80 00, GLAZING.

B. Field 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. Manufacturer's Literature and Data: Fire extinguisher cabinet including installation instruction and rough opening required.

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 the basic designation only.

B. American Society of Testing and Materials (ASTM):

ASTM A1008/A1008M.....Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

ASTM E814.....Standard Test Method for Fire Tests of Penetration Firestop Systems

D4802-02 Poly (Methyl Methacrylate) Acrylic Plastic SheetC.

National Fire Protection Association (NFPA):

NFPA 70.....National Electrical Code

1.5 QUALITY ASSURANCE

A. Fire Extinguisher Cabinets: Listed and labeled to comply with requirements in ASTM E 814.

B. 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.

C. Source Limitations: Obtain fire-protection cabinets through one source from a single manufacturer, unless otherwise specified.

1.6 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers are accommodated; coordinate with COTR for fire extinguishers requirements.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHER CABINET

Semi-recessed type.

2.2 FABRICATION

A. Form body of cabinet from 0.9 mm (0.0359 inch) thick sheet steel.

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

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 3 mm (1/8 inch) thick ASTM C1048, Kind FT, Condition A, Type I, Quality Q3, Class 1 (clear). 2. Design doors to open 180 degrees.

3. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

a. Provide projecting lever handle with cam-action latch.

b. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

4. Door Style: Vertical duo panel with frame.

2.3 ACCESSORIES

A. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

B. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.

C. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.

D. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by COTR/Architect.

1. Identify fire extinguisher in fire protection cabinet with the words

"FIRE EXTINGUISHER". Coordinate with COTR.

2. Application Process: Pressure-sensitive vinyl letters.
3. Lettering Color: Match existing. Coordinate with COTR.
4. Orientation: Match existing. Coordinate with COTR.

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.

C. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

D. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

1. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
2. Color and Gloss: As selected by Architect from manufacturer's full range.

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, unless otherwise specified.

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SECTION 10 73 00

ALUMINUM PROTECTIVE COVER SYSTEM

PART 1 - GENERAL

1.1 Related Documents

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-I Specification Sections, shall apply to work specified in this Section.

1.2 General Description of Work

A. Work in this section shall include design, fabrication and installation of complete welded, extruded aluminum protective cover system. All work shall be in complete accordance with the drawings and this specification.

1.3 References

A. Aluminum Design Manual 2000, Specifications & Guidleines for Aluminum Structures.

B. ASCE 7, Minimum Design Loads for Buildings and Other Structures.

C. American Architectural Manufacturers Association (AAMA)

D. American Society for Testing and Materials (ASTM)

1.4 Related Sections

A. Cast In Place Concrete 03 30 00

B. Unit Masonry 04 20 00

D. Flashing and Sheet Metal 07 60 00

E. Joint Sealants 07 92 00

1.5 Submittals

A. Product Data: Submit manufacturer's product information, specifications and installation instructions for building components and accessories.

B. Shop Drawings: Submit complete shop drawings including all necessary plan dimensions, elevations and details. General Contractor shall verify all dimensions and provide elevations at each column, finish floor, and related soffit before releasing to manufacturer for fabrication.

C. Certification: Submit design calculations signed by a Registered

Professional Engineer, licensed in the project state. Design calculations shall state that the protective cover system design complies with the wind requirements of ASCE 7-95, the stability criteria of applicable building code, and all other governing criteria.

1.6 Quality Assurance

A. Protective Cover shall be wholly produced by a recognized manufacturer with at least five years experience in the design and fabrication of extruded aluminum walkway cover systems. Components shall be assembled in shop to greatest extent possible to minimize field assembly. Protective cover shall be installed by manufacturer. Third party installation is not acceptable. Protective cover system, including material and workmanship, shall be warranted from defects for a period of one year from substantial completion of installation.

PART 2 - PRODUCT

2.1 Manufacturers

A. Contract documents are based on products manufactured by:

1. Peachtree Protective Covers, Inc.
2. E.L. Burns Company, Shreveport, LA
3. Dittmer Architectural Aluminum, Winter Springs, FL

B. Other manufacturers will be considered for substitution only when the following conditions are met:

1. Other manufacturers must qualify to bid not less than 10 days prior to bid closing date.
2. Complete details, including sizes of all members and structural calculations showing loads applied in accordance with the specification must be submitted to the architect for review.

2.2 Design

A. Protective cover shall be all welded extruded aluminum system complete with internal drainage. Non-welded systems are not acceptable.

B. Roll formed deck is not acceptable. Expansion joints shall be included to accommodate temperature changes of 120oF. Expansion joints shall have no metal to metal contact.

2.3 Materials

A. Aluminum Members: All sections shall be extruded aluminum 6063 alloy, heat treated to T-6 temper.

B. Fasteners: Fasteners shall be aluminum, 18-8 stainless steel or 300 series stainless steel.

C. Protective Coating: Aluminum columns embedded in concrete shall be protected by clear acrylic.

D. Grout: Grout shall be 2000 p.s.i. compressive strength, 1 part Portland cement and 3 parts masonry sand. Add water to produce pouring consistency.

E. Gaskets: Gaskets shall be dry seal santoprene pressure type.

2.4 Components

A. Columns: Columns shall be radius-cornered tubular extrusion of size shown on drawings with cutout and internal diverter for drainage where indicated. Circular downspout opening in column not acceptable.

B. Beams: Beams shall be open-top tubular extrusion of size and shape shown on drawings, top edges thickened for strength and designed to receive deck members in self-flashing manner. Structural ties shall be installed in tops of all beams.

C. Deck: Deck shall be extruded self-flashing sections interlocking into a composite unit. Closures at deck ends shall be welded plates.

D. Fascia: Fascia shall be manufacturer's standard shape. Size as indicated on drawings.

E. Flashing: Flashing shall be .040 aluminum (min.).

2.5 Fabrication

A. Bent Construction: Beams and columns shall be factory welded with neatly mitered corners into one-piece rigid bents. All welds shall be smooth and uniform using an inert gas shielded arc. Suitable edge preparation shall be performed to assure 100% penetration. Grind welds only where interfering with adjoining structure to allow for flush connection. Field welding is not permitted. Rigid mechanical joints shall be used when shipping limitations prohibit the shipment of fully welded bents.

B. Deck Construction: Deck shall be manufactured of extruded modules that interlock in a self-flashing manner. Interlocking joints shall be positively fastened at 8" O.C. creating a monolithic structural unit capable of developing the full strength of the sections. The fastenings must have minimum shear strength of 350 pounds each. Deck shall be assembled with sufficient camber to offset dead load deflection.

2.6 Factory Finishing

A. Flouropolymer (Kynar) finish, AAMA 2605, three coat.

PART 3 - EXECUTION

3.1 Preparation

A. Erection shall be performed after all concrete, masonry, and roofing work in the vicinity is complete and cleaned.

3.2 Installation

A. Column Sleeves: Column sleeves (styrofoam blockouts) or anchor bolts (if required) shall be furnished by manufacturer and installed by the General Contractor.

B. Erection: Protective cover shall be erected true to line, level and plumb. Aluminum columns embedded in concrete shall be protected by clear acrylic. Downspout columns shall be filled with grout to the discharge level to prevent standing water. Non-draining columns shall have weep holes installed at top of concrete to remove condensation.

3.3 Cleaning

A. All protective cover components shall be cleaned promptly after installation.

3.4 Protection

A. Extreme care shall be taken to protect materials during and after installation.

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SECTION 11 52 13

PROJECTION SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrically operated projection screens and controls.

1.2 DEFINITIONS

A. Gain of Front-Projection Screens: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.

B. Half-Gain Angle: The angle, measured from the axis of the screen surface to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For projection screens. Show layouts and types of projection screens. Include the following:

1. For electrically operated projection screens and controls:

a. Location of screen centerline relative to ends of screen case.

b. Location of wiring connections for electrically operated units.

c. Location of seams in viewing surfaces.

d. Drop lengths.

e. Details of juncture of exposed surfaces with adjacent finishes.

f. Accessories.

g. Wiring diagrams.

D. Samples for Initial Selection: For finishes of surface-mounted screen cases.

E. Maintenance Data: For projection screens to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations for Projection Screens: Obtain projection screens from single manufacturer. Obtain accessories, including necessary mounting hardware, from screen manufacturer.

B. 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Environmental Limitations: Do not deliver or install projection screens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Deliver and store projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

C. Handling: Handle electrically operated projection screen materials with care in order to prevent damage.

1.6 COORDINATION

A. Coordinate layout and installation of projection screens with adjacent construction, including ceiling suspension systems, light fixtures, HVAC equipment, fire-suppression system, and partitions.

1. Comply with projection screen manufacturer’s written recommendations for sequencing construction operations.

1.7 WARRANTY

A. Manufacturer’s warranty: Submit manufacturer’s standard written warranty document executed by authorized company official. Manufacturer’s warranty shall be subject to the terms of FAR Clause 52.24-21 and is in addition to, and does not limit, other rights VAMC may have under Contract Documents.

1. Warranty: Commencing on date of substantial completion.

PART 2 - PRODUCTS

2.1 ELECTRICALLY OPERATED PROJECTION SCREENS

A. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Controls: Remote and key-operated, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
    a. Provide two control switches for each screen.
    b. Provide power supply for low-voltage systems if required.
    c. Provide locking cover plates for switches.
    d. Provide key-operated, power-supply switch.
    e. Provide infrared remote control consisting of battery-powered transmitter and receiver.
    f. Provide video interface control for connecting to projector. Projector provides signal to raise or lower screen.
2. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
3. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch-(9.5-mm-) diameter metal rod with ends of rod protected by plastic caps.
    a. Roller for motor in roller supported by vibration- and noise-absorbing supports.
4. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen connected to edge of screen by tabs to pull screen flat horizontally.

B. Surface-Mounted, Metal-Encased, Electrically Operated Screens: Motor-in-roller units designed and fabricated for surface mounting on wall or ceiling, fabricated from formed-steel sheet not less than 0.027 inch (0.7 mm) thick or from aluminum extrusions; with flat back design and vinyl covering or baked-enamel finish. Provide with matching end caps and concealed mounting.
    1. Motor:
        a. 120V, 60 Hz, 3-wire permanently lubricated, reversal type designed for mounting inside roller.
        b. Amperage: 2.4 amps maximum.

c. Include automatic thermal overload protection, integral gears, capacitor and electric brake to prevent coasting.

d. Include preset, adjustable limit switches to automatically stop viewing surface in UP or DOWN positions.

e. Housing: Inside metal roller.

2. Controls:

a. Electric Screen Control Switch:

1) Wall mounted 115V, 60 Hz, 3 position control switch with cover plate for UP, DOWN and STOP functions.

2) Integral junction box incorporated into screen housing.

3. Screen Mounting: Ceiling.

a. Include mounting hardware and roller mounting brackets that adjust to allow centering or offsetting of the screen within the case.

4. Screen Case: Designed to receive mounting hardware and is sized to suit projection screen.

a. Material: Extruded aluminum.

b. Design: 2-piece with curved contour flat-backed case with heavy duty end caps concealing roller ends.

c. Length: 113 1/4 inches.

d. Finish: Black or white powder coated, color to be selected by VAMC.

5. Acceptable Material:

a. Tab Guide Cable Tensioned Screen Material:

1) Include tab and cable guide on each side of fabric to maintain even, lateral tension and hold viewing surface flat.

2) Bottom end of fabric to be inserted into a custom aluminum slat bar with added weight to provide vertical tension on the screen surface.

3) Slat ends to be protected by heavy duty plastic caps enclosing a preset adjustable mechanism for screen tensioning.

4) Seamless in all sizes.

6. Silent motor for sizes to 9 feet x 12 feet.

7. Key locking cover plate: Hinged cover plate with brushed stainless steel finish provides keyed access to 120 V wall switch.

8. Video projector interface control: Internal, DC controls and white rocker switch with cover plate for wall switch operation.
9. Serial Control Board:
   a. SCB-200 RS-232: Built-in with IR-200 infrared remote.

2.2 FRONT-PROJECTION SCREEN MATERIAL

A. Matte-White Viewing Surface: Gain not less than 1.0.
   1. Gain: To SMPTE RP 94-2000, 1.0
   2. Viewing angle: 60
   3. Format: HDTV
   4. Material: Easily cleaned with mild soap and water solution and as specified.
B. Mildew-Resistance Rating: 0 or 1 when tested according to ASTM G 21.
C. Flame Resistance: Passes NFPA 701.
D. Flame-Spread Index: Not greater than 75 when tested according to ASTM E 84.
E. Seams: Where length of screen indicated exceeds maximum length produced without seams in material specified, provide screen with horizontal seam placed as follows:
   1. At top of screen at juncture between extra drop length and viewing surface.
F. Seamless Construction: Provide screens, in sizes indicated, without seams.
G. Size of Viewing Surface: 52 inches by 92 inches.
H. Provide extra drop length of dimensions indicated.
   1. Color: Black.

PART 3 - EXECUTION

3.1 FRONT-PROJECTION SCREEN INSTALLATION

A. Install front-projection screen at location indicated to comply with screen manufacturer's written instructions.
B. Install front-projection screen with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
   1. Install low-voltage controls according to NFPA 70 and complying with manufacturer's written instructions.
      a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions

where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.

3.2 PROTECTING AND CLEANING

A. After installation, protect projection screens from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

3.3 PROJECTION SCREEN SCHEDULE

A. Electrically Operated, Front-Projection Screen Type: Surface mounted, metal encased.

1. Motor Configuration: Motor in roller.
2. Viewing Surface Size: 52 inches by 92 inches.
3. Extra Drop Length: 12 inches black fabric at top, not to exceed 13 feet maximum.

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SECTION 11 73 00

CEILING MOUNTED PATIENT LIFT SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

Ceiling Mounted Patient Lift Systems for the transfer of physically challenged patients are specified in this section.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS: Requirements for pre-test of equipment.

B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural equipment.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General Electrical Requirements and items, which are common to sections of Division 26.

1.3 QUALITY ASSURANCE

Certification for compliance is required for Ceiling Mounted Patient Lift Systems. Certifications shall be provided by an independent third party who will conduct testing to ensure that the ceiling lift and charging system are safe and in compliance with ISO 10535 & UL 60601-1

1.4 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Certificates of Compliance

C. Manufacturer's Literature and Data:

1. Lifting Capacity
2. Lifting Speed
3. Horizontal Displacement Speeds
4. Horizontal Axis Motor
5. Vertical Axis Motor
6. Emergency Brake
7. Emergency Lowering Device
8. Emergency Stopping Device
9. Electronic Soft-Start and Soft-Stop Motor Control
10. Current Limiter for Circuit Protection
11. Low Battery Disconnect System
12. Strap Length

13. All equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.

D. Individual Room layouts showing location of lift system installation shall be approved before proceeding with installation of lifts.

1.5 APPLICABLE PUBLICATIONS

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

B. International Organization for Standardization (IOS):

10535-06.....Hoist for the Transfer of Disabled Persons-Requirements and Test Methods

C. Underwriters Laboratories (UL):

60601-1.....Medical Electrical Equipment: General Requirements for Safety

94-1996.....UL Standards for Safety Test for Flammability of Plastic Materials for Parts in Devices and Appliances-Fifth Edition

D. International Electromagnetic Commission (IEC):

CISPR 11.....Industrial Scientific and Medical (ISM) Radio Frequency Equipment –Electromagnetic Disturbance Characteristics-Limits and Methods of Measurement-Amendment 2

801-2.....Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment-Part 2: Electromagnetic Discharge Requirements

PART 2 - PRODUCTS

2.1 CEILING MOUNTED PATIENT LIFT SYSTEM

A. The entire Carl Vinson VA Medical Center shall utilize the same Ceiling Patient Lift System, for maintenance and safety purposes. The currently installed Ceiling Patient Lift System at the Carl Vinson VAMC is:

1. Manufacturer: Arjo Inc.
2. Model: Maxi Sky 600 2F ECS Ceiling Lift System.

2.2 CEILING TRACK SYSTEM

The Ceiling Track shall be made from high strength extruded aluminum T66081-T5 at a thickness of 3/16" (4.8mm). Provide anchor supports at a minimum 3 per linear foot at ceiling substrate. The ceiling track shall be finished with baked enamel paint. Anchor supports shall be at each end of the fixed rail and at the center of Kwiktrak T5 rail and as recommended by manufacturer's written instructions.

2.3 LIFT UNIT

A. The Lift Unit shall be constructed of a steel frame system (2205lbs / 1000kg tested) driven by a gear reduced high torque motor

B. The Lift system shall have the following features.

1. Lifting capacity: 600 lbs (272 kg)
2. Electronic soft-start and soft-stop motor control
3. Emergency lowering device
4. Emergency stopping device
5. Current limiter for circuit protection in case of overload.
6. Safety device that stops the motor to lift when batteries are low.
7. Lifting speed: 2.3in/s (6 cm/s), 1.6in/s (3.5cm) in full capacity
8. Horizontal displacement speed: 5.9in/s (150mm/s)
9. Horizontal axis motor: 24VDC at 62 watts and vertical axis motor at 110 watts
10. Emergency brake (in case of mechanical failure)
11. Strap length up to 90in (2.3m) tested for 2998lbs (1360kg)
12. Cab: VO plastic–fire retardant, UL 94
13. Wireless remote control
14. Enhanced Charging System so that the motor can be recharged on the Kwiktrak rail, regardless of the position on the track. No clip on charging station is required.
15. Charging indicator on motor- blinking yellow (charging) full yellow (charging complete).

2.4 MOTORS

A. All motors shall be able to do more than 10,000 cycles in compliance with IEC CISPR 11.

B. Vertical Movement-DC Motor

1. Type: Class A, fully enclosed, permanent magnet.
2. Rating: 24Vdc, 1.1A, 110W, 4000RPM, 0.3N-m.
3. Mounting: Secured to chassis.

C. Horizontal Movement-DC Motor

1. Type: Fully enclosed, permanent magnet, integral reducer.
2. Rating: 24Vdc, 1.8A, 62W, 260RPM, 1.0N-m.
3. Mounting: Secured to chassis.

2.5 BATTERIES

A. The life cycle (number of charging cycles) for batteries shall be in compliance with IEC 801-2.

B. Provide rechargeable batteries with up to 120 transfers with a load of 200lbs (74kg) and up to 70 transfers with its maximum load of 600lbs (272kg).

2.6 CHARGER

A. Charger Input: 100-240 Vac, 50/60 Hz.

B. Charger Output: 27 Vdc, 1 A max.

C. The ECS system does not require a chip on the charging station since there is a continuous charge in any position on the track.

2.7 STRAPS AND SLING

A. The straps shall be made of threaded nylon. The straps shall ensure the patient’s safety by preventing the patient from falling out of the sling.

B. The sling shall be made from a polyester/nylon net material that is pliable, breathable and easy to use. The sling shall cradle the body of the patient.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install ceiling mounted patient lift system as per manufacturer's instruction and under the supervision of manufacturer's qualified representative and as shown on drawings.

B. If the distance in between the suspended ceiling and anchors is more than 18” consult with manufacturer to determine if lateral braces will be required. Refer to drawings for additional ceiling mounting requirements.

3.2 INSTRUCTION AND PERSONNEL TRAINING

Training shall be provided for the required personnel to educate them on proper operation and maintenance for the lift system equipment.

3.3 TEST

Conduct performance test, in the presence of the COTR and a manufacturer's field representative, to show that the patient lift system equipment and control devices operate properly and in accordance with design and specification requirements.

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SECTION 12 32 00

MANUFACTURED WOOD CASEWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies wood veneer 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. Refer to the Manufactured Casework Schedule in the drawings (A603) for information about each specific casework unit.

1.2 RELATED WORK

A. Custom Casework and Plastic Lamninate: 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

The fabrication of casework shall be by a manufacturer who produces casework similar to the casework specified and shown.

1.4 DEFINITIONS

A. Exposed Surfaces of Cabinets: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.

B. Semiexposed Surfaces of Cabinets: Surfaces behind opaque doors or drawer fronts, including interior faces of doors and interiors and sides of drawers, and bottoms of wall cabinets.

C. Concealed Surfaces of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, ends of cabinets installed directly against and completely concealed by walls or other cabinets, and tops of wall cabinets and utility cabinets.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

Sinks, trim and fittings.

Locks for doors and drawers

Adhesive cements

C. Samples:

Wood Face Veneer or Hardwood Plywood

D. Shop Drawings:

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.

E. Mock-Up: Where required for special casework and where four or more similar units are involved, submit a mock-up of a typical unit for approval by the COTR.

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):

A167-99 (R2004).....Stainless and Heat-Resisting chromium-Nickel Steel Plate, Sheet and Strip

A1008-07.....Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy

C1036-06.....Flat Glass

C. Composite Panel Association (CPA):

A208.1-99.....Particleboard

D. U.S. Department of Commerce Product Standards (Prod. Std):

PS1-95.....Construction And Industrial Plywood

E. Hardwood, Plywood and Veneer Association (HPVA):

HP.1-04.....Hardwood and Decorative Plywood

F. Architectural Woodwork Institute (AWI):

Architectural Woodwork Quality Standards, Guide Specifications Quality Certification Program - 1999

G. American Society of Mechanical Engineers (ASME):

A112.18.1-05.....Plumbing Fixture Fittings

H. Kitchen Cabinet Manufacturer's Association (KCMA):ANSI/KCMA A161.1 Performance & Construction Standard for Kitchen and Vanity Cabinets

I. National Electrical Manufacturers Association (NEMA):
LD3-05.....High Pressure Decorative Laminates
LD3.1-95.....Performance, Application Fabrication and Installations of High-Pressure Decorative Laminates

J. Hardwood Plywood and Veneer Association
HP-1.....Hardwood and Decorative Plywood

1.7 QUALITY ASSURANCE

A. Source Limitations for Cabinets: Obtain cabinets from single source/single manufacturer.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete and dry, and temporary HVAC system is operating and maintaining temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.

C. Field Measurements for Countertops: Verify actual dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.9 COORDINATION

A. Coordinate layout and installation of blocking and reinforcement in partitions for support of casework.

B. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 CABINETS

A. Style: Raised Panel, Square Wall and Square Base Doors, Full Door Style.

B. Species: Oak

C. Quality Standard: Provide cabinets that comply with KCMA A161.1.

D. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semiexposed location of each unit and showing compliance with the above standard.

E. Face Style: Flush overlay; door and drawer faces cover cabinet fronts with only enough space between faces for operating clearance.

F. Cabinet Style: Face frame.

G. Door and Drawer Fronts: Solid-wood stiles and rails, 5/8 inch (16 mm) thick, with 3/4-inch- (19-mm-) thick, solid-wood center panels.

H. Face Frames: 3/4-by-1-5/8-inch (19-by-41-mm) solid wood.

I. Exposed Cabinet End Finish: Wood veneer to match cabinet.

J. Cabinet End Construction: 3/4-inch- (19-mm-) thick veneered plywood with flush design.

K. Cabinet Tops and Bottoms: 5/8-inch- (16-mm-) thick particleboard or 1/2-inch- (12.7-mm-) thick plywood, fully supported by and secured in rabbets in end panels, front frame (if any), and back rail.

L. Back, Top, and Bottom Rails: 3/4-by-2-1/2-inch (19-by-63-mm) solid wood, interlocking with end panels and rabbeted to receive top and bottom panels. Back rails secured under pressure with glue and with mechanical fasteners.

M. Wall-Hung-Unit Back Panels: 3/16-inch- (4.8-mm-) thick plywood fastened to rear edge of end panels and to top and bottom rails.

N. Base-Unit Back Panels: 3/16-inch- (4.8-mm-) thick plywood fastened to rear edge of end panels and to top and bottom rails.

O. Front Frame Drawer Rails: 3/4-by-1-1/4-inch (19-by-32-mm) solid wood mortised and fastened into face frame.

P. Drawers: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

Q. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

R. Subfronts, Backs, and Sides: 1/2-inch- (12.7-mm-) thick solid wood.

S. Bottoms: 1/4-inch- (6.4-mm-) thick plywood.

T. Shelves: 5/8-inch- (16-mm-) thick plywood.

U. Joinery: Rabbet backs flush into end panels and secure with concealed mechanical fasteners. Connect tops and bottoms of wall cabinets and bottoms and stretchers of base cabinets to ends and dividers with mechanical fasteners. Rabbet tops, bottoms, and backs into end panels.

V. Factory Finishing: Finish cabinets at factory. Defer only final touchup until after installation.

W. Cabinet Construction: All plywood construction, unless otherwise noted.

2.2 CABINET MATERIALS

A. General:

1. Hardwood Lumber: Kiln dried to 7 percent moisture content.
2. Softwood Lumber: Kiln dried to 10 percent moisture content.
3. Hardwood Plywood: HPVA HP-1.
4. Particleboard: ANSI A208.1, Grade M-2.

B. Exposed Materials:

1. Exposed Wood species: Oak.
   a. Select materials for compatible color and grain. Do not use two adjacent exposed surfaces that are noticeably dissimilar in color, grain, figure, or natural character markings.
   b. Staining and Finish: Coordinate with Architect.
2. Solid Wood: Clear hardwood lumber of species indicated, free of defects.
3. Plywood: Hardwood plywood with face veneer of species indicated, with Grade A faces and Grade C backs of same species as faces.
   a. Edge band exposed edges with minimum 1/8-inch- (3-mm-) thick, solid-wood or veneer edging of same species as face veneer.
4. Plastic Laminate (for countertops only): Particleboard faced with high-pressure decorative laminate complying with NEMA LD 3, HGP 1.0 mm (0.039 inch) thick.
   a. Colors, Textures, and Patterns: As indicated.

C. Semiexposed Materials: Unless otherwise indicated, provide the following:

1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects. Same species as exposed surfaces.
2. Plywood: Hardwood plywood with Grade C faces and not less than Grade 3 backs of same species as faces. Face veneers of same species as exposed surfaces.
3. Cabinet Interior: Veneered plywood, unless otherwise noted. Species and stain to match exposed faces.
4. Concealed Materials: Solid wood or plywood, of any hardwood or softwood species, with no defects affecting strength or utility; particleboard; medium-density fiberboard; or hardboard.

2.3 CABINET HARDWARE

A. General: Manufacturer's standard units complying with BHMA A156.9, of

type, size, style, material, and finish indicated by manufacturer's designations as listed within these Contract Documents.

B. Pulls: Back-mounted decorative pulls.

C. Hinges: Concealed European-style self-closing hinges. BHMA A156.9, B01602, 110 degrees of opening, size and quantity as appropriate for cabinet door size.

D. Drawer Guides: Heavy Duty (Grade 1 HD-100), side mounted, epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or B05091; Full Extension Buffered runners with easy-release mechanism option.

2.4 PLASTIC-LAMINATE COUNTERTOPS

Refer to Section 06 20 00, FINISH CARPENTRY

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.

C. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.

D. Install cabinets without distortion so doors and drawers fit openings, are aligned, and are uniformly spaced. Complete installation of hardware and accessories as indicated.

E. Install cabinets and countertop level and plumb to a tolerance of 3 mm in 2.4 m (1/8 inch in 8 feet).

F. Fasten cabinets to adjacent units and to backing.

1. Fasten wall cabinets through back, near top and bottom, at ends and not less than 600 mm (24 inches) o.c. with No. 10 wafer-head screws sized for 25 mm (1 inch) penetration into wood framing, blocking, or hanging strips.

2. Fasten wall cabinets through back, near top and bottom, at ends and not less than 600 mm (24 inches) o.c., with toggle bolts through metal backing behind gypsum board.

G. Fasten plastic-laminate countertops by screwing through corner blocks of base units into underside of countertop. Form seams using splines

to align adjacent surfaces, and secure with glue and concealed clamping devices designed for this purpose.

1. Provide cutouts for sinks and lavatories, including holes for faucets and accessories.
2. Seal edges of cutouts by saturating with varnish.

3.2 ADJUSTING AND CLEANING

A. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

B. Clean casework on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

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SECTION 13 05 41

SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 – GENERAL

1.1 DESCRIPTION:

A. Provide seismic restraint in accordance with the requirements of this section in order to maintain the integrity of nonstructural components of the building so that they remain safe and functional in case of seismic event.

B. Definitions: Non-structural building components are components or systems that are not part of the building's structural system whether inside or outside, above or below grade. Non-structural components of buildings include:

1. Architectural Elements: Facades that are not part of the structural system and its shear resistant elements; cornices and other architectural projections and parapets that do not function structurally; glazing; nonbearing partitions; suspended ceilings; stairs isolated from the basic structure; cabinets; bookshelves; medical equipment; and storage racks.
2. Electrical Elements: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; special life support systems; and telephone and communication systems.
3. Mechanical Elements: Heating, ventilating, and air-conditioning systems; medical gas systems; plumbing systems; sprinkler systems; pneumatic systems; boiler equipment and components.

1.2 QUALITY CONTROL:

A. Shop-Drawing Preparation:

1. Have seismic-force-restraint shop drawings and calculations prepared by a professional structural engineer experienced in the area of seismic force restraints. The professional structural engineer shall be registered in the state where the project is located.
2. Submit design tables and information used for the design-force levels, stamped and signed by a professional structural engineer registered in the State where project is located.

B. Coordination:

1. Do not install seismic restraints until seismic restraint submittals are approved by the COTR.
2. Coordinate and install trapezes or other multi-pipe hanger systems prior to pipe installation.

1.3 SUBMITTALS:

A. Submit a coordinated set of equipment anchorage drawings prior to installation including:
   1. Description, layout, and location of items to be anchored or braced with anchorage or brace points noted and dimensioned.
   2. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, bolts, welds etc. clearly identified and specified.
   3. Numerical value of design seismic brace loads.
   4. For expansion bolts, include design load and capacity if different from those specified.

B. Submit prior to installation, a coordinated set of bracing drawings for seismic protection of piping, with data identifying the various support-to-structure connections and seismic bracing structural connections, include:
   1. Single-line piping diagrams on a floor-by-floor basis. Show all suspended piping for a given floor on the same plain.
   2. Type of pipe (Copper, steel, cast iron, insulated, non-insulated, etc.).
   3. Pipe contents.
   4. Structural framing.
   5. Location of all gravity load pipe supports and spacing requirements.
   6. Numerical value of gravity load reactions.
   7. Location of all seismic bracing.
   8. Numerical value of applied seismic brace loads.
   9. Type of connection (Vertical support, vertical support with seismic brace etc.).
   10. Seismic brace reaction type (tension or compression). Details illustrating all support and bracing components, methods of connections, and specific anchors to be used.

C. Submit prior to installation, bracing drawings for seismic protection of suspended ductwork and suspended electrical and communication cables, include:

1. Details illustrating all support and bracing components, methods of connection, and specific anchors to be used.
2. Numerical value of applied gravity and seismic loads and seismic loads acting on support and bracing components.
3. Maximum spacing of hangers and bracing.
4. Seal of registered structural engineer responsible for design.

D. Submit design calculations prepared and sealed by the registered structural engineer specified above in paragraph 1.2A.

E. Submit for concrete anchors, the appropriate ICBC evaluation reports, OSHPD pre-approvals, or lab test reports verifying compliance with OSHPD Interpretation of Regulations 28-6.

1.4 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 basic designation only.

SPEC WRITER NOTE: Edit applicable publications to indicate the most recent edition.

B. American Concrete Institute (ACI):

355.2-07.....Qualification for Post-Installed Mechanical Anchors in Concrete and Commentary

C. American Institute of Steel Construction (AISC):

Load and Resistance Factor Design, Volume 1, Second Edition.

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

A36/A36M-05.....Standard Specification for Carbon Structural Steel.

A53/A53M-07.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

A307 (REV A-07).....Standard Specification for Carbon Steel Bolts and Studs; 60,000 PSI Tensile Strength.

A325-07.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

A325M-05.....Standard Specification for High-Strength Bolts for Structural Steel Joints [Metric].

A490-06.....Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.

A490M (REV A-04).....Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric].

A500/A500M-07.....Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

A501-07.....Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

A615/A615M-07.....Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

A992/A992M (REV A-06)...Standard Specification for Steel for Structural Shapes for Use in Building Framing.

A996/A996M (REV A-06)...Standard Specification for Rail-Steel and Axel-Steel Deformed Bars for Concrete Reinforcement.

E488-96(R2003).....Standard Test Method for Strength of Anchors in Concrete and Masonry Elements.

E. International Building Code (IBC) 2003 Edition.

F. VA Seismic Design Requirements, H-18-8, December 2003.

G. National Uniform Seismic Installation Guidelines (NUSIG).

H. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
Seismic Restraint Manual - Guidelines for Mechanical Systems, 1998 Edition and Addendum.

1.5 REGULATORY REQUIREMENT:

A. IBC 2003.

B. Exceptions: The seismic restraint of the following items may be omitted:

1. Equipment weighing less than 400 pounds, which is supported directly on the floor or roof.
2. Equipment weighing less than 20 pounds, which is suspended from the roof or floor or hung from a wall.
3. Gas and medical piping less than 2 ½ inches inside diameter.

4. Piping in boiler plants and equipment rooms less than 1 ¼ inches inside diameter.
5. All other piping less than 2 ½ inches inside diameter, except for automatic fire suppression systems.
6. All piping suspended by individual hangers, 12 inches or less in length from the top of pipe to the bottom of the support for the hanger.
7. All electrical conduits, less than 2 ½ inches inside diameter.
8. All rectangular air handling ducts less than six square feet in cross sectional area.
9. All round air handling ducts less than 28 inches in diameter.
10. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of support for the hanger.

PART 2 – PRODUCTS

2.1 STEEL:

A. Structural Steel Wide Flange Shapes: A992.
B. Structural Steel Channels, Angles, Plates, Bar, Etc.: ASTM A36/A36M.
C. Structural Square and Rectangular Tubing: ASTM A500, Grade B.
D. Structural Round Tubing: ASTM A501.
E. Steel Pipe: ASTM A53/A53M, Grade B.
F. Anchor Bolts & Nuts: A307.
G. High Strength Threaded Fasteners: ASTM A325/A325M/A490/A490M.

2.2 CAST-IN-PLACE CONCRETE:

A. Concrete: 28 day strength, f’c = 25 MPa (3,000 psi) or 30 MPa (4,000 psi).
B. Reinforcing Steel: ASTM A615/615M or ASTM A996/A996M deformed.

PART 3 – EXECUTION

3.1 CONSTRUCTION, GENERAL:

A. Provide equipment supports and anchoring devices to withstand the seismic design forces, so that when seismic design forces are applied, the equipment cannot displace, overturn, or become inoperable.
B. Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.
C. Construct seismic restraints and anchorage to allow for thermal expansion.
D. Testing Before Final Inspection:
   1. Test 10-percent of anchors in masonry and concrete per ASTM E488, and ACI 355.2 to determine that they meet the required load

capacity. If any anchor fails to meet the required load, test the next 20 consecutive anchors, which are required to have zero failure, before resuming the 10-percent testing frequency.

2. Before scheduling Final Inspection, submit a report on this testing indicating the number and location of testing, and what anchor-loads were obtained.

3.2 EQUIPMENT RESTRAINT AND BRACING:

A. Support, restrain, and brace equipment to resist directional forces (lateral, longitudinal, and vertical).

3.3 MECHANICAL DUCTWORK AND PIPING; BOILER PLANT STACKS AND BREACHING; ELECTRICAL BUSWAYS, CONDUITS, AND CABLE TRAYS; AND TELECOMMUNICATION WIRES AND CABLE TRAYS

A. Support and brace mechanical ductwork and piping; electrical busways, conduits and cable trays; and telecommunication wires and cable trays including boiler plant stacks and breeching to resist directional forces (lateral, longitudinal and vertical).

B. Brace duct and breeching branches with a minimum of 1 brace per branch.

D. Provide supports and anchoring so that, upon application of seismic forces, piping remains fully connected as operable systems which will not displace sufficiently to damage adjacent or connecting equipment, or building members.

E. Seismic Restraint of Piping:

1. Design criteria:

a. Piping resiliently supported: Restrain to support 120-percent of the weight of the systems and components and contents.

b. Piping not resiliently supported: Restrain to support 60-percent of the weight of the system components and contents.

F. Piping Connections: Provide flexible connections where pipes connect to equipment. Make the connections capable of accommodating relative differential movements between the pipe and equipment under conditions of earthquake shaking.

3.4 PARTITIONS

A. In buildings with flexible structural frames, anchor partitions to only structural element, such as a floor slab, and separate such partition by a physical gap from all other structural elements.

B. Properly anchor masonry walls to the structure for restraint, so as to carry lateral loads imposed due to earthquake along with their own weight and other lateral forces.

3.5 CEILINGS AND LIGHTING FIXTURES

A. At regular intervals, laterally brace suspended ceilings against lateral and vertical movements, and provide with a physical separation at the walls.

B. Independently support and laterally brace all lighting fixtures. Refer to applicable portion of lighting specification, Section 26 51 00, INTERIOR LIGHTING.

3.6 FACADES AND GLAZING

A. Install attachments to structure for all façade materials as shown on construction drawings to ensure strength against applicable seismic forces at the project location.

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SECTION 21 05 02

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide UL Listed, FM approved fire protection specialties or accessories as required by either the equipment manufacturer or the Local Code Authority.

B. Standards: Currently listed as approved in the "Fire Protection Equipment List" as published by Underwriters' Laboratories, Inc. (UL), or the Factory Mutual System Approval guide (FM) and shall bear the proper labels as identified therein.

C. The Fire Protection Contractor provides and installs supervisory valve and flow switches. The Electrical Contractor provides wiring.

PART 2 PRODUCTS

2.01 FLOW SWITCH

A. Vane-type switch, weather-resistant adjustable pneumatic time delay 90 seconds or less, two (2) sets of single-pole double-throw micro-switches, tamper-proof cover (extra set of contacts), steel U-bolt clamp, saddle type mounting directly to piping.

2.02 SUPERVISORY (TAMPER) SWITCH

A. Weather-resistant, single-pole, double-throw switch, roller type switch actuator, spring-loaded plunger, tamper-proof cover (extra set of contacts).

2.03 PRESSURE GAUGE

A. Dial spring, brass case, 3 1/2 inches diameter, 1/4 inch NPT male connection, range: 0-300 psig.

2.04 ELECTRIC SPRINKLER ALARM SWITCH

A. Two (2) single-pole, double-throw snap-acting electric switches, spring loaded plunger, self-setting, 4-20 psi adjustable range, 180 degrees F, NEMA 1 enclosure with tamper switch.

2.05 INSPECTOR'S TEST CONNECTIONS

A. Sight Test Connection:

1. Steel, clear tube, smooth bore, non-corrosive orifice with flow equivalent to one (1) sprinkler head, 1 inch NPT connection.

B. Blind Test Connection:

1. Bronze, non-corrosive, smooth bore orifice with flow equivalent to one (1) sprinkler head, 1 inch NPT connection.

2.06 ACCELERATOR

A. UL Listed, FM approved for use with dry pipe alarm valve, and equipped with an external anti-flooding device.

2.07 IDENTIFICATION SIGNS

A. All control, drain, and test valves shall have marked identification signs indicating the portion of the system controlled by each valve.

B. 18 gauge steel, porcelain enameled, white lettering on red background.

1. General Purpose Valve Control
2. Specific Identification
3. Fire Alarm
4. Hydraulic Calculated System

C. 20 gauge steel, porcelain enameled, white lettering on red background.

1. Cold Weather

D. Locate signs per NFPA 13 requirements.

E. When item being identified is above suspended ceiling, sign is to be placed on nearest ceiling pad below shut-off valve or other item being identified.

F. Signs shall be secured with noncorrosive wire, chain(s) or other approved means.

2.08 DRAINS

A. Furnish drains using Schedule 40 black steel pipe (ASTM A120). Exterior piping shall be galvanized steel (with no raw steel exposed) or non-ferrous to prevent staining exterior walls.

2.09 HANGERS

A. Refer to Section 20 05 45, "Hanger, Supports and Inserts" which is part of this contract work.

B. All component parts of hanger assemblies shall be UL Listed, FM and NFPA approved.

C. All hangers shall support the total load of the water-filled pipe in addition to a minimum of 250 lb. load applied at the hanger.

D. All hangers installed shall be appropriate for type of building structure indicated.

E. C-clamps without retaining straps are expressly prohibited.

2.10 SPRINKLER GUARDS

A. Welded wire steel, baked synthetic red enamel finish, for use with 1/2 inch or 3/4 inch NPT male pipe threads, 2 3/4 inches by 3 inch square base, 2 7/8 inches high.

2.11 BAFFLES

A. 18 inches by 18 inches galvanized steel.

2.12 WATER MOTOR GONG

A. Cast iron body, plastic impeller, cast aluminum gong, red finish, 3/4 inches inlet piping, 1 inch drain outlet in body housing.

2.13 ELECTRIC ALARM BELL [USED WHEN THERE IS NO FIRE ALARM PANEL OR WATER MOTOR GONG]

A. 6 inch electric alarm bell with weatherproof back box.

B. Furnished and installed by the Fire Protection Contractor, wired by the Electrical Contractor.

2.14 SPRINKLER PIPING COVERS

A. NFPA, FM Approved, UL Listed 18 gauge cold rolled steel primer for painting, for pendant or sidewall installation, with snap-lock brackets, end caps, corners, wall flanges and couplings to make-up a complete pipe covering system where indicated on Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install supervisory switches on all operable valves except fire department valves. Refer to Drawings.

B. Install flow switches at locations indicated on the Drawings and as required.

C. Do not install a flow switch within 12 inches of a "tee" or "elbow" or within 18 inches of a gate valve.

D. Install pressure gauges on top of sprinkler riser at each test connection and where shown on the Drawings.

E. Pressure gauges shall be located where water will not freeze, provided with a shutoff valve and with provision for draining.

F. All drain and Inspectors Test piping passing through an exterior wall shall be galvanized or non-ferrous. No raw steel surface shall be exposed.

G. Install a blind test connection in test pipes connected to an open drain and a sight test connection in test pipes that connect to closed drains.

H. Install water motor gong on exterior building wall where directed by Architect.

I. Install all necessary pipe hangers of approved spacing, type and size per NFPA 13.

J. Provide splash blocks for all drain and inspectors test outlets occurring in sodded areas.

K. Install baffles on sprinklers less than 6 feet apart.

L. Install sprinkler piping covers plumb and per manufacturer's recommendations.

3.02 COORDINATION OF WIRING

A. Required wiring from fire protection specialties to the fire alarm panel is provided by the Electrical Contractor.

B. Electric alarm bell's wiring is to be interlocked with the fire alarm riser pressure switch. Wiring is provided by the Electrical Contractor.

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SECTION 21 05 11

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 00 72 00, GENERAL CONDITIONS.

B. Section 01 00 00, GENERAL REQUIREMENTS.

C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

D. Excavation and Backfill: Section 31 20 00, EARTH MOVING.

E. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.

F. Section 05 50 00, METAL FABRICATIONS.

G. Section 07 84 00, FIRESTOPPING.

H. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

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 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

M. Section 21 05 12, GENERAL MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION EQUIPMENT.

N. 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; 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; 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; 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 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.

C. Guaranty: Section 00 72 00, GENERAL CONDITIONS.

D. Supports for sprinkler piping shall be in conformance with NFPA 13.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23.

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 shall be provided in accordance with Section 00 72 00, GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION; including detailed layout drawings of all piping systems. Additionally, the drawings shall provide details of the following:
1. Mechanical equipment rooms.
2. Interstitial space.
3. Hangers, inserts, supports, and bracing.
4. Pipe sleeves.

5. Equipment penetrations of floors, walls, ceilings, or roofs.

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.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent 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)

E84-2003.....Standard Test Method for Burning Characteristics of Building Materials

E119-2000.....Standard Test Method for Fire Tests of Building Construction and Materials

C. National Fire Protection Association (NFPA):

90A-2009.....Installation of Air Conditioning and Ventilating Systems

101-2009.....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 ELECTRIC MOTORS

A. Section 21 05 12, GENERAL MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION EQUIPMENT, specifies the applicable requirements for electric motors. 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. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

2.3 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 color coded thumb tack in ceiling.

2.4 FIRESTOPPING

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping.

2.5 GALVANIZED REPAIR COMPOUND

Mil. Spec. DOD-P-21035B, paint form.

2.6 PIPE PENETRATIONS

A. Install sleeves during construction.

B. Sheet Metal Sleeves: Provide for pipe passing through interior walls and partitions.

C. 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.

D. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges.

E. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.

F. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

G. 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.

H. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.7 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: Hardwood or metal, permanently identified for in tended service and mounted, or located, where directed by the COTR.

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.

2.8 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 and 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 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. Tightly cover and protect equipment against dirt, water, chemical, or mechanical injury. At completion of all work thoroughly clean all 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 MOTOR AND DRIVE ALIGNMENT

A. 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.

3.3 LUBRICATION

Field check and lubricate equipment requiring lubrication prior to initial operation.

3.4 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.

3.5 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 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.

3.6 INSTRUCTIONS TO VA PERSONNEL

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

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SECTION 21 05 23

FIRE PROTECTION VALVES

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide UL listed, FM approved, and labeled valves for the fire protection water piping system shown on the Drawings.

B. Tag all valves, provide valve chart per Project Specifications.

1.02 QUALITY ASSURANCE

A. Standards: Underwriters' Laboratories (UL), Factory Mutual (FM) and National Fire Protection Association (NFPA).

B. All valves of the same type used on the project shall be by the same manufacturer, except as noted.

PART 2 PRODUCTS

2.01 SWING CHECK VALVE

A. UL listed, FM approved, 175 lb. (WWP) cast iron body; brass moving parts including clapper valve seat and pivot shaft, Buna-N "O" ring, flanged connections.

B. The use of interior springs to assist closing of disc(s) shall not be accepted.

2.02 BRONZE GATE VALVES (UP TO 2 INCHES)

A. UL listed, FM approved, 175 lb. (WWP) bronze body, threaded ends, OS & Y rising stem, bronze yoke, solid wedge, repackable when wide open.

2.03 IRON BODY GATE VALVES (2 1/2 INCHES AND LARGER)

A. UL listed, FM approved, 175 lb. (WWP) high strength reinforced alloy iron body and bonnets, 125 lb. ANSI flanges, OS & Y rising stem, renewable bronze yoke bushing, bronze seat rings, solid taper wedge, repackable when wide open, blind bosses for drain tapping.

2.04 BUTTERFLY VALVES (IN LIEU OF GATE VALVES 2 1/2 INCHES AND LARGER)

A. UL listed, FM approved, 175 lb. (WWP) ductile iron body, aluminum-bronze disc, stainless steel stem, Buna-N seat, phenolic ring, lever lock handle (up to 6 inches) or gear operator for 8 inches and larger.

2.05 MISCELLANEOUS VALVES

A. All valves to be UL listed, FM approved.

B. Angle Valves: 175 lb. (WWP) bronze, rubber disc, wheel handle.

C. Hose End Gate Valves: 175 lb. (WWP), bronze, solid wedge, screw-in bonnet non-rising stem, iron handwheel with cap and chain.

D. Hose End Angle Valves: 175 lb. (WWP), bronze, renewable composition disc, iron handwheel w/cap and chain.

E. Test Valve: 300 lb. (WWP) bronze, three-way, needle seat, integral tapered disc, wheel handle.

2.06 WET PIPE ALARM VALVE AND TRIM

A. UL listed, FM approved, 175 lb. (WWP), cast iron body, tapped bases for alarm accessories, pressure gauges, drain, bronze moving parts, including clapper and bushings, rubber gasket, flanged connections.

B. Trim: Include retard chamber, pressure switch, strainers, gauges, fittings, piping and drain, control, and test valves.

2.07 DRY PIPE ALARM VALVE, TRIM AND ACCESSORIES

A. UL listed, FM approved, 175 lb. (WWP), cast iron body, malleable iron clapper, neoprene rubber gasket, brass pins and springs, bronze air plate, bronze seat with Buna-N "O" ring seals, replaceable rubber air seat, 2 inch boss.

B. Trim: Include air pressure gauge, three-way valve, air piping and unions, pressure switch, water pressure gauge, check gate, globe, 3/4 inch O.S.&Y. valves, drain cup and all fittings.

C. Accessories:

1. Accelerator: UL listed, FM approved, cast iron body, brass cover, phosphorus bronze diaphragm, brass and stainless steel interior parts, integral anti-flooding device. The accelerator shall guarantee that the sprinkler water arrives at the most remote head in less than 60 seconds.
2. Automatic Air Maintenance Device: UL listed, FM approved, including regulator, shutoff valves, bypass valve, strainer and check valve.
3. Provide a low pressure switch on all systems to detect a gradual loss of air pressure. The Electrical Contractor shall wire switch to fire alarm system as a distinct zone.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install valves and accessories as indicated on the Drawings and as required by NFPA 13 and 14 and in locations that are accessible to qualified personnel.

B. Tag all valves as required.

C. Torque hose end valve caps to prevent unauthorized use or removal.

D. Install hose end valves pointed down and away from wall at 15 degrees.

3.02 COORDINATION

A. Coordinate location of valves with Architect.

B. Coordinate location of access panels as required with Architect and Contractors.

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SECTION 21 13 13.00 10

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

05/09

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C104/A21.4	(2008) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(2006) Grooved and Shouldered Joints
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C652	(2002) Disinfection of Water-Storage Facilities

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Gray Iron Threaded Fittings; Classes 25, 125 and 250
ASME B16.11	(2009) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2005) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.22	(2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(2006) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2006) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.9	(2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.2	(1987; R 2005) Standard for Square and Hex Nuts

ASTM INTERNATIONAL (ASTM)

ASTM A 135/A 135M	(2009) Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A 183	(2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2009) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 449	(2007b) Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A 47/A 47M	(1999; R 2009) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2007) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 795/A 795M	(2008) Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized)

	Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 62	(2009) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 75	(2002) Standard Specification for Seamless Copper Tube
ASTM B 75M	(1999; R 2005) Standard Specification for Seamless Copper Tube (Metric)
ASTM B 88	(2009) Standard Specification for Seamless Copper Water Tube
ASTM B 88M	(2005) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM D 2000	(2008) Standard Classification System for Rubber Products in Automotive Applications
ASTM F 436	(2009) Hardened Steel Washers
ASTM F 436M	(2009) Hardened Steel Washers (Metric)
ASTM F 442/F 442M	(2009) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/CC_host/pages/public/custom

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71	(2005) Gray Iron Swing Check Valves, Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2009; Amd 09-1 & 09-2) Life Safety Code
NFPA 13	(2010) Standard for the Installation of Sprinkler Systems
NFPA 13D	(2010) Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes
NFPA 13R	(2010) Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height
NFPA 1963	(2009; Errata 09-1) Standard for Fire Hose

	Connections
NFPA 24	(2010) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(2003) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL 668	(2004; R 2008) Standard for Hose Valves for Fire Protection Service
UL Bld Mat Dir	(2009) Building Materials Directory
UL Fire Prot Dir	(2009) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

Furnish piping offsets, fittings, and any other accessories as required to provide a complete installation and to eliminate interference with other construction. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage. Provide wet pipe sprinkler system in all areas of the building. The system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. Design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

1.2.1 Hydraulic Design

Hydraulically design the system to discharge a minimum density of 0.15 gpm/square foot (6.09 L/min per square meter) over the hydraulically most demanding 1500 square feet (139 square m) of floor area. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch (32 mm). Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed 20 ft/s (6 m/s).

1.2.1.1 Hose Demand

Add a total inside and outside hose streams of 250 gpm (946 L/min) to the

sprinkler system demand at the fire hydrant closet to the point where the water service enters the building.

1.2.1.2 Basis for Calculations

Water flow and pressure is presumed adequate based on information provided by the Owner. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping.

1.2.1.3 Hydraulic Calculations

Prepare hydraulic calculations as outlined in NFPA 13, except that calculations shall be performed by computer using software intended specifically for fire protection system design using flow test data obtained at the site. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the flow test data to substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.2.2 Sprinkler Coverage

Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, mechanical rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13, but shall not exceed 130 square feet (12 square m) for ordinary hazard occupancies, and 225 square

feet (21 square m) for light hazard occupancies. Sprinklers may be omitted from small rooms which are exempted for specific occupancies in accordance with NFPA 101.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.][information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; GAE

Three copies of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of sprinkler system installation.

As-Built Drawings

As-built shop drawings, at least 14 days after completion of the Final Tests, updated to reflect as-built conditions after all related work is completed. Drawings shall be on reproducible full-size mylar film.

SD-03 Product Data

Fire Protection Related Submittals

A list of the Fire Protection Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist.

Materials and Equipment; GAE

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, provide a complete equipment list that includes equipment description, model number and quantity.

Spare Parts; GAE

Spare parts data for each different item of material and equipment specified.

Preliminary Tests; G

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests. Proposed date and time to begin the preliminary tests.

Final Acceptance Test; G

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests. Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

Onsite Training; G

Proposed Onsite Training schedule, at least 14 days prior to the start of related training.

Fire Protection Specialist; G

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer; G

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

Hydraulic Calculations; GAE

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

SD-06 Test Reports

Preliminary Test Report; GAE

Three copies of the completed Preliminary Test Report, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

Final Acceptance Test Report; GAE

Three copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

SD-07 Certificates Inspection by Fire Protection Specialist; GAE

SD-10 Operation and Maintenance Data; GAE

Operating and Maintenance Instructions

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

1.4 QUALITY ASSURANCE

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

1.4.1 Fire Protection Specialist

Perform work specified in this section under the supervision of and certified by the Fire Protection Specialist who is an individual registered professional engineer who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES) in a related engineering discipline with a minimum of 5 years experience, dedicated to fire protection engineering that can be verified with documentation or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall prepare a list of the fire protection related submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the contract documents, and shall have

served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.2 Sprinkler System Installer

Work specified in this section shall be performed by the Sprinkler System Installer who is regularly engaged in the installation of the type and complexity of system specified in the contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.3 Shop Drawings

Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1:100 1/8" = 1'-0" which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each riser assembly; pipe hanger; and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

1.5 DELIVERY, STORAGE, AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to

preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Provide Materials and Equipment that have been tested by Underwriters Laboratories, Inc. and are listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE.

2.4 UNDERGROUND PIPING COMPONENTS

2.4.1 Pipe

Piping from a point 6 inches (150 mm) above the floor to a point 5 feet (1500 mm) outside the building wall shall be ductile iron with a rated working pressure of 350 psi (2413 kPa) conforming to AWWA C151/A21.51, with cement mortar lining conforming to AWWA C104/A21.4. Piping more than 5 feet (1500 mm) outside the building walls shall comply with Section 33 11 00 WATER DISTRIBUTION.

2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110/A21.10. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111/A21.11.

2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel or copper.

2.5.1 Steel Piping Components

2.5.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black, Schedule 40, and galvanized Schedule 40 where indicated and shall conform to applicable provisions of ASTM A 795/A 795M, ASTM A 53/A 53M, or ASTM A 135/A 135M. Pipe in which threads are cut or grooves are rolled formed shall be Schedule 40. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Galvanized fittings shall be used for portions of piping system utilizing galvanized piping. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.5.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi (1200 kPa) service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

2.5.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch (1.6 mm) thick, and full face or self-centering flat ring type.

2.5.1.5 Flange Bolts, Nuts, and Washers

Bolts shall be conform to ASTM A 449, Type 1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque. Nuts shall be hexagon type conforming to ASME B18.2.2 or ASTM A 193/A 193M, Grade 5. Washers shall meet the requirements of ASTM F 436M ASTM F 436. Flat circular washers shall be provided under all bolt heads and nuts.

2.5.2 Copper Tube Components

2.5.2.1 Copper Tube

Copper tube shall conform to ASTM B 88M ASTM B 88, Type L.

2.5.2.2 Copper Fittings and Joints

Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M ASTM B 75. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 125 psig (862 kPa) service and shall be the product of the same manufacturer.

2.5.3 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM APP GUIDE and of the type suitable for the application, construction, and pipe type and sized to be supported.

2.5.4 Valves

2.5.4.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM APP GUIDE.

2.5.4.2 Check Valve

Check valve 2 inches (50 mm) and larger shall be listed in UL Bld Mat Dir or FM APP GUIDE. Check valves 4 inches (100 mm) and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5.4.3 Hose Valve

Valve shall comply with UL 668 and shall have a minimum rating of 300 psi (2070 kPa). Valve shall be non-rising stem, all bronze, 90 degree angle type, with 2-1/2 inch (65 mm) American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valve shall be provided with 2-1/2 to 1-1/2 inch (65 to 40 mm) reducer. Hose valves shall be equipped with lugged cap with drip drain, cap gasket and chain. Valve finish shall be polished brass.

2.6 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

2.7 WATERFLOW ALARM

Mechanically operated, exterior-mounted, water motor alarm assembly shall be

provided and installed in accordance with NFPA 13. Water motor alarm assembly shall include a body housing, impeller or pelton wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 3/4 inch (19 mm) galvanized piping shall be provided between the housing and the alarm check valve. Drain piping from the body housing shall be minimum 1 inch (25 mm) galvanized and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and outside surfaces.

2.8 ALARM INITIATING AND SUPERVISORY DEVICES

2.8.1 Sprinkler Waterflow Indicator Switch, Vane Type

Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 10 gpm (38 L/min) or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

2.8.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 1/2 inch (13 mm) NPT male pipe thread. The switch shall have a maximum service pressure rating of 175 psi (1207 kPa). There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi (28 to 55 kPa). The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

2.8.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.9 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations.

2.9.1 Recessed Sprinkler

Recessed sprinkler shall be white polyester, quick-response type, and shall

have a nominal 1/2 inch (13 mm) orifice.

2.9.2 Pendent Sprinkler

Pendent sprinkler shall be brass, glass bulb type, quick-response with nominal 1/2 inch (13 mm) orifice.

2.9.3 Upright Sprinkler

Upright sprinkler shall be brass, glass bulb type, quick-response, and shall have a nominal 1/2 inch (13 mm) orifice.

2.9.4 Sidewall Sprinkler

Sidewall sprinkler shall be brass, glass bulb type, quick-response with a nominal 1/2 inch (13 mm) orifice.

2.9.5 Dry Sprinkler Assembly

Dry sprinkler assembly shall be of the sidewall type as indicated. Assembly shall include an integral escutcheon. Maximum length shall not exceed maximum indicated in UL Fire Prot Dir. Sprinklers shall be brass.

2.10 DISINFECTING MATERIALS

2.10.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.10.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.11 ACCESSORIES

2.11.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.11.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch (19 mm) and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler.

2.11.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

2.11.4 Sprinkler Guard

Guard shall be a steel wire cage, without shield, designed to encase the sprinkler and protect it from mechanical damage.

2.11.5 Identification Sign

Valve identification sign shall be minimum 6 inches wide by 2 inches high (150 mm wide by 50 mm high) with enamel baked finish on minimum 18 gauge (1.214 mm) steel or 0.024 inch (0.6 mm) aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 13.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

Prior to ceiling installation and concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports. The Fire Protection Specialist shall: 1) inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements, 2) witness the preliminary and final tests, and sign the test results, 3) after completion of the system inspections and a successful final test, certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

3.4.1 Piping in Exposed Areas

Install exposed piping without diminishing exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.4.2 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping

shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.4.3 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 1 inch (25 mm) pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches (300 mm) for steel pipe or 6 inches (150 mm) for copper tubing. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch (25 mm) below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches (100 mm). Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches (150 mm) from ceiling grid.

3.4.4 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches (750 mm) in length shall be individually supported.

3.4.5 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools shall be products of the same manufacturer. For copper tubing, pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the

intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.4.6 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch (13 mm).

3.4.7 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.8 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.4.9 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch (25 mm) pipe connected [to the remote branch line] [at the riser as a combination test and drain valve]; a test valve located approximately 7 feet (2 m) above the floor; a smooth bore brass outlet equivalent to the smallest orifice

sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

3.4.10 Drains

Main drain piping shall be provided to discharge [at a safe point outside the building] [at the location indicated]. Auxiliary drains shall be provided as required by NFPA 13.

3.4.11 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 3.5 feet (1067 mm). The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches (150 mm) above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet (1500 mm) outside the building wall shall meet the requirements of Section 33 11 00 WATER DISTRIBUTION.

3.6 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 31 00 00 EARTHWORK.

3.7 ELECTRICAL WORK

Except as modified herein, electric equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 28 31 00.00 10 FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP.

3.8 DISINFECTION

After all system components are installed and hydrostatic test(s) are completed, the entire sprinkler system shall be disinfected. Flush all sprinkler system piping with potable water until any entrained dirt and other foreign materials have been removed before introducing chlorinating material. Remove the flushing fitting of each cross main and of each grid branch line and then back-flush through the sprinkler main drain.

a. The water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. Feed either a hypochlorite solution (using a hypochlorinator) or liquid chlorine (using a solution-fed chlorinator and booster pump) into the system at a constant rate of 50 parts per million (ppm) until the entire system is filled.

b. Monitor the chlorine residual level in the water at six hour intervals for a period of 24 hours. If the residual chlorine is below 25 ppm in any interval sampled, flush all piping and repeat the chlorination procedure. Open and close each valve in the system several times during this 24 hour period to ensure its proper disinfection. Following the 24-hour period, verify that no less than 25 ppm chlorine residual remains in the system. After the chlorine residual level is successfully maintained at or above 25 ppm for a 24 hour period, flush the system with water from the distribution system until the residual chlorine is reduced to less than one ppm.

c. Take additional samples of water at locations specified by the Contracting Officer in disinfected containers for bacterial examination. Test these samples in an approved laboratory for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA Standard Method SM9223, Total Coliforms-PA Test.

d. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in two separate test samples taken 24 hours apart. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.9 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.10 PRELIMINARY TESTS

The system, including the underground water main, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior

piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, complete certificates as specified in paragraph SUBMITTALS.

3.10.1 Underground Piping

3.10.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less that the calculated maximum water demand rate of the system. Coordinate flushing of underground piping with requirements of Section 33 11 00 WATER DISTRIBUTION.

3.10.1.2 Hydrostatic Testing

Underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts (1.89 L) per hour per 100 gaskets or joints, regardless of pipe diameter. Coordinate testing of underground piping with requirements of Section 33 11 00 WATER DISTRIBUTION.

3.10.2 Aboveground Piping

3.10.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi (1400 kPa) and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.10.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

3.10.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.11 FINAL ACCEPTANCE TEST

Begin the Final Acceptance Test only when the Preliminary Test Report has

been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. Submit the Final Acceptance Test Report as specified in the Submittals paragraph.

3.12 ONSITE TRAINING

The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 2 hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. The Onsite Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section -

SECTION 21 13 17

AIR COMPRESSORS

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide a new air compressor and connect to the new dry pipe alarm valve.

1.02 QUALITY ASSURANCE

A. Standards: American Society of Mechanical Engineers (ASME) and National Fire Protection Association (NFPA).

1.03 MAXIMUM DUTY CYCLE

A. Unit shall have sufficient capacity and designed to limit compressor operation to 25% duty cycle.

1.04 RATINGS AND CAPACITIES

A. Contractor shall size air compressor for the dry pipe sprinkler system.

B. Refer to Drawings for SCFM, outlet psig, tank gallonage, HP and electrical requirements.

PART 2 PRODUCTS

2.01 AIR COMPRESSOR

A. Simplex unit, including compressor, ASME receiver, pressure gauges, relief and safety valves, motor starter, pressure switch, solenoids, silencers, valves, and piping.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install compressor assembly on vibration isolators. Install intake and make discharge piping final connection.

3.02 COORDINATION OF WIRING

A. Provide all compressor and air maintenance device control wiring.

B. Power wiring to air compressor shall be provided by the Electrical Contractor. Coordinate electrical requirements with Electrical Contractor.

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SECTION 21 13 17.00 10

DRY PIPE SPRINKLER SYSTEM, FIRE PROTECTION

05/09

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C104/A21.4	(2008) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C652	(2002) Disinfection of Water-Storage Facilities

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Gray Iron Threaded Fittings; Classes 25, 125 and 250
ASME B16.11	(2009) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2005) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.9	(2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.2	(1987; R 2005) Standard for Square and Hex Nuts

ASTM INTERNATIONAL (ASTM)

ASTM A 135/A 135M (2009) Standard Specification for Electric-Resistance-Welded Steel Pipe

ASTM A 183 (2003; R 2009) Standard Specification for

ASTM A 193/A 193M

ASTM A 449

ASTM A 47/A 47M

ASTM A 53/A 53M

ASTM A 536ASTM A 563

ASTM A 563M

ASTM A 795/A 795M

ASTM F 436

ASTM F 436M

FM GLOBAL (FM)

FM APP GUIDE

Carbon Steel Track Bolts and Nuts

(2009) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

(2007b) Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use

(1999; R 2009) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

(1984; R 2009) Standard Specification for Ductile Iron Castings

(2007a) Standard Specification for Carbon and Alloy Steel Nuts

(2007) Standard Specification for Carbon and Alloy Steel Nuts (Metric)

(2008) Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

(2009) Hardened Steel Washers

(2009) Hardened Steel Washers (Metric)

(updated on-line) Approval Guide

http://www.approvalguide.com/CC_host/pages/public/custom

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71 (2005) Gray Iron Swing Check Valves, Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2009; Amd 09-1 & 09-2) Life Safety Code
NFPA 13	(2010) Standard for the Installation of Sprinkler Systems
NFPA 13D	(2010) Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes
NFPA 13R	(2010) Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height
NFPA 1963	(2009; Errata 09-1) Standard for Fire Hose Connections
NFPA 24	(2010) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(2003) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2009) Building Materials Directory
UL Fire Prot Dir	(2009) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

a. Furnish piping offsets, fittings, and any other accessories as required to provide a complete installation and to eliminate interference with other construction. Install sprinkler over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

b. Provide dry pipe sprinkler system in attic area of the building. The sprinkler system shall provide fire sprinkler protection for the entire area. Design and install the system in accordance with NFPA 13. Pipe sizes, which are not indicated on the drawings, shall be determined by hydraulic calculation. Gridded systems shall not be used.

c. Design any portions of the sprinkler system that are not indicated

on the drawings or are not specified herein, including locating sprinklers, piping, and equipment, and size piping and equipment. Base the design of the sprinkler system on hydraulic calculations, and the other provisions specified herein.

1.2.1 Hydraulic Design

Hydraulically design the system to discharge a minimum density of 0.10 gpm per square foot (4.05 L/min per square m) over the hydraulically most demanding 1500 square feet (139 square m) of floor area. Provide hydraulic calculations in accordance with the Area\Density Method of NFPA 13. Water velocity in the piping shall not exceed 20 ft/s (6 m/s).

1.2.1.1 Hose Demand

Add a total inside and outside hose streams of 250 gpm (946 L/min) to the sprinkler system demand at the fire hydrant closest to the point where the water service enters the building.

1.2.1.2 Basis for Calculations

Waterflow and pressure is presumed adequate based on information provided by the Owner. Base hydraulic calculations upon the Hazen-Williams formula with a "C" value of 120 for galvanized steel piping, and 140 for new cement-lined ductile-iron piping.

a. Outline hydraulic calculations as in NFPA 13, except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically.

b. Plot water supply curves and system requirements on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows. Indicate elevations of hydraulic reference points (nodes). Documentation shall identify each pipe individually and the nodes connected thereto. Indicate for each pipe the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient.

c. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is

being used. Also for gridded systems, include a flow diagram indicating the quantity and direction of flows. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.2.2 Sprinkler Coverage

Uniformly space sprinklers on branch lines. Provide coverage throughout 100 percent of the attic spaces. Coverage per sprinkler shall be in accordance with NFPA 13, but not exceeding 130 square feet (12 square m) for ordinary hazard occupancies, and 225 square feet (21 square m) for light hazard occupancies.

1.2.3 System Volume Limitations

Where the volume of individual system piping exceeds 500 gallons (1890 L), provide the dry pipe valve with a quick-opening device. The maximum system capacity controlled by one dry pipe valve shall not exceed 750 gallons (2800 L). Indicate the calculated volume of each system on the Sprinkler System Shop Drawings.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.][information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; GAE

Three copies of the Sprinkler System Drawings, no later than 21 days prior to the start of sprinkler system installation. The drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance.

As-Built Drawings

As-built shop drawings, at least 14 days after completion of the Final Tests.

SD-03 Product Data

List of the Submittals

A list of the Fire Protection Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist.

Materials and Equipment; GAE

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. Highlight the data to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, provide a complete equipment list that includes equipment description, model number and quantity.

Spare Parts; GAE

Spare parts data for each different item of material and equipment specified.

Fire Protection Specialist; G

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system shop drawings and hydraulic calculations.

Installer Qualifications; G

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

Onsite Training; G

Proposed Onsite Training schedule, at least 14 days prior to the start of related training.

Hydraulic Calculations; GAE

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

SD-06 Test Reports

Preliminary Tests; GAE

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests. Proposed date and time to begin Preliminary Tests, submitted with the Preliminary Tests Procedures.

Three copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

Final Acceptance Test; GAE

Proposed procedures for Final Acceptance Test, no later than 14

days prior to the proposed start of the tests. Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

Three copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

SD-07 Certificates

Inspection by Fire Protection Specialist; GAE

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

SD-10 Operation and Maintenance Data; GAE

Operating and Maintenance Instructions

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

1.4 QUALITY ASSURANCE

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

1.4.1 Fire Protection Specialist

Perform the work specified in this section under the supervision of and certified by the Fire Protection Specialist who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.2 Installer Qualifications

Work specified in this section shall be performed by the Sprinkler System Installer. The Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.3 Shop Drawings

Submit shop drawings, on reproducible full-size mylar film, as specified herein and in the Submittals paragraph; update the Shop drawings to reflect as-built conditions after all related work is completed. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1:100 1/8" = 1'-0" which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Indicate each type of fitting used and the locations of bushings, reducing couplings, and welded joints.

c. Actual center-to-center dimensions between sprinklers on branch

lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of riser assembly; air supply system and piping; pipe hanger; and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

1.5 DELIVERY, STORAGE, AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE.

2.4 ABOVEGROUND PIPING COMPONENTS

2.4.1 Steel Pipe

Except as modified herein, steel pipe shall be galvanized Schedule 40 and shall conform to applicable provisions of ASTM A 795/A 795M, ASTM A 53/A 53M, or ASTM A 135/A 135M. Pipe in which threads are cut or grooves are rolled formed shall be Schedule 40. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.4.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be galvanized steel conforming to ASME B16.9 or ASME B16.11. Fittings that sprinklers, drop nipples or riser nipples (sprigs) are screwed into shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.4.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi (1200 kPa) service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gaskets shall be of silicon compound and approved for dry fire protection systems. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

2.4.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch (1.6 mm) thick, and full face or self-centering flat ring type.

2.4.4.1 Flange Bolts

Bolts shall be ASTM A 449, Type 1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2.4.4.2 Nuts

Nuts shall be hexagon type conforming to ASME B18.2.2 or ASTM A 193/A 193M, Grade 5.

2.4.4.3 Washers

Washers shall meet the requirements of ASTM F 436M ASTM F 436. Flat circular washers shall be provided under all bolt heads and nuts.

2.4.5 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM APP GUIDE and of the type suitable for the application, construction, and pipe type and size to be

supported.

2.4.6 Valves

2.4.6.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM APP GUIDE.

2.4.6.2 Check Valve

Check valve 2 inches (50 mm) and larger shall be listed in UL Bld Mat Dir or FM APP GUIDE. Check valves 4 inches (100 mm) and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5 DRY PIPE VALVE ASSEMBLY

The dry pipe valve shall be a latching differential type listed in UL Fire Prot Dir or FM APP GUIDE and shall be complete with trim piping, valves, fittings, pressure gauges, priming water fill cup, velocity drip check, drip cup, and other ancillary components as required for proper operation. The assembly shall include a quick-opening device by the same manufacturer as the dry pipe valve for systems over 500 gallons (1890 L) in capacity.

2.6 SUPERVISORY AIR SYSTEM

Provide an air supply system in accordance with NFPA 13. The connection pipe from the air compressor shall not be less than 1/2 inch (13 mm) in diameter and shall enter the system above the priming water level of the dry pipe valve. Install a check valve in the system supply air piping from the compressor. A shutoff valve of the renewable disc type shall be installed upstream of this check valve. The air supply system shall be sized to pressurize the sprinkler system to 45 psi (310 kPa) within 30 minutes.

2.6.1 Air Compressor

Compressor shall be single stage oil-free type, air-cooled, electric-motor driven, equipped with a check valve, shutoff valve and pressure switch for automatic starting and stopping. Pressure switch shall be factory set to start the compressor at 35 psi (241 kPa) and stop it at 45 psi (310 kPa). A safety relief valve, set to operate at 70 psi (483 kPa), shall be provided.

2.6.2 Air Pressure Maintenance Device

Device shall be a pressure regulator that automatically reduces supply air to provide the pressure required to be maintained in the piping system. The device shall have a cast bronze body and valve housing complete with diaphragm assembly, spring, filter, ball check to prevent backflow, 1/16

inch (1.6 mm) restriction to prevent rapid pressurization of the system, and adjustment screw. The device shall be capable of reducing an inlet pressure of up to 100 psig (680 kPa) to a fixed outlet pressure adjustable to 10 psig (70 kPa).

2.6.3 Air Supply Piping System

Piping shall be galvanized steel in accordance with ASTM A 795/A 795M or ASTM A 53/A 53M.

2.6.4 Low Air Pressure Alarm Device

Each dry pipe valve trim shall be provided with a local alarm device consisting of a metal enclosure containing an alarm horn or bell, silence switch, green power-on light, red low-air alarm light and amber trouble light. Activate the alarm device by the low air pressure switch. Upon reduction of sprinkler system pressure to approximately 10 psig (70 kPa) above the dry valve trip point pressure, the low air pressure switch shall actuate the audible alarm device and a red low-air alarm light. Restoration of system pressure shall cause the low-air alarm light to be extinguished and the audible alarm to be silenced. An alarm silence switch shall be provided to silence the audible alarm. An amber trouble light shall be provided which will illuminate upon operation of the silence switch and shall be extinguished upon return to its normal position.

2.7 WATERFLOW ALARM

Mechanically operated, exterior-mounted, water motor alarm assembly shall be provided and installed in accordance with NFPA 13. Water motor alarm assembly shall include a body housing, impeller or pelton wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 3/4 inch (19 mm) valve. Drain piping from the body housing shall be minimum 1 inch (25 mm) galvanized and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and outside surfaces.

2.8 ALARM INITIATING AND SUPERVISORY DEVICES

2.8.1 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 1/2 inch (13 mm) NPT male pipe thread. The switch shall have a maximum service pressure rating of 175 psi (1207 kPa). There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi (28 to 55 kPa). The switch shall be capable of being mounted in any position in the alarm line trim piping of the dry pipe valve.

2.8.2 Low Air Pressure Supervisory Switch

The pressure switch shall supervise the air pressure in system and shall be set to activate at 10 psi (70 kPa) above the dry pipe valve trip point pressure. The switch shall have an adjustable range between 5 and 80 psi (35 and 500 kPa). The switch shall have screw terminal connection and shall be capable of being wired for normally open or normally closed circuit.

2.8.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.9 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Areas where sprinklers are connected to or are a part of the dry pipe system shall be considered unheated and subject to freezing. Temperature classification shall be ordinary for ventilated spaces and intermediate for unventilated attic spaces. Sprinklers in high heat areas including attic spaces shall have temperature classification in accordance with NFPA 13.

2.10.1 Pendent Sprinkler

Pendent sprinkler heads shall be the dry pendent type, unless otherwise indicated. Pendent sprinkler shall be of the glass bulb type, quick-response type with nominal 1/2 inch (13 mm) orifice. Pendent sprinklers shall be brass. Maximum length shall not exceed the maximum length indicated in UL Fire Prot Dir.

2.10.2 Upright Sprinkler

Upright sprinkler shall be brass, quick-response type, and shall have a nominal 1/2 inch (13 mm) orifice.

2.11 DISINFECTING MATERIALS

2.11.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.11.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.12 ACCESSORIES

2.12.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be

provided.

2.12.2 Identification Sign

Valve identification sign shall be minimum 6 inches wide by 2 inches high (150 mm wide by 50 mm high) with enamel baked finish on minimum 18 gauge (1.214 mm) steel or 0.024 inch (0.6 mm) aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, and publications referenced therein.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

3.4.1 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches (750 mm) in length shall be individually supported.

3.4.2 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13

at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.4.3 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch (13 mm).

3.4.4 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve in accordance with NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.5 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch (25 mm) pipe connected to the remote branch line; a test valve located approximately 7 feet (2 m) above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test."

The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

3.4.6 Drains

Provide main drain piping to discharge at a safe point outside the building. Auxiliary drains shall be provided as indicated and as required by NFPA 13. When the capacity of trapped sections of pipe is less than 3 gallons (11 L), the auxiliary drain shall consist of a valve not smaller than 1/2 inch (13 mm) and a plug or nipple and cap. When the capacity of trapped sections of piping is more than 3 gallons (11 L), the auxiliary drain shall consist of two 1 inch (25 mm) valves and one 2 x 12 inch (50 x 300 mm) condensate nipple or equivalent, located in an accessible location. Tie-in drains shall be provided for multiple adjacent trapped branch pipes and shall be a minimum of 1 inch (25 mm) in diameter. Tie-in drain lines shall be pitched a minimum of 1/2 inch per 10 feet (13 mm per 3 m).

3.4.7 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 ELECTRICAL WORK

Except as modified herein, electric equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 28 31 00.00 10 FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP.

3.6 DISINFECTION

After all system components are installed and hydrostatic test(s) are completed, the entire sprinkler system shall be disinfected. Flush all sprinkler system piping with potable water until any entrained dirt and other foreign materials have been removed before introducing chlorinating material. Remove the flushing fitting of each cross main and of each grid branch line and then back-flush through the sprinkler main drain.

a. The water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. Feed either a hypochlorite solution (using a hypochlorinator) or liquid chlorine (using a solution-fed chlorinator and booster pump) into the system at a constant rate of 50 parts per million (ppm) until the entire system is filled.

b. Monitor the chlorine residual level in the water at six hour intervals for a period of 24 hours. If the residual chlorine is below 25 ppm in any interval sampled, flush all piping and repeat the chlorination procedure. Open and close each valve in the system several times during this 24 hour period to ensure its proper disinfection. Following the 24-hour period, verify that no less than 25 ppm chlorine residual remains in the system. After the chlorine residual level is successfully maintained at or above 25 ppm for a 24 hour period, flush the system with water from the distribution system until the residual chlorine is reduced to less than one ppm.

c. Take additional samples of water at locations specified by the Contracting Officer in disinfected containers for bacterial examination. Test these samples in an approved laboratory for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA Standard Method SM9223, Total Coliforms-PA Test.

d. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in two separate test samples taken 24 hours apart. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.7 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.8 PRELIMINARY TESTS

The system, including the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, complete certificates as specified in paragraph SUBMITTALS.

3.8.2 Aboveground Piping

3.8.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi (1400 kPa) and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.8.3 Testing of Alarm Devices

Each alarm initiating device, including pressure alarm switch, low air pressure switch, valve supervisory switch, and electrically-operated switch shall be tested for proper operation. Water motor alarm shall be tested. The connecting circuit to the building fire alarm system shall be inspected and tested.

3.8.4 Trip Tests of Dry Pipe Valves

Dry pipe valve shall be trip-tested by reducing normal system air pressure through operation the inspector's test connection. System equipped with quick opening device shall be first tested without the operation of the quick opening device and then with it in operation. Test results will be witnessed and recorded. Test results shall include the number of seconds elapsed between the time the test valve is opened and tripping of the dry valve; trip-point air pressure of the dry pipe valve; water pressure prior to valve tripping; and number of seconds elapsed between time the inspector's test valve is opened and water reaches the orifice.

3.8.5 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.9 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. Each system shall be completely drained after each trip test. The system air supply system shall be tested to verify that system pressure is restored in the specified time. In addition, the Fire Protection Specialist shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. After the system has been tested and drained, the system shall be drained periodically for at least 2 weeks until it can be assured that water from the system has been removed.

3.10 ONSITE TRAINING

The Fire Protection Specialist and Manufacturer's Representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 2 hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. The Onsite Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

SECTION 22 05 11

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section 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

E. Section 00 72 00, GENERAL CONDITIONS.

F. Section 01 00 00, GENERAL REQUIREMENTS.

G. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

H. Excavation and Backfill: Section 31 20 00, EARTH MOVING.

E. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.

F. Section 05 50 00, METAL FABRICATIONS.

G. Section 07 84 00, FIRESTOPPING.

H. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

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, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

M. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

N. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

O. 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. 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; see other specification sections for any exceptions.

2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 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. Submit 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.
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. Conform to codes and standards as required by the specifications and local codes; refer any conflicts to the COTR (RE)/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 a single manufacturer.
6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
7. Nameplate bearing the manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment. Or the manufacturer’s name or trademark shall be 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. Before any welding is performed, the 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 the certification is current.

C. Manufacturer's installation procedures shall be followed for all equipment or any part thereof with a copy 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. Apply and install all items in accordance with manufacturer's written instructions; refer conflicts between the manufacturer's instructions, contract drawings and specifications to the COTR for resolution. Provide written hard copies or computer files of manufacturer’s installation instructions to the COTR at least two weeks prior to commencing installation of any item.
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: filters and strainers, transmitters, control devices, etc. Prior to commencing installation work, refer conflicts between this requirement and contract drawings to the 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.

E. Guaranty: Section 00 72 00, GENERAL CONDITIONS.

F. Plumbing Systems: International Plumbing Code.

1.4 SUBMITTALS

A. Submit 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, COMMON WORK RESULTS FOR PLUMBING", with applicable "Group" number.

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; jointly coordinated and properly integrating their equipment and controls to provide a complete and efficient installation.

F. 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.

G. Manufacturer's Literature and Data: shall be submitted under the pertinent section rather than under this section.

1. Submit electric motor data and variable speed drive data 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 shall be provided in accordance with Section 00 72 00, GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION. Submit complete consolidated and coordinated layout drawings for all new systems and existing systems (if applicable) that are in the same areas. The drawings shall include plan views, elevations and sections of all systems 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. Show the access means for all items requiring access for operations and maintenance. Do not install equipment foundations, equipment or piping until layout drawings have been approved. Provide detailed layout drawings of all piping systems, additionally provide details of the following.

1. Mechanical equipment rooms.
2. Interstitial space.

3. Hangers, inserts, supports, and bracing.
4. Pipe sleeves.
5. 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. 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.

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. Place damaged equipment in first class, new operating condition; or replace same as determined and directed by the 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; 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. 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 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-98.....Qualifications Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

C. American Society for Testing and Materials (ASTM):
A36/A36M-2001.....Carbon Structural Steel
A575-96.....Steel Bars, Carbon, Merchant Quality, M-Grades R (2002)
E84-2003.....Standard Test Method for Burning Characteristics of Building Materials
E119-2000.....Standard Test Method for Fire Tests of Building Construction and Materials

D. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
SP-58-93.....Pipe Hangers and Supports-Materials, Design and Manufacture
SP 69-2003.....Pipe Hangers and Supports-Selection and Application

E. National Electrical Manufacturers Association (NEMA):
MG1-2003, Rev. 1-2004...Motors and Generators

F. International Plumbing Code, IPC-2009

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 so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 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.

2.4 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). 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. 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; includes wiring on 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.

C. 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 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" 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. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

F. 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.

G. Insulation Resistance shall not be less than one-half meg-ohm between stator conductors and frame, determined at the time of final inspection.

2.5 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. Valve Tags and Lists:

1. Plumbing: Provide for all valves (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: 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.

2.6 FIRESTOPPING

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 firestop pipe insulation.

2.7 GALVANIZED REPAIR COMPOUND

Mil. Spec. DOD-P-21035B, paint form.

2.8 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. 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.

B. 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 (four 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 (four inches) thick when approved by the COTR for each job condition.

C. For Attachment to Wood Construction: Wood screws or lag bolts.

D. 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.

E. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 62 mm by 41 mm (2-7/16 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.

F. 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 preinsulated calcium silicate shields, or provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers.
   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. Saddle support: Type 36, 37 or 38.
      e. Turnbuckle: Types 13 or 15. preinsulate
      f. U-bolt clamp: Type 24.
      g. 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 supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
3) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

h. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.

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.

G. 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.

H. Seismic Restraint of Piping: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

2.9 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 drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

C. 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.

D. 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.

E. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide sleeve for pipe passing through floor of mechanical room.

F. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors; connect sleeve with floor plate.

G. Sleeves are not required in drywall construction.

H. Sleeve Clearance: Sleeve through floors, walls, and partitions 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.

I. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.10 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: Hardwood or metal, permanently identified for in tended service and mounted, or located, where directed by the COTR.

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.

2.11 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; used 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.

2.12 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, and equipment, access provisions, and work of all trades; locate piping, sleeves, inserts, hangers, 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. Piping Support: Coordinate structural systems necessary for pipe support with pipe locations to permit proper installation.

D. Location of pipe sleeves and chases shall be accurately coordinated with equipment and piping locations.

E. Cutting Holes:

1. Cut holes through masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COTR where working area space is limited.
2. Do not penetrate membrane waterproofing.

F. Interconnection of Instrumentation or Control Devices: Generally, electrical 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. 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.

I. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

J. 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.

K. Electrical 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.

L. 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.

M. 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 PIPE SUPPORTS

A. Where hanger spacing does not correspond with trusses, use steel channels secured directly to trusses that will correspond to the required hanger spacing, and then suspend the piping from the channels.

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. Plumbing horizontal and vertical pipe supports, refer to the International Plumbing Code.

E. Overhead Supports:
   1. The basic structural system of the building is designed to sustain the loads imposed by piping to be supported overhead.
   2. Provide steel channels of adequate capability to support the imposed loads, located in accordance with the final approved layout of piping.
   3. Tubing and capillary systems shall be supported in channel troughs.
F. Floor Supports:
   1. Provide concrete bases, concrete anchor blocks and pedestals for support of plumbing equipment and piping; anchor and dowel concrete bases 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 100 mm (4 inch) excess on all edges. Bases shall be neatly finished and smoothed; having chamfered edges at the top, and 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.
   4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.3 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 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.

3.4 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. Control valves and thermostatic elements.
   d. Lubrication devices and grease fittings.
   e. Copper, brass, aluminum, stainless steel and bronze surfaces.
   f. Valve stems and rotating shafts.
   g. Pressure gauges and thermometers.
   h. Glass.
   i. Name plates.
3. Control and instrument panels shall be cleaned; damaged surfaces repaired, and 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. 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.

3.5 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.

3.6 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.

3.7 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 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.

3.8 OPERATION AND MAINTENANCE MANUALS

A. Provide four bound copies; delivered to COTR not less than 30 days prior to completion of a phase or final inspection.

B. Include all new and temporary equipment and all elements of each assembly.

C. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size and other data.

D. Manufacturer’s installation, maintenance, repair, and operation instructions for each device; include assembly drawings and parts lists along with operating precautions and reasons for precautions.

E. Lubrication instructions including type and quantity of lubricant.

F. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications.

G. Set points of all interlock devices.

H. Trouble-shooting guide for control systems.

I. Operation of the combustion control system.

J. Emergency procedures.

3.9 INSTRUCTIONS TO VA PERSONNEL

Provide 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 specifies the furnishing, installation and connection of motors for plumbing equipment.

1.2 RELATED WORK:

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements 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 Division22.

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. 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 COTR:

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-(most current).....Motors and Generators

MG 2-(most current).....Safety Standard and Guide for Selection, Installation and Use of Electric Motors and Generators

C. National Fire Protection Association (NFPA):

70-(most current).....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.
2. Three phase:
   a. Motors connected to 208-volt systems: 200 volts.

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 raises 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.

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

A. Water meter shall be installed in an outside pit and shall be the responsibility of the Contractor. Integration of water meter with facility wireless metering data collection is part of the scope of this project and is the responsibility of the Contractor.

B. 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.

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):
B40.1-(current edition).Gauges-Pressure Indicating Dial Type-Elastic

C. International Plumbing Code: IPC (current edition)

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 1375 kPa (0 to psi) gauge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the manufacturers’ recommendations.

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SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. General-duty valves for domestic water systems.

1.2 RELATED WORK

A. 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 Valve.
4. 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. American Society for Testing and Materials (ASTM):

A536-84(R1999) E1.....Ductile Iron Castings

C..International Plumbing Code: IPC (current edition)

D. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-67-(current edition).Butterfly Valve of the Single flange Type (Lug Wafer)

SP-70-(current edition).Cast Iron Gate Valves, Flanged and Threaded Ends.

SP-72-(current edition).Ball Valves With Flanged or Butt Welding For General Purpose

SP-80-(current edition).Bronze Gate, Globe, Angle and Check Valves.

SP-110-(current edition) Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

E. American Society of Sanitary Engineers (ASSE):

1013-(current edition)..Reduced Pressure Principle Backflow Preventers

1015-(current edition)..Double Check Backflow Prevention Assembly

PART 2 - PRODUCTS

2.1 VALVES

A. Asbestos packing is prohibited.

B. Shut-off:

1. Water:

a. Fifty millimeter (2 inches) and smaller:

1) Ball, Mss SP-72, SP-110, Type II, Class 125, Style 1, three piece or double union end construction, full ported, full flow, with solder end connections, 2750 kPa (400 psi) WOG, MSS-SP-67.

b. Less than 100 mm (4 inches): Butterfly, iron body, aluminum bronze disc, 416 stainless steel stem, EPDM seat, wafer design, lever operator to six 150 mm (6 inch)size, , 1375 kPa (200 pound) WOG, Fed. Spec WW-V-1967.

1) Gate, MSS-SP-70, wedge disc, class 125, cast iron body with bronze trim, flanged.

2) Grooved end butterfly valves with ductile iron body and disc core ASTM A536. Disc rubber coated with compatible material for intended service, maximum working pressure 2050 kPa (300 pounds psi) grooved ends for connection with mechanical grooved couplings.

2. Reagent Grade Water: Shall be ball type of same material as used for pipe.

C. Check:

1. Less than 100 mm (3 inches) and smaller): Bronze body and trim, swing type, MSS-SP-80, 850 kPa (125 pound) WSP.

2. Larger than 100 mm (4 inches and larger):

a. Iron body, bronze trim, swing type, vertical or horizontal installation, flange connections, 1375 kPa (200 pound) WOG.

b. Ductile iron (ASTM A536) or malleable iron (ASTM A47) body, stainless steel or aluminum bronze trim, dual disc, spring loaded, non-slamming design with grooved ends for connection with mechanical grooved couplings. Consult manufacturer for appropriate elastomeric seal for intended service. Maximum working pressure 3450 kPa (500 pounds psi), depending on size.

D. Globe:

1. Eighty millimeters (3 inches) or smaller: Bronze body and bonnet, MSS-SP-80, 850 kPa (125 pound) WSP. Disk shall be free to swivel on

the stem. Composition seating surface disk construction may be substituted for all metal disk construction. Packing shall be a woven non-asbestos material, impregnated with not less than 25 percent, by weight, tetrafluoroethylene resin.

2. Larger than 80 mm (3 inches): Similar to above, except with cast iron body and bronze trim.

2.2 WATER PRESSURE REDUCING VALVE AND CONNECTIONS

A. Single-seated, for dead end service for 200 to 850 kPa (30 to 125 pounds) range on low pressure side. Composition diaphragm and stainless steel springs, bronze body with threaded connections for sizes 15 to 55 mm (1/2 to 2 inch), cast iron or semi-steel body with brass or bronze trimmings and flanged connections for sizes 15 to 50 mm (2-1/2 to 4 inch).

B. Operation: Diaphragm and spring to act directly on valve stem. Delivered pressure shall vary not more than one kPa for each 10 kPa (one pound for each 10 pounds) variation on inlet pressure.

C. Setting: Entering water pressure, discharge pressure, capacity, size, and related measurements shall be as shown on the drawings.

D. Connections Valves and Strainers: Install shut off valve on each side of reducing valve and full sized bypass with globe valve. Install strainer on inlet side of, and same size as pressure reducing valve. Install pressure gage on low pressure side of line.

2.3 BACKFLOW PREVENTERS

A. Provide a backflow prevention device at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. Device shall be certified by the American Society of Sanitary Engineers. Listed below is a partial list of connection to the potable water system which shall be protected against backflow or back siphonage.

B. Reduced Pressure Backflow Preventer: ASSE 1013.

1. Water make-up to heating and chilled water systems.
2. Water service entrance from loop system.

C. Pressure Type: ASSE 1020

1. Detergent systems

D. Atmospheric Vacuum Breaker: ASSE 1001

1. Hose bibbs and sinks w/threaded outlets.
2. Showers (telephone type).
3. Hydrotherapy units.

E. Double Check Detector Backflow Prevention Assembly: Fire service. ASSE 1015.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International Plumbing Code and the following:

1. Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible; installing valve in each water connection to fixture.
2. Install union and shut-off valve on pressure piping at connections to equipment.
3. Backflow prevention device shall be installed in an accessible location, 4 (four) feet above finish floor.

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SECTION 22 05 33

HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

Hot water temperature maintenance/cable for domestic hot water piping.

1.2 RELATED WORK

A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

B. Section 26 05 11, COMMON WORK RESULTS FOR ELECTRICAL.

C. Section xx xx xx, COMMON WORK RESULTS FOR CONTROLS.

D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT 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: Hot water temperature maintenance heat tracing.

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.):

L-T-1512A.....Cable, Pressure Sensitive Adhesive, Pipe Wrapping

C. International Plumbing Code: IPC (current edition).

PART 2 - PRODUCTS

2.1 HOT WATER TEMPERATURE MAINTENANCE HEAT TRACING

Electric heat tracing, automatic self-regulating cable, UL listed, tinned copper braid shield, able to crossover itself without overheating, parallel circuit design able to be cut to any length at job site and shall be corrosive and chemical resistant. Heat tracing shall maintain hot water temperature as scheduled on drawings. Heat tracing shall operate on a 208V, maximum 30-amp circuit. Heat tracing components shall not require stripping of the heating cable. All components shall be UV stabilized and water proof. All power components and end seals shall be set on pipe stands above the insulation as required by NEC. End seals shall include LED lights with a 40-year

useful life. All components shall include labels to identify the component as required by NEC.

2.2 HEAT TRACING SYSTEM

Heat tracing system shall include a controller for control and monitoring of the heat trace system. Controller shall be able to set system temperature. Controller shall include a temperature probe to be mounted on the hot water supply line; monitoring temperature. Controller shall also monitor the heat tracing system for high and low temperature; alarming on out of range conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

General: Comply with the manufacturer's installation instructions, NEC and plumbing code requirements.

3.2 Heating cable secured to the pipe every 18" with glass fiber tape. Heating cable shall be held tight to the piping system. Service loops are required for components and to allow removal of the heat tracing cable without removal or disconnection of system components.

3.3 Controller shall be located as indicated on the drawings. Each heat trace circuit shall be connected to a controller per the manufacturer's recommendations. RTD and/or thermistors shall also be wired into the controller. All controllers shall be wired to a 30-amp ground fault circuit protector.

3.4 TESTS

A. Heat Tracing Systems Testing: Continuity test heat tracing systems and test insulation resistance. Continuity test each cable by applying 12 or 24 VCD to bus wires at the power connection kit and checking voltage drop at the ends of each branch of the circuit. Voltage drop shall not be less than 75 % of the applied voltage. For insulation resistance test (Megger Test) of each cable, use a megometer. Megger Test at 2500 VDC each cable system two times. Perform first Megger Test after cable is installed, but prior to the installation of insulation. Minimum Megger readings shall be 20 megohms, regardless of heater length. If Megger reading is less than 20 megohms, locate the fault and correct or replace cable. Manufacturer's representative of the tracing shall supervise tests. Submit "test Certificates of Approval" for all tests, including test values of each circuit, signature of manufacturer's

representative, and manufacturer's representative’s approval of test results.

B. Capacitance Test – to determine the installed length the heat trace cable per circuit.

C. System shall include a 10-year system warranty from the manufacturer and be include with final test results.

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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 23 07 11, HVAC, PLUMBING, AND BOILER PLANT 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. 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-(current edition).Scheme for Identification of Piping Systems

B16.3-(current edition).Malleable Iron Threaded Fittings ANSI/ASME

B16.4-(current edition).Cast Iron Threaded Fittings Classes 125 and 250 ANSI/ASME

B16.9-(current edition).Factory-Made Wrought Steel Buttwelding Fittings ANSI/ASME

B16.11-(current edition) Forged Steel Fittings, Socket-Welding and Threaded ANSI/ASME

B16.12-(current edition) Cast Iron Threaded Drainage Fittings ANSI/ASME

B16.15-(current edition) Cast Bronze Threaded Fittings ANSI/ASME

B16.18-(current edition) Cast Copper Alloy Solder-Joint Pressure Fittings ANSI/ASME

B16.22-(current edition) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings ANSI/ASME Element ANSI/ASME

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

A47-(current edition)...Ferritic Malleable Iron Castings

A53-(current edition)...Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless

A74-(current edition)...Cast Iron Soil Pipe and Fittings

A183-(current edition)..Carbon Steel Track Bolts and Nuts

A312-(current edition)..Seamless and Welded Austenitic Stainless Steel Pipe

A536-(current edition)..Ductile Iron Castings

A733-(current edition)..Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

B32-(current edition)...Solder Metal

B61-(current edition)...Steam or Bronze Castings

B62-(current edition)...Composition Bronze or Ounce Metal Castings

B75-(current edition)...Seamless Copper Tube

B88-(current edition)...Seamless Copper Water Tube

B584-(current edition)..Copper Alloy Sand Castings for General Applications Revision A

B687-(current edition)..Brass, Copper, and Chromium-Plated Pipe Nipples

E1120.....Standard Specification For Liquid Chlorine

E1229.....Standard Specification For Calcium Hypochlorite

E. American Water Works Association (AWWA):

C110-03/ A21.10-(current edition) 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-(current edition) Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids AWWA/ ANSI

C203-(current edition)Steel Water Pipelines - Enamel and Tape - Hot Applied AWWA/ ANSI

C651-(current edition)..Disinfecting Water Mains

F. American Welding Society (AWS):

A5.8-(current edition)..Filler Metals for Brazing

G. International Plumbing Code: IPC – current edition.

H. International Mechanical Code: IMC – current edition

I. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-72-(current edition).Ball Valves With Flanged or Butt Welding For General Purpose

SP-110-(current edition) Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

J. American Society of Sanitary Engineers (ASSE):

1001-(current edition)..Pipe Applied Atmospheric Type Vacuum Breakers

1018-(current edition)..Performance for trap seal primer valve-water supply fed

1020-(current edition)..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 approximately 300 mm (1 foot) above the finished floor, terminated with a blind flange, 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; “megaflange” shall be used on all fittings within the foundation wall to a point at least 1500 mm (5 feet).

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.

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.

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 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.

2.5 DIELECTRIC FITTINGS

Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

2.6 STERILIZATION CHEMICALS

A. Liquid Chlorine: ASTM E1120.

B. Hypochlorite: ASTM E1229, or Fed. Spec. AA-1427C, grade B.

2.7 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International 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.
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 International Plumbing Code.
   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. Reagent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 690 kPa (100 psi) gage during inspection and prove tight.
D. 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 13 00

FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 DESCRIPTION

Sanitary sewerage 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 23 07 11, HVAC, PLUMBING, AND BOILER PLANT 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. 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 National Standards Institute (ANSI):

American Society of Mechanical Engineers (ASME): (Copyrighted Society)

A112.1.1M-(current edition) Floor Drains ANSI/ASME

A13.1-(current edition) Scheme for Identification of Piping Systems

B16.3-(current edition) Malleable Iron Threaded Fittings ANSI/ASME

B16.4-(current edition) Cast Iron Threaded Fittings Classes 125 and 250 ANSI/ASME

B16.12-(current edition)...Cast Iron Threaded Drainage Fittings ANSI/ASME

B16.15-(current edition)...Cast Bronze Threaded Fittings ANSI/ASME Element ANSI/ASME

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

A47-(current edition)...Ferritic Malleable Iron Castings

A53-(current edition)...Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless

A74-(current edition)...Cast Iron Soil Pipe and Fittings

A183-(current edition)..Carbon Steel Track Bolts and Nuts

A536-(current edition)..Ductile Iron Castings

B32-(current edition)...Solder Metal

B75-(current edition)...Seamless Copper Tube

B306-(current edition)..Copper Drainage Tube (DWV)

B584-(current edition)..Copper Alloy Sand Castings for General Applications Revision A

C564-(current edition)..Rubber Gaskets for Cast Iron Soil Pipe and Fittings

D2000-(current edition).Rubber Products in Automotive Applications

D2564-(current edition).Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

D2665-(current edition).Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

D. International Plumbing Code: (current edition)

E. Cast Iron Soil Pipe Institute (CISPI):

301-(current edition)...Hubless Cast Iron Soil and Fittings

F. International Mechanical Code: (current edition)

G. Factory Mutual (FM):

a. Coupling Used in Hubless Cast Iron Systems for Drains, Waste and Vent Systems.

H. Plumbing and Drainage Institute (PDI):

PDI WH-201.....Water Hammer Arrestor

PART 2 - PRODUCTS

2.1 SANITARY PIPING

A. Cast Iron Soil Pipe and Fittings: Used for pipe buried in or in contact with earth and for extension of pipe to a distance of approximately 1500 mm (5 feet) outside of building walls and interior waste and vent piping above grade. Pipe shall be bell and spigot, modified hub, or plain end (no-hub) as required by selected jointing method:

1. Material, (Pipe and Fittings): ASTM A74, C1SP1-301, Service Class.

2. Joints: Provide any one of the following types to suit pipe furnished.
   a. Double seal, compression-type molded neoprene gasket. Gaskets shall suit class of pipe being jointed.
   b. Mechanical: Meet the requirements and criteria for pressure, leak, deflection and shear tests as outlined in Factory Mutual No. 1680 for Class 1 couplings.
      1) Stainless steel clamp type coupling of elastomeric sealing sleeve, ASTM C564 and a Series 300 stainless steel shield and clamp assembly. Sealing sleeve with center-stop to prevent contact between pipes/fittings being joined shall be marked ASTM C564.
      2) Cast Iron coupling with neoprene gasket and stainless steel bolts and nuts.

B. Steel Pipe and Fittings: May be used for vent piping above grade.
   1. Pipe Galvanized: ASTM A53, standard weight.
   2. Fittings:
      a. Soil, Waste and Drain Piping: Cast iron, ANSI B16.12, threaded, galvanized.
      b. Sanitary and Exhaust Vent Piping: Malleable iron, ANSI B16.3, or cast iron, ANSI B16.4. All piping shall be of the same kind. Couplings of vent piping may be standard couplings furnished with pipe.
      c. Unions: Tucker connection or equivalent type throughout.

C. Copper Tube, (DWV): May be used for piping above ground, except for urinal drains.
   1. Tube: ASTM B306.
   2. Fittings:
      a. Solder type.
      b. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper conforming to ASTM B75 C12200, 125 to 150 mm (5 to 6 inch) bronze casting conforming to ASTM B584, CDA 844(81-3-7-9). Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or malleable iron, ASTM A47 (Grade 32510) housings, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
   3. Joints: ASTM B32, 50/50, special alloy, lead free. Solder using non-corrosive flux.

D. Polyvinyl Chloride (PVC): Schedule 40 shall not be used where waste temperature may exceed 60°C (140°F)or in waste risers due to higher noise than other specified material.

1. Pipe: Shall be manufactured from Type I normal impact resins in conformance with ASTM D2665 and ASTM B16.12.
2. Fittings:
   a. Solvent Welded Socket Type: Use solvent cement, ASTM D2564.
   b. Threaded Type: Molded threads only. Use tape or lubricant specifically intended for use with PVC plastic pipe.

2.2 EXPOSED WASTE PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping 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. 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: 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.

2.3 CLEANOUTS

A. 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; provide a minimum clearance of 600 mm (24 inches) for the rodding. Exterior cleanout at the interface of the building drain and building sewer shall be full size for testing purposes.

B. In Floors: Floor cleanouts shall have cast iron body and frame with square adjustable scoriated secured nickel bronze top. Unit shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, provide clamping collars on the cleanouts. Cleanouts shall consist of "Y" fittings and 1/8 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, provide carpet cleanout flanges.

C. Provide cleanouts 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. Extend the cleanouts to the wall access cover. Cleanout shall consist of sanitary tees. Furnish nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed roughing work, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required by the International Plumbing Code.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or 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.

2.4 FLOOR DRAINS

A. ANSI A112.21.1. Provide a caulking flange for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe, and side outlet when shown. Provide membrane clamp and extensions 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, provide a 2.2 kg (16-ounce) soft copper membrane, 600 mm (24 inches) square.

B. Type B: Galvanized cast iron with medium duty nickel bronze grate, double drainage pattern, clamping device, without sediment bucket but with secondary strainer in bottom; one hundred seventy five millimeters (seven inch) minimum square grate.

C. Type C: Cast iron body, double drainage pattern, clamping device, light duty square or round nickel bronze adjustable strainer and grate with vandal proof screws; one hundred fifty millimeter (6 inch) minimum square grate.

D. Type D: Cast iron drain with flange, integral reversible clamping device, seepage openings and 175 mm (7 inch) diameter or square satin

nickel bronze or satin bronze strainer with 100 mm (4 inch) flange for synthetic covering.

E. Type E: Heavy, cast iron body, double drainage pattern, heavy non-tilting nickel bronze grate not less than 300 mm (12 inches) square, removable sediment bucket. Clearance between body and bucket shall be ample for free flow of waste water.

F. Type F: Cast iron drain with flange, integral reversible clamping device, seepage openings and a 225 mm (9 inch) two-piece satin nickel - bronze or satin bronze strainer for use with seamless vinyl floors.

G. Type G: Cast iron body, shallow type with double drainage flange with removable, perforated aluminum sediment bucket with all interior exposed surfaces provided with acid resistant porcelain enamel finish and clamping device. Frame and grate, shall be nickel bronze. Grate shall be approximately 200 mm (8 inches) in diameter; space between body of drain and basket to be ample for free flow of waste water.

H. Type H: Cast iron body, double drainage pattern, without sediment bucket but with loose set nickel bronze grate, secondary strainer, and integral clamping collar; 300 mm (12 inches) in diameter or 300 mm (12 inches) square and approximately 150 mm (6 inches) deep.

I. Type I: Cast iron body, wide flange for seamless floor, double drainage pattern, with all interior exposed surfaces provided with acid resistant enamel finish, clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket, perforated with not less than 19 300 square mm (30 square inches) of free area, approximately 100 mm (4 inches) deep, and be provided with grips for easy handling; loose-set, nickel bronze grate approximately 300 mm (12 inches) square and of sufficient strength to support pedestrian traffic. Provide ample space between body of drain and sediment basket for free flow of waste liquids.

J. Type N: Cast iron body, wide flange for seamless floors, double drainage pattern, with all interior exposed surfaces provided with acid resistant enamel finish, clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket, perforated with not less than 9 000 square mm (14 square inches) of free area, approximately 50 mm (2 inches) deep, and be provided with grips for easy handling; loose-set, nickel bronze grate approximately 200 mm (8 inches) round and of sufficient strength to support pedestrian traffic. Provide ample space between body of drain and sediment basket for free flow of waste liquids.

K. Type O: Cast iron body, double drainage pattern, clamping device, less grate and sediment basket but with dome type secondary strainer. Three hundred millimeter 300 mm (12 inches) in diameter or 300 mm (12 inches) square and approximately 150 mm (6 inches) deep. Interior exposed surfaces and rim to have acid resisting, enamel finish.

L. Type P: Cast iron body, double drainage pattern, with all interior exposed surfaces provided with acid resistant enamel finish, clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket, perforated with not less than 27 000 mm^2 (42 square inches) of free area, approximately 100 mm (4 inches) deep, and be provided with grips for easy handling; loose-set, nickel bronze grate approximately 300 mm^2 (12 inches square) and of sufficient strength to support pedestrian traffic. Provide ample space between body of drain and sediment basket for free flow of waste liquids.

M. Type R: Cast iron body, double drainage pattern and clamping device, less grate and sediment basket but with dome type secondary strainer. Two hundred millimeter (8 inches) in diameter or 200 mm (8 inches) square and approximately 150 mm (6 inches) deep. Interior exposed surfaces and rim to have acid resisting finish.

2.5 TRAPS

Provide 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 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.

2.6 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International Plumbing Code and the following:

1. Install branch piping 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.
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. All gravity waste drain lines inside the building with vertical drops over 6 m (20 feet) shall be provided with joint restraint on the vertical drop and horizontal offset or branch below the vertical drop. Joint restraint shall be accomplished by threaded, soldered, lead and oakum or grooved joints or a combination of pipe clamps and tie-rods as detailed in NFPA 24. Vertical joint restraint shall be provided from the fitting at the bottom of the vertical drop through every joint up to the riser clamp at the floor penetration of the floor above. Horizontal joint restraint shall be provided from the same fitting at the bottom of the vertical drop through every joint on the horizontal offset or branch for a minimum of 18 m (60 feet) or to anchoring point from the building structure. Joint restraint below ground shall be accomplished by thrust blocks detailed in NFPA 24.
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. Waste and Vent Drain to main stacks:

Pipe Size	Minimum Pitch
80 mm (3 inches) and smaller	1 : 50 (1/4" to the foot).
80 mm (4 inches) and larger	1 : 100 (1/8" to the foot).

2. Exhaust Vent: Extend separately through roof. Sanitary vents shall not connect to exhaust vents.

3.2 TESTS

A. General: Test system either in its entirety or in sections.

B. Waste Systems: Conduct before trenches are backfilled or fixtures are connected. Conduct water test or air test, as directed.

1. Water Test: If entire system is tested, tightly close all openings in pipes except 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. Keep water in system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
2. Air Test: Maintain air pressure of 35 kPa (5 psi) gage for at least 15 minutes without leakage. Use force pump and mercury column gage.
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 (one inch of water) with a smoke machine. Chemical smoke is prohibited.
   b. Peppermint Test: Introduce (two ounces) of peppermint into each line or stack.

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SECTION 22 35 00

DOMESTIC WATER HEAT EXCHANGERS

PART 1 - GENERAL

1.1 DESCRIPTION:

Domestic water heater exchangers complete, ready for operation including thermometers and all necessary accessories, connections and equipment.

1.2 RELATED WORK:

A. Preparation and finish painting Section 09 91 00, PAINTING.

B. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

C. Circulating Pump: Section 22 11 23, DOMESTIC WATER PUMPS.

D. Heater Insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

E. Piping, Fittings, Valves and Gages: Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING, 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING, and 22 11 00, FACILITY WATER DISTRIBUTION.

1.3 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. Heat Exchangers.
2. Pressure and Temperature Relief Valves.
3. Steam Control Valves.
4. Thermometers.
5. Pressure Gages.
6. Vacuum Breakers.

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):

Z21.22-00/4.4A-(current edition) Relief Valves for Hot Water Supply systems

C. American Society of Mechanical Engineers (ASME):

B1.20.1-(current edition) Pipe Threads, General Purpose (Inch)

B16.5-(current edition).Pipe Flanges and Flanged Fittings

B16.24-(current edition) Cast Copper Alloy Pipe Flanges

PTC 25.3-(current edition) Pressure Relief Devices
Section IV-(current edition) Heating Boilers
Section VIII-(current edition) Pressure Vessels Division 1

PART 2 - PRODUCTS

2.1 SHELL AND STEAM COIL DOMESTIC WATER HEATERS:

A. General: Semi-Instantaneous type, vertical with water in the shell and steam in the tubes, mounted on structural supports and shall be suitably insulated, jacketed, painted and provided with lugs. The entire unit shall be packaged ready for water and steam service. Construct in accordance with ASME Code for Pressure Vessels for a working pressure of 1000 kPa (150 psi).

B. Pressure vessel: Shall be all welded construction and ASME Code Section VIII stamped for a working pressure of 1035 kPa (150 psig). The storage tank shall be carbon steel with a minimum of 13 mm (1/2 inch) thick cement lining. Provide heavy-duty thick polyurethane foam insulation to comply with ASHRAE 90.1.

C. Steam Heating Coil: U-tube type tubes are to be made of double wall seamless drawn copper fin tubing, designed for a maximum pressure of 1035 kPa (150 psig).

D. Controls:

1. Steam control valve shall regulate the control of steam flow to the heating coil to control water temperature and shall be pilot operated. Outlet water temperature shall not vary more than ± 1 degrees C (± 2.5 degrees F).
2. A drip trap, steam condensate trap (if required), Y strainer, vacuum breaker, and pressure gage shall be factory sized and piped with steam control valve.

E. Tapping: 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, coil, and controls as required.

1. 50-mm (2-inch) and smaller: Threaded ends according to ASME B1.20.1.

F. Supports: heavy duty integrally welded steel supports for floor mounting.

2.2 THERMOMETERS:

Rigid stem or remote sensing, dial type; aluminum, black metal, stainless steel, or chromium plated brass case, back connected;

mercury, vapor, BI-metal or gas actuated, with circular dial 90 mm (3 1/2 inches) in diameter graduated from 4 to 100 degrees C (40 to 210 degrees F), with two-degree graduations guaranteed accurate within one scale division. Socket shall be separable, double-seat, micrometer-fittings, with extension neck not less than 65 mm (2 1/2 inches) to clear tank or pipe covering. Suitable for 20 mm (3/4 inch) pipe threads. Thermometers may be consoles mounted with sensor installed in separate thermometer well.

2.3 SAFETY VALVES FOR SHELL AND STEAM HEATERS:

A. Provide a combination temperature and pressure relief valve on each water heater. Pipe discharge to floor drain using an air gap fitting.

B. Combination Temperature and Pressure Relief Valves: Bronze, automatic, self-closing reseating type valve, equipped with a noncorrosive metal thermostat with bulb extending into tank, that can be manually displaced from its seat for test purposes. Valve shall be tested and approved as to its BTU capacity by ASME or an independent laboratory satisfactory to the Contracting Officer. In no case shall total rated BTU relieving capacity of temperature and pressure relief valve be less than BTU input into water heater.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install water heaters 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. Install water heaters level and plumb.

C. Install and connect water heaters in accordance with manufacturer’s written instructions.

D. Pipe all pressure and temperature relief valves discharge to nearby floor drains.

E. Install thermometers on water heater inlet and outlet piping.

F. Set the thermostats for a maximum setting of 54 degrees C (140 degrees F).

3.2 LEAKAGE TEST:

Before piping connections are made, test water heaters with hydrostatic pressure of 1375 kPa (200 psi and 240 psi for a unit with a MAWP of 160 psi. Correct any leakage or replace water heater and retest at no additional cost to the VA.

3.3 PERFORMANCE TEST:

Ensure that all of the remote water outlets will have a maximum of 54 degrees C (140 degrees F) water flow at all times. If necessary, 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. 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. 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-(current edition) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
A112.19.2M-(current edition) Vitreous China Plumbing Fixtures
A112.19.3M-(current edition) Stainless Steel Plumbing Fixtures

C. American Society for Testing and Materials (ASTM):
A276-(current edition)..Stainless and Heat-Resisting Steel Bars and Shapes

D. National Association of Architectural Metal Manufacturers (NAAMM):
NAAMM AMP 500-505 Metal Finishes Manual (current edition).

E. American Society of Sanitary Engineers (ASSE):
1016-(current edition)..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-(current edition) Drinking Water System Components-Health Effects

G. American with Disabilities Act(A.D.A) Section 4-19.4 Exposed Pipes and Surfaces

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 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.

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 (0.5 gpm) for lavatories; 125 to 140 mL/s (2.0 to 2.2 gpm) for sinks unless noted otherwise.

2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 170 and 550 kPa (25 and 80 psi).
3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-clearing action, and is capable of easy manual cleaning.

2.5 CARRIERS

A. ASME/ANSI A112.6.1M, with adjustable gasket faceplate chair carrier for wall hung clinic service sink with auxiliary anchor foot assembly, hanger rod support feet, and rear anchor tie down.

B. ASME/ANSI A112.6.1M, lavatory, chair carrier for thin wall construction; all lavatory chair carriers shall be capable of supporting the lavatory with a 250-pound vertical load applied at the front of the fixture.

C. Where 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-101) Water Closet (Floor Mounted, ANSI 112.19.2M, Figure 6) - office and industrial, elongated bowl, siphon jet 6 L (1.28 gallons) per flush, floor outlet. Top of rim shall be 381 mm (15 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 , white in color.
2. Fittings and Accessories: Floor flange fittings-cast iron; gasket; bolts with chromium plated cap nuts and washers.
3. Flush valve: Large chloramines resistant diaphragm, semi red brass valve body, exposed chrome plated, non-hold-open ADA approved side oscillating handle, water saver design 6 L (1.28 gallons) per flush with maximum 10 percent variance, top spud connection, adjustable tailpiece, one-inch IPS screwdriver back check angle stop with vandal resistant cap, high back pressure vacuum breaker, and sweat solder adapter with cover tube and cast set screw wall flange. Set centerline of inlet 275 mm (11-1/2) inches above rim. Seat bumpers

shall be integral part of flush valve. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM Alloy classification for semi-red brass.

B. (P-102) Water Closet Floor Mounted with Bedpan Washer ASME/ANSI A112.19.2M, Figure 6, floor outlet, with bed pan lugs - bedpan washer, flush valve operated, 6 L (1.28 gallons) per flush. Top of rim shall be 419 mm (16 1/2 inches) above finished floor. Provide standoff bracket support between studs for bedpan washer at height as recommended by manufacturer.

1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, antimicrobial 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 in white color.
2. Fittings and Accessories: Floor Flange fittings - cast iron; gasket; bolts with chromium plated cap nuts and washers.
3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, non-hold-open, ADA approved side oscillating handle, water saver design 6 L (1.28 gallons) per flush with maximum 10 percent variance, offset top spud connection, adjustable tailpiece, one-inch IPS screwdriver back check angle stop with vandal resistant cap, sweat solder adapter with cover tube and cast set screw wall flange, and high back pressure vacuum breaker. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM Alloy classification for semi-red brass. Set centerline of inlet 673 mm (26 1/2) inches above rim. Seat bumpers shall be set in wall behind fixture at proper contact height.

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), 0.125 gallons per flush with 50mm (2-inch) back outlet and 20 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, exposed flush valve non-hold-open, water saver design, 20 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-401) Lavatory: Wall-mounted, vitreous china, ASME/ANSI A112.19.2M, approximately 500 by 450 mm (20 by 18 inches) and a 102 mm (4-inch) maximum apron, front overflow, d-shaped bowl, self-draining deck with contoured back and side splash shields; punching for faucet on 102mm (4-inch) centers and set with rim 864 mm (34 inches) above finished floor.

1. Solid cast brass construction with chrome-plated finish ASME/ANSI A112.18.1M, 1/2 inch IPS connections, solid brass waterways, 6 inch single lever handle with red and blue temperature indicators with 0.5 gpm laminar flow control.
2. Drain: Cast or wrought brass with flat grid strainer offset tailpiece, chrome plated. Provide cover per A.D.A 4-19.4.
3. Stops: Angle type, see paragraph 2.2 Stops. Provide cover per A.D.A 4-19.4.
4. Trap: Cast copper alloy, 40 by 32 mm (1-1/2 by 1-1/4 inch) P-trap, adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extensions to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish with trap set parallel to wall and covered per A.D.A 4-19.4.

D. (P-413) Lavatory: Solid surface countertop with integral oval-shaped bowls, 406 by 330 by 191 mm (16 by 13 by 7 1/2 inches), Figure 25 with punching for faucet on 100 mm (4-inch) centers.

1. Solid cast brass construction with chrome-plated finish ASME/ANSI A112.18.1M, 1/2 inch IPS connections, solid brass waterways, 6 inch single lever handle with red and blue temperature indicators with 0.5 gpm laminar flow control.
2. Drain: cast or wrought brass with flat grid strainer, offset tailpiece, brass, chrome plated.
3. Stops: Angle type. See paragraph 2.2. Stops
4. Trap: Cast copper alloy, 40 by 32 mm (1-1/2 by 1-1/4 inch) P-trap, adjustable with connected elbow and 1.4mm thick (17 gauge) tubing

extension to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish and set parallel to the wall.

5. Provide cover for drain, stops and trap per A.D.A 4-19.4.

2.9 SINKS

A. (P-502) Service Sink: Floor mounted, stain resistant terrazzo, 610 by 610 mm (24 by 24 by 12 inches) with 152 mm (six-inch) drop front. Shoulder shall not be less than 2 inches wide with 1/2 inch pitch toward inside Terrazzo, composed of marble chips and white Portland cement, shall develop compressive strength of 20,684 kPa (3000 psi) seven days after casting. Provide stainless steel caps on all curbs.

1. Faucet: Solid brass construction, combination faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear. Spout shall have a pail hook, 20 mm (3/4-inch) male hose coupling threads, vacuum breaker, and top or bottom brace to wall. Hot and cold spring check cartridges with color coded indexed lever handles. 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 (three-foot) hose with wall hook. Centerline of rough in is 1220 mm (48 inches) above finished floor.
2. Drain: Eighty millimeter (3-inch) cast brass drain with nickel bronze strainer.
3. Trap: P-trap, drain through floor.

B. (P-505) Clinic Service Sink (Flushing Rim, Wall Hung) approximately 500 by 635 mm (20 by 25 inches) by 203 mm (8 inches) deep. Support with ASME/ANSI A112.61M chair carrier and secure with 10 mm (3/8-inch) bracket studs and nuts. Set sink with rim 762 mm (30 inches) above finished floor. Provide three (3) stainless steel rim guards.

1. Faucet: Elbow control, wall hung, integral stops, single spout with 20 mm (3/4 inch) hose threaded outlet and pail hook, continuous vacuum breaker and brace to wall. Outlet 305 mm (12 inches) from wall. Exposed metal parts shall be chromium plated with a smooth bright finish.
2. Flush valve: Large diaphragm, semi-red brass body, ADA compliant, non-hold-open handle of front of valve, exposed chromium plated flush valve with screwdriver back check straight stop with cap, union outlet, street ells, elevated high pressure vacuum breaker,

casing cover, 32 mm (1-1/4 inch) elbow flush connection from finished wall to 40 mm (1-1/2 inch) top spud. Spud coupling, wall and spud flanges.

3. Bed Pan Washer: Loose key angle stop, self closing valve, wall hung, and supply from valve to nozzle with wall hook hose connection; 1220 mm (4-feet) of heavy duty rubber hose, with extended spray outlet elevated vacuum breaker. Supply pipe from wall to valve stop shall be rigid, threaded, IPS copper alloy pipe. Exposed metal parts shall be chromium plated with a smooth bright finish. Provide inline laminar flow control device.

C. (P-521) Laundry Sink: Seamless, Type 316, 18-8 stainless steel, Single Compartment Countertop ASME/ANSI A112.19.3M, approximately 635 by 559 mm (25 by 22 inches) by 356 mm (12 inches) deep, self-rimming, fully coated underside insulates for sound and reduced condensation.

1. Faucet: Solid brass construction, chrome plated finish, ASME A112.18.1, with hot and cold color indicators, ceramic disc cartridge, 1.5 gpm laminar flow control device in swivel, gooseneck spout with 216 mm (8 1/2 inch reach).
2. Drain: Stopper.
3. Trap: Cast copper alloy, 40 mm (1-1/2 inch) P-trap. Adjustable with connected elbow, and nipple to wall and escutcheon.

D. (P-524) Sink: Seamless, Type 304, 18-8 stainless steel, Double Compartment, Counter Top, ASME/ANSI A112.19.3M, Kitchen Sinks, Figure 6, self rimming, approximately 838 by 559 mm (33 by 22 inches) with two compartments inside dimensions approximately 356 by 406 by 203 mm (14 by 16 by 8 inches), minimum 18 gage CRS. Corners and edges shall be well rounded.

1. Faucet: Solid brass construction, chrome plated finish, ASME A112.18.1 203 mm (8 inch) centers, wrist blade handles with hot and cold color indicators, ceramic disc cartridges, 1.5 gpm laminar flow control device in swivel, gooseneck spout with 216 mm (8 1/2 inch reach).
2. Drain: Drain plug with cup strainer, stainless steel.
3. Trap: Cast copper alloy, 40 mm (1/-1/2 inch) 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.

E. (P-528) Sink: Seamless, Type 304, 18-8 stainless steel, Single Compartment, Counter Top ASME/ANSI A112.19.3M, Kitchen Sinks, Figure 5,

self rimming, back faucet ledge, approximately 558 by 558 mm (22 by 22 inches) with single compartment inside dimensions approximately 406 by 483 by 266 mm (16 by 19 by 10 1/2 inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:

1. Faucet: Solid brass construction, chrome plated finish, ASME A112.18.1 203 mm (8 inch) centers, wrist blade handles with hot and cold color indicators, ceramic disc cartridge, 1.5 gpm laminar flow control device in swivel, gooseneck spout with 216 mm (8 1/2 inch reach).
2. Drain: Drain plug with cup strainer, stainless steel.
3. Trap: Cast copper alloy 40 mm (1-1/2 inch) P-trap with cleanout plug. Provide 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. (P-608) Electric Water Cooler: Barrier-free, split-level, Wall Hung, with Glass Filler, bubbler style, air cooled compressor, 8.4 mL/s (8 gph) minimum capacity, lead free. Tops shall be stainless steel anti-splash design. Cabinet, stainless steel satin finish, approximately 889 by 470 by 635 mm (35 by 18 1/2 inches by 25 inches) high with floor-mounted carrier. Units shall be push pad operated with front and side pads, automatic stream regulator, and heavy chrome plated brass push down glass fillers with adjustable flow control, and all trim chrome plated. Set bubbler 838 mm (33 inches) above finished floor.

2.11 SHOWER BATH FIXTURE

A. (P-701) Shower Bath Fixture (Detachable, Wall Mounted, Concealed Supplies:

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: Chrome-plated brass shower head with flow control to limit discharge to 190 mL/s (2.5 gpm), 1500 mm (5-foot) length of rubber lined stainless steel or chrome plated metal flexible 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: Pressure balancing, with chrome plated metal lever type operating handle adjustable for rough-in variations and chrome

plated metal or stainless steel face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, or stainless steel. Valve inlet and outlet shall be 15 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 190 mL/s at 207 kPa (3 gpm at 30 psi) pressure drop.

2.12 EMERGENCY FIXTURES

A. (P-707) Emergency Shower and Eye/Face Wash (Free Standing) ANSI Z358.1:

1. Shower Head: Stainless steel, 254 mm (10 3/4 inches) in diameter, install head 2100 mm (84 inches) above floor. Equip with stay-open ball valve, chrome plated. Operate valve with 600 mm (24-inch) stainless steel pull-rod with triangle handle. Pull-down opens valve; push-up closes valve.
2. Emergency Eye and Face Wash: Stainless steel receptor, 273 mm (10 inches) in diameter. Provide 15 mm (1/2-inch) stay open ball valve operated by push flag handle.
3. Shower head and emergency eye and face wash shall be mounted to stanchion with floor flange.
4. Emergency Thermostatic Mixing Valve: Conform to ANSI Standard Z351.8, rough bronze body, 125 psig working pressure, 1 1/4 inch pipe connections, 1,262 mL/s at 34.47 kPA (20 gpm at 5 psig) drop, with lock set to prevent unauthorized temperature adjustment, 85 degree F outlet setpoint, outlet temperature gage. The valve shall control outlet temperature at 29 degrees C (85 degrees F) over a wide range of domestic cold water temperatures and shall be suitable for emergency shower and eye/face wash applications. In the event of interruption or failure of hot water supply, the control mechanism shall allow cold flow through assembly to emergency fixture. Factory assembled and tested device shall be mounted in an exposed stainless steel wall-mounted cabinet.

2.13 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; 20 mm (3/4-inch)

hose thread on spout; 20 mm (3/4-inch) pipe thread on inlet. Finish may be rough; exposed surfaces shall be chrome plated. Set not less than 460 mm (1-1/2 feet) nor more than 920 mm (3-feet) above grade. Provide integral vacuum breaker which automatically drains when shut off.

B. (P-804) Hose Bibb (Single Faucet, Wall Mounted, Exposed 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 20 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. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 6 mm (1/4-inch) diameter bolts, and to extend at least 75 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.

D. Power Set Fasteners: May be used for concrete walls, shall be 6 mm (1/4-inch) threaded studs, and shall extend at least 35 mm (1-1/4 inches) into wall.

E. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.

F. 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.

G. Do not use aerators on lavatories and sinks, use laminar flow control devices.

3.2 CLEANING

At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.

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SECTION 22 50 00

PROTECTED/SECONDARY CONTAINED ABOVEGROUND TANK

PART 1 - GENERAL

1.1 DESCRIPTION

Provide an aboveground tank system approved for listing under UL Standard 2085, Aboveground Tanks, Protected Type, Secondary Containment with Vehicle Impact and Projectile Resistance. Unit must comply with all provisions of U.F.C. 79-7, Appendix A-II-F. The tank and its enclosure shall be a completed unit at the factory (shop fabricated).

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE

B. Section 09 91 00, PAINTING

C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING

1.3 QUALITY ASSURANCE

A. Product Criteria:

1. Aboveground tank system shall be the standard product of a manufacturer regularly engaged in the manufacture of the product.
2. Equipment Service: Product shall be supported by a service organization which maintains inventory of repair parts located reasonably close to the site.
3. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on the tank.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23.

PART 2 - PRODUCTS

2.1 ABOVEGROUND TANK SYSTEM

A. Primary Tank: The primary tank shall be rectangular in shape, constructed with a minimum of 10 gauge thick carbon steel, listed per UL Standard 142, and meet the requirements of NFPA 30. Welds shall be continuous on all sides, conforming to the American Welding Society Standard for continuous weld. The tank shall be warranted for a minimum of 20 years by the manufacturer.

B. Concrete Easement: The concrete encasement shall be 6" thick with a minimum design strength of 4,000 psi. Concrete enclosure shall encase and protect both the primary steel tank and the secondary containment. The concrete design shall include the following for long-term durability: less than 3% air entrainment, water-reducing admixture,

and steel reinforcing bars. Concrete placement shall be monolithic (without seams) and placement methods shall ensure the absence of voids on all sides and beneath the steel tank. An exterior steel jacket covering the concrete vault will NOT be permitted. The steel tank shall be prestressed at factory by pressurizing the primary steel tank to 5 psi during concrete encasement to allow for expansion and contraction of the primary steel tank. Vault enclosure shall have concrete support legs of unitized monolithic construction raising the concrete enclosure a minimum of 3" above the ground to meet visual inspection requirements. A mid-level seam or other joint construction which could compromise the liquid tightness (secondary containment) and fire protection capability of the vault is not permitted.

C. Fire Resistance: The tank system shall be designed and tested to provide two hour fire protection for the primary tank as per UL 2085, two-hour furnace fire test and two-hour simulated pool fire test. No steel members shall penetrate the walls or floor of the concrete encasement to assure isolation from pool fire heat.

D. Thermal and Corrosion Protection: The tank construction shall include thermal insulation equivalent to 0.25 inches of polystyrene to protect against temperature extremes, and to protect against corrosion by isolating the steel tank from the concrete or other corrosive material. All steel exterior to the concrete encasement shall be anti-oxidant powder coated to inhibit corrosion and meet ASTM B117.

E. Blast Resistance: The tank system design shall be the subject of a Blast Effects Analysis (BEA) for resistance and performance under the following blast threat scenarios:

1. A 50 pound man-portable improvised explosive device (MPIED) at the standoff distance of 5 feet and 20 feet.
2. A 500 pound vehicle-born improvised explosive device (VBIED) at the standoff distance of 5 feet and 20 feet.
3. A vapor cloud explosion (VCE) with a load of 10 psi.

The BEA shall conclude that the tank system shall resist and remain intact, without failure of the primary tank. The engineering consultants performing the BEA shall be a nationally recognized firm with over 10 years experience offering comprehensive services related to blast and impact effects analysis, explosive safety design, vulnerability assessments and threat mitigation.

F. Secondary Containment with Leak Monitoring: The tank system shall include an impervious barrier of 30 mil high-density polyethylene to contain leaks from the primary tank. A monitoring tube shall be located between the inner tank and secondary barrier.

G. Spill/Overfill Containment: The tank system shall include a UL listed 7 gallon spill/overfill container manufactured as an integral part of the primary tank, surrounding the fill pipe, and protected by two hour fire rating of the enclosure. The spill/overfill container shall include a stick port and normally closed valve to release spilled product into the main tank. Exterior steel shall be anti-oxidant powder coated to inhibit rust.

H. Overfill Protection: Overfill protection shall be provided by the following methods: a) direct reading level gauge visible from fill pipe access; b) valve rated for pressurized delivery located within fill pipe to close automatically at 95% full level; c) high level alarm.

I. Exterior Finish: The tank system shall be a low maintenance exposed aggregate exterior concrete finish. Fiber clad steel, or painted steel vault tanks are not acceptable.

J. Signage: Tank shall be marked on all sides as per state and local codes. Signs will be recessed in concrete exterior to insure against damage during off-loading, refilling, or general functions.

K. Venting: Tank system shall include a 2 inch atmospheric vent and emergency venting in accordance with NFPA 30.

2.2 TANK MONITORING SYSTEM

A. Tank monitoring system shall include continuous inventory monitoring, Ethernet/IP communications, external inputs, relay outputs, programmable alarms, and data communications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Manufacturer will have a minimum of 5 years experience in producing specified tank for commercial use and document at least 10 installations in satisfactory operation.

B. The tank system including accessories shall be installed in strict accordance with the manufacturer's recommendations and applicable fire and environmental codes. All state and local permits shall be obtained by contractor prior to installation.

C. Tank shall be installed on a reinforced concrete base slab designed to support the fully loaded tank. Protective bollards shall be installed where required by state and local codes.

D. Tank shall be marked on all sides with warning signs: "FLAMMABLE" or "COMBUSTIBLE", "NO SMOKING", product identification and other signs as required by applicable codes.

E. Electrical work shall be in accordance with applicable codes and shall be rated for hazardous area as required. Tank shall be electrically grounded in accordance with NFPA 78.

3.2 INSPECTION

A. The system installation shall be inspected and approved by the system supplier or its certified contractor. The system supplier shall submit a comprehensive checklist of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

3.3 INSTRUCTIONS

A. Any proposed equal alternatives to this specification must be submitted for review and approval prior to bid opening. If the proposed alternative is deemed to present a better solution, review expenses will be waived. If the proposed alternative is denied or deemed to be equal, all expenses incurred for such review is to be paid for by the bidder prior to submittal of bid.

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SECTION 22 62 00

VACUUM SYSTEMS HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Central Healthcare Vacuum Systems: Consisting of vacuum services; complete, ready for operation, including all necessary piping, fittings, valves, cabinets, station outlets and inlets, rough-ins, gages, alarms including low voltage wiring, vacuum pumps, electric motors and starters, receivers, and all necessary parts, accessories, connections and equipment.

B. Vacuum system alarm wiring from equipment to alarm panels.

1.2 RELATED WORK

A. Sealing around pipe penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.

B. Sealing around pipe penetrations through the floor to prevent moisture migration: Section 07 92 00, JOINT SEALANTS.

C. General requirements and items common to more than one section of Division 22: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

D. Alarm interface with ECC. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

E. Conduit: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

F. Control wiring: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).

G. Electrical wiring and accessories: Section 26 27 26, WIRING DEVICES.

H. Electric motors: Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

I. Motor starters: Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

J. Prefabricated bedside patient units: Section 10 25 13, PATIENT BED SERVICE WALLS.

K. Healthcare Gases and Vacuum Alarms: Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES.

L. Healthcare Gas Piping and Equipment: SECTION 22 63 00, GAS SYSTEMS FOR HEALTHCARE FACILITIES.

1.3 QUALITY ASSURANCE

A. Materials and Installation: In accordance with NFPA 99, and as specified.

B. Equipment Installer: Show technical qualifications and previous experience in installing medical gas equipment.

C. Medical Gas System Testing Organization: The testing shall be conducted by a party technically competent and experienced in the field of medical gas pipeline testing; such testing shall be performed by a party other than the installing contractor.

D. Provide names of three projects where testing of vacuum systems has been performed by the testing agency. Include the name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification.

E. Submit the testing agency's detailed procedure which will be followed in the testing of this project; include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm tests, purity tests, etc., as required by this specification. Purity test procedures shall include data on test methods, types of equipment to be used, calibration sources and method references.

F. Certification: Provide documentation prior to submitting request for final inspection to include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.

G. Installing contractor shall maintain as-built drawings of each completed phases for verification; providing the complete set at the time of final systems certification testing, for certification by the Third Party Testing Company. As-built drawings are to be provided, and a copy of them on Auto-Cad version (R-14 or later) provided on compact disk. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

1.4 SUBMITTALS

A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Piping.
2. Valves.

3. Inlet and outlet cocks
4. Valve cabinets.
5. Gages.
6. Station inlets, and rough-in assemblies.
7. Alarm controls and panels.
8. Vacuum switches.
9. Vacuum bottle brackets.
10. Vacuum pump systems (Provide certified pump test data at start-up):
    a. Pumps: Manufacturer and model.
    b. Pump performance curves.
    c. Pump operating speed (RPM).
    d. Capacity: Free air exhaust from 65 and 80 kPa (19 and 24 inches Hg.) gage vacuum (L/s) (SCFM).
    e. Capacity: Expanded air capacity at 65 and 80 kPa (19 and 24 inches Hg.) gage vacuum (L/s) (SCFM).
    f. Type of bearing in pump.
    g. Type of lubrication.
    h. Type and adjustment of drive.
    i. Electric motors: Manufacturer, frame and type.
    j. Speed of motors (RPM).
    k. Current characteristics and horsepower of motors.
    l. Receiver capacity and rating.
    m. Silencers: Manufacturer, type and model.

C. Station Inlets: Submit letter from manufacturer stating that inlets are designed and manufactured to comply with NFPA 99. Inlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation. In lieu of above labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer, certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.

D. Certification: The completed systems have been installed, tested, purged and analyzed in accordance with the requirements of this specification.

1.5 TRAINING

A. Furnish the services of a competent instructor for not less than two four-hour periods for instructing personnel in the operation and maintenance of the vacuum systems, on the dates requested by COTR.

B. Coordinate with other requirements specified in Section 01 00 00, GENERAL REQUIREMENTS.

1.6 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced.

A. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI):

A13.1-(current edition).Scheme for Identification of Piping Systems

B16.22-(current edition) Wrought Copper and Bronze Solder-Joint Pressure Fittings

B40.1-(current edition). Pressure Gauges and Gauge Attachments

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

B819-(current edition)..Standard Specification for Seamless Copper Tube for Medical Gas Systems

D. American Society of Mechanical Engineers (ASME):

Section IX-(current edition) Welding and Brazing Qualifications

E. American Welding Society (AWS):

AWS A5.8-(current edition) Brazing Filler Metal

AWS B2.2-(current edition) Standard for Brazing Procedure and Performance Qualification (Modified per NFPA 99)

F. Compressed Gas Association (CGA):

P-9-(current edition)...Inert Gases Argon, Nitrogen and Helium

G. National Electrical Manufacturers Association (NEMA):

ICS-6-(current edition).Industrial Controls and Systems Enclosures

H. National Fire Protection Association (NFPA):

99-(current edition)....Health Care Facilities

I. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)

J. Manufacturing Standardization Society (MSS):

MSS-SP-72-(current edition) Ball Valves With Flanged or Butt Welding For General Purpose

MSS-SP-110-(current edition) Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

MSS-SP-73-(current edition) Brazing Joints for Copper and Copper Alloy Solder Pressure Fittings

PART 2 - PRODUCTS

2.1 PIPING

A. Copper Tubing: Type "K" or "L", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ANSI B16.22 or brazing fittings complying with MSS SP-73. Size designated reflecting nominal inside diameter. All tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".

B. Brazing Alloy: AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux is strictly prohibited for copper-to-copper connections.

C. Screw Joints: Polytetrafluoroethylene (teflon) tape.

D. Galvanized Steel: Use only for discharge from vacuum producer.

1. Pipe: ASTM A53, standard weight.
2. Fittings:
   a. Flexible groove, malleable iron, ASTM A47, or ductile iron, ASTM A536.
   b. Malleable iron screwed, ANSI B16.3.

E. Memory metal couplings having temperature and pressure rating not less than that of a brazed joint shall be permitted.

F. Apply piping identification labels shall be done at time of installation in accordance with current NFPA. Supplementary color identification shall be in accordance with CGA Pamphlet C-9.

G. Special Fittings: The following special fittings shall be permitted to be used in lieu of brazed joints:

1. Memory-metal couplings having temperature and pressure ratings joints not less than that of a brazed joint.
2. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint.
3. Dielectric fittings where required by the manufacturer of special medical equipment to electrically isolate the equipment from the piping distribution system.
4. Axially swaged, elastic strain preload fittings providing metal to metal seal having pressure and temperature ratings not less than

that of a brazed joint and when complete are permanent and non-separable.

2.2 EXPOSED HEALTHCARE VACUUM PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed laboratory and healthcare vacuum 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).
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.
5. Valves: Mss SP-72, SP-110, Brass or bronze with chrome finish.

2.3 VALVES

A. Ball: In-line, other than zone valves in cabinets.

1. Seventy five millimeter (2 1/2 inches) and smaller: Bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1, with tubing extensions for brazed connections, full ported, three-piece or double union end connections, teflon seat seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle. An acceptable manufacturer that meets the specification: Jomar model S-100.

B. Check:

1. Eighty millimeter (3 inches) and smaller: brass and Bronze body, straight through design for minimum pressure drop, spring loaded, self aligning with teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, 2750 kPa (400 psi) WOG minimum working pressure.
2. One hundred millimeter (4 inches) and larger: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 1025 kPa (150 psi) WSP.

C. Zone Valve in Cabinet: Ball valve, bronze/ brass body, double seal, three piece or double union end connections, replaceable teflon seat seals, teflon stem seal, 4125 kPa (600 psi) WOG, cold, non-shock gas working pressure or vacuum service to 29 inch Hg, blowout proof stem, one quarter

turn of handle to completely open or close. Provide tubing extensions factory brazed, pressure tested, cleaned for oxygen service. Provide 3 mm (1/8 inch) NPT gauge port for a 50mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type-K copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be products of one manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick-on labels. Install valves in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
MEDICAL VACUUM	Black letters on white background	WHITE

2.4 VALVE CABINETS

A. Flush mounted commercially available item for use with medical gas services, not lighter than 1.3 mm (18 gage) steel or 1.9 mm (14 gage) extruded aluminum, rigidly assembled, of adequate size to accommodate valve(s) and fittings. Punch or drill sides to receive tubing. Provide anchors to secure cabinet to wall construction. Seal openings in cabinet to be substantially dust tight. Locate bottom of cabinet approximately 1375 mm (4 foot 6 inches) above floor.

B. Mount engraved rigid plastic identification plate on wall above or adjacent to cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate must be clearly visible at all times. Provide inscriptions on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS."

C. Cover plate: Fabricate from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or .85 mm (22 gage) stainless steel. Provide cover window of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. Permanently paint or stencil on window: "FOR EMERGENCY SHUT-OFF VALVES ONLY, SHUT-OFF VALVES FOR PIPED GASES", or equivalent wording. Configure such that it is not possible to install window with any valve in the closed position. Each valve shall have gauge upstream of valve inside valve box.

D. Cabinets and isolation valves shall be located and piped as shown, and at a minimum, so as to allow the isolation of each smoke compartment separately. No cabinet shall serve more than one smoke compartment.

2.5 GAGES

A. Vacuum Gages:

1. For vacuum line use adjacent to source equipment: ANSI B40.1, vacuum gage, size 115 mm (4-1/2 inches), gage for air, accurate to within two percent, with metal case. Range shall be 0-100 kPa (0-30 inches Hg). Dial graduations and figures shall be black on a white background, or white on a black background. Label for vacuum service. Install with gage cock. Provide compound gages for Vacuum system.
2. For vacuum service upstream of main shutoff valve: Provide 40 mm (1-1/2 inch) diameter gage with steel case, bourdon tube and brass movement, dial range 0-100 kPa (0-30 inches Hg). Provide compound gages for Vacuum system.

2.6 STATION INLETS

A. For designated service, consisting of a quick coupler and inlet supply tube. Provide coupler that is non-interchangeable with other services, and leak proof under three times normal working pressure. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each inlet securely to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm outside diameter) (3/8-inch outside diameter) tubing for connection to supply. Label stub tubing for appropriate service. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPU) are furnished under this specification but installed by manufacturer of PBPUs before initial test specified herein. Install completion kits (valve body and face plate) for the remainder of required tests.

2.7 STATION INLETS

For all services: Brass, stainless steel or chromed metal non-interchangeable DISS connections for appropriate service to conform to CGA V-5. Equip each station inlet with an automatic valve to conform to NFPA 99. Place valves in the assembly to provide easy access after installation, for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each inlet securely to inlet

rough-in to prevent floating, and provide each inlet with a capped stub length of 6 mm (1/4-inch) (10 mm (3/8-inch) outside diameter) tubing for connection to supply; label stub tubing for appropriate service and adjustable to compensate for variations in plaster or cover thickness. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPU) are furnished under this specification but installed by manufacturer of PBPUs before initial tests specified herein. Install outlet completion kits (valve body and face plate) for the remainder of required tests.

2.8 STATION INLET ROUGH-IN

A. Flush mounted, protected against corrosion. Anchor rough-in securely to unit or wall construction.

B. Modular Cover Plate: Die cast plate, two-piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, secured to rough-in with stainless steel or chromium plated countersunk screws.

C. Cover Plate for Prefabricated Bedside Patient Units (PBPU): One-piece with construction and material as indicated for modular cover plate.

D. Provide permanent, metal or plastic, identification plates securely fastened at each inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked-on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
MEDICAL VACUUM	Black letters on white background

2.9 VACUUM SWITCHES

General purpose, digital pressure sensors, allowing both high and low set points, with adjustable range; switches activate when indicated by alarm requirements.

2.10 VACUUM BOTTLE BRACKET

Single, plate of one piece, .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal or aluminum, finish matching cover of adjoining vacuum inlet; keepers of same material as plate and anchored securely; provide bracket and plastic vacuum bottle holder for each vacuum wall inlet.

2.11 VACUUM PUMP SYSTEMS

A. General: All components factory packaged (prewired and pre-piped), single stage, air cooled, reciprocating type, belt driven with OSHA approved totally enclosed belt guard, maximum compressor rotating speed shall not exceed 1180 RPM, tank mounted. Package piping shall be type K or L copper tubing with brazed joints per current NFPA. Provide discharge separator/silencer.

B. Compressors: Duplex such that design load is provided with the one unit out of service.

   1. Rated for continuous duty, 24 hours per day, seven days per week.

C. Motor and Starter: Maximum 40 °C ambient temperature rise, open drip proof type motor, ball bearings, for operation with current, voltage, phase and cycle specified in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT. Motor shall be of such capacity that brake horsepower required by driver equipment at normal rated capacity will not exceed nameplate rating of the motor. Provide each motor with automatic, fully enclosed, magnetic starter of type specified in Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

D. Controls:

   1. Automatic: Adjustable, vacuum operated, automatic, electric switch to start and stop motor at receiver vacuum indicated. Provide heavy duty alternator, automatic, operating on a timed basis, to alternate the pumps by time forced alternation.

   2. Control panel: Housed in a NEMA ICS-6, Type 12, listed, dust proof enclosure; prewired to include all specified electrical, electronic and electropneumatic devices. Include wiring diagrams and operating descriptions in the cabinet. Include the following:

      a. Circuit breakers for each control and motor circuit.

      b. Hand-off-automatic selector switch for each pump.

      c. Hour meter for each pump.

      d. Control circuit transformers.

      e. One magnetic motor starter for each pump.

      f. Provide panel with external visual (lights, red for running, green for off) and audible (horn/buzzer) signals. The signals provided include:

         1) Pump in operation (visual only).

         2) Thermal overload shutdown (visual and audible).

3) Oil discharge filter differential pressure or back pressure alarm (visual), with contacts for external signal. Wire to master alarm panel.
4) Cancel button, which will silence an audible alarm, reactivate should a second alarm occur while the horn is silenced, and reset automatically upon correction of the original signal.

E. Receiver Tank: Welded galvanized steel, in compliance with ASME Section VIII, 850 kPa (125 psi) working pressure stamped and certified. Equip with vacuum gage and gage glass. Receiver shall be of sufficient capacity to ensure practical on/off operation of pumps.

F. Bio-Hazard Safety Statement: "BIOHAZARD CAUTION: Fluid and waste material inside vacuum pipelines and vacuum equipment may be contaminated with blood and other potentially infectious material. Construction and service personnel should use PERSONAL PROTECTIVE EQUIPMENT and practice UNIVERSAL PRECAUTIONS when opening or servicing vacuum systems."

PART 3 - EXECUTION

3.1 INSTALLATION

A. In accordance with current NFPA requirements.

B. Install cast escutcheon with set screw at each wall and ceiling penetration in exposed finished locations and within cabinets and millwork.

C. Keep open ends of tube capped or plugged at all times or otherwise sealed until final assembly.

D. Cut piping square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. Ream tube to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. Work into place without springing or forcing. Bottom tube in socket so there are no gaps between tube and fitting. Exercise care in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease being introduced into tubing. Where contamination has occurred, material is no longer suitable for oxygen service.

E. Spacing of hangers: Current NFPA.

F. Rigidly support valves and other equipment to prevent strain on tube or joints.

G. While being brazed, joints shall be continuously purged with *oil* free nitrogen. The flow of purged gas shall be maintained until joint is cool to touch.

H. Do not bend tubing; use fittings.

I. Install pressure and vacuum switches, transmitter and gauges to be easily accessed, and provide access panel where installed above plaster ceiling. Install pressure switch and sensors with orifice nipple between the pipe line and switches/sensors.

J. Apply pipe labeling during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.

K. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.

L. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoked 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, with intumescent materials only. Completely fill and seal clearances between raceways and openings with the fire stopping material.

M. Provide 40mm (1 1/2 inch) diameter line vacuum gage downstream of zone valve in cabinets.

N. Provide zone valves in cabinets where indicated

3.2 TESTS

A. Initial Tests: Blow down along with high and low pressure leakage tests as required by current NFPA with documentation.

B. Medical gas testing agency shall perform the following:

1. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.

2. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.

3. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no

discoloration, and shall accrue no more than 0.1 mg of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.

4. Inlet flow test:
   a. Test all inlets for flow. Perform test with the use of an inert gas as described in CGA P-9.
   b. Needle valve vacuum inlets must draw no less than 1.0 scfm with adjacent inlet flowing, at a dynamic inlet pressure of 12-inches Hg, and a static vacuum of 15-inches Hg.
   c. Vacuum inlets must draw no less than 85 Lpm (3.0 scfm) with adjacent inlet flowing, at a dynamic inlet pressure of 40 kPa (12-inches Hg), and a static vacuum of 50 kPa (15-inches Hg).
5. System is considered and to be tested as a Level II.

- - - E N D - - -

SECTION 22 63 00

GAS SYSTEMS FOR HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Healthcare Gas Systems: Consisting of oxygen and medical air services; complete, ready for operation, including all necessary piping, fittings, valves, cabinets, station outlets, rough-ins, ceiling services, gages, alarms including low voltage wiring, nitrogen control panels, cylinder manifolds, air compressors, electric motors and starters, air dryers, filters, pressure regulators, dew point, carbon monoxide monitors and all necessary parts, accessories, connections and equipment; match existing station outlet and inlet terminal connections.

B. Oxygen System: Ready for connection to existing oxygen system at point located on the drawings; no bulk storage work is involved.

C. Supply Lines Outside of Building (including PVC protective pipe): As specified in this Section.

D. Healthcare gas system alarm wiring from equipment to alarm panels.

1.2 RELATED WORK

A. Sealing around pipe penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.

B. Sealing around pipe penetrations through the floor to prevent moisture migration: Section 07 92 00, JOINT SEALANTS.

C. General requirements and items common to more than one section of Division 22. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

D. Alarm interface with ECC. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

E. Conduit: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

F. Control wiring: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).

G. Electrical wiring and accessories: Section 26 27 26, WIRING DEVICES.

H. Electric motors: Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

I. Motor starters: Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

J. Prefabricated bedside patient units: Section 10 25 13, PATIENT BED SERVICE WALLS.

K. Vacuum Piping and Equipment: SECTION 22 62 00, VACUUM SYSTEMS FOR HEALTHCARE FACILITIES

1.3 QUALITY ASSURANCE

A. Materials and Installation: In accordance with NFPA 99, and as specified.

B. Equipment Installer: Show technical qualifications and previous experience in installing laboratory and healthcare equipment.

C. Healthcare System Testing Organization: The testing shall be conducted by a party technically competent and experienced in the field of healthcare pipeline testing. Such testing shall be performed by a party other than the installing contractor.

D. Provide references of projects where testing of medical gases systems have been performed by the testing agency. Include the name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification.

E. Submit the testing agency's detailed procedure which will be followed in the testing of this project. Include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, include data on test methods, types of equipment to be used, calibration sources and method references.

F. Certification: Provide documentation prior to submitting request for final inspection to include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.

G. Installing contractor shall maintain as-built drawings of each completed phases for verification; providing the complete set at the time of final system certification testing, for certification by the Third Party Testing Company. As-built drawings are to be provided, and a copy of them on Auto-Cad version (R-14 or later) provided on compact disk. Should the installing contractor engage the testing company to provide as-built or any portion thereof; it shall not be deemed a conflict of interest or breach of the ‘third party testing company’ requirement.

1.4 SUBMITTALS

A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Piping.
2. Valves.
3. Inlet and outlet cocks
4. Valve cabinets.
5. Gages.
6. Station outlets and rough-in assemblies.
7. Ceiling services.
8. Alarm controls and panels.
9. Pressure Switches.
10. Manifolds.
11. Air compressor systems (Provide certified compressor test data at start-up.):
    a. Compressors: Manufacturer and model.
    b. Characteristic performance curves.
    c. Compressor operating speed (RPM).
    d. Capacity: Free air delivered at indicated pressure (L/s) (SCFM).
    e. Type of bearing in compressor.
    f. Type of lubrication.
    g. Type and adjustment of drive.
    h. Electric motors: Manufacturer, frame and type.
    i. Speed of motors (RPM).
    j. Current characteristics and horsepower of motors.
    k. Receiver capacity and rating.
    l. Air silencer: Manufacturer, type and model.
    m. Air filters: Manufacturer, type, model and capacity.
    n. Pressure regulators: Manufacturer and capacity.
    o. Dew point monitor: Manufacturer, type and model.
    p. Air dryers: Manufacturer, type, model and capacity (L/s) (SCFM).
    q. Carbon monoxide monitor manufacturer, type and model.
    r. Aftercoolers.

C. Station Outlets: Submit letter from manufacturer stating that outlets are designed and manufactured to comply with NFPA 99. Outlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation. In lieu of above

labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer, certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.

D. Certification: The completed systems have been installed, tested, purged and analyzed in accordance with the requirements of this specification.

1.5 TRAINING

A. Furnish the services of a competent instructor for not less than two four-hour periods for instructing personnel in the operation and maintenance of the laboratory and healthcare gas systems, on the dates requested by COTR.

B. Coordinate with other requirements specified in Section 01 00 00, GENERAL REQUIREMENTS.

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 test by the basic designation only.

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

B819 (current edition) Seamless Copper Tube for Medical Gas Systems

C. American Society of Mechanical Engineers (ASME):

A13.1-(current edition) Scheme for Identification of Piping Systems

B16.22-(current edition) Wrought Copper and Bronze Solder-Joint Pressure Fittings

B40.100-(current edition) Pressure Gauges and Gauge Attachments

Boiler and Pressure Vessel Code -

Section VIII-(current edition) Pressure Vessels, Division I

Section IX-(current edition) Welding and Brazing Qualifications

D. American Welding Society (AWS):

AWS A5.8-(current edition) Brazing Filler Metal

AWS B2.2-(current edition) Standard for Brazing Procedure and Performance Qualification (Modified per NFPA 99)

E. Compressed Gas Association (CGA):

C-9-(current edition)	Standard Color Marking of Compressed Gas Cylinders
G-4.1-(current edition)	Cleaning Equipment for Oxygen Service
P-9-(current edition)	Inert Gases Argon, Nitrogen and Helium
V-1-(current edition)	Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections

F. National Electrical Manufacturers Association (NEMA):

ICS-6-(current edition)	Industrial Controls and Systems Enclosures

G. National Fire Protection Association (NFPA):

99-(current edition)....Health Care Facilities

H. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)

I. Manufacturing Standardization Society (MSS):

MSS-SP-72-(current edition)	Ball Valves With Flanged or Butt Welding For General Purpose
MSS-SP-110-(current edition)	Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends
MSS-SP-73-(current edition)	Brazing Joints for Copper and Copper Alloy Solder Pressure Fittings

PART 2 - PRODUCTS

2.1 PIPING

A. Copper Tubing: Type "K" or "L", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ASME B16.22 or brazing fittings complying with MSS SP-73. Size designated reflecting nominal inside diameter. All tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".

B. Brazing Alloy: AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux is strictly prohibited for copper-to-copper connections.

C. Screw Joints: Polytetrafluoroethylene (teflon) tape.

D. Underground Protective Pipe: Polyvinyl Chloride (PVC), ASTM D1785, Schedule 80.

E. Memory metal couplings having temperature and pressure rating not less than that of a brazed joint shall be permitted.

F. Apply piping identification labels shall be done at time of installation in accordance with current NFPA. Supplementary color identification shall be in accordance with CGA Pamphlet C-9.

G. Special Fittings: The following special fittings shall be permitted to be used in lieu of brazed joints:

1. Memory-metal couplings having temperature and pressure ratings joints not less than that of a brazed joint.
2. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint.
3. Dielectric fittings where required by the manufacturer of special medical equipment to electrically isolate the equipment from the piping distribution system.
4. Axially swaged, elastic strain preload fittings providing metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and non-separable.

2.2 EXPOSED HEALTHCARE GASES PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed laboratory and healthcare 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: ASME B16.15 cast bronze threaded fittings with chrome finish, 125.
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.
5. Valves: Mss SP-72, SP-110, Brass or bronze with chrome finish.

2.3 VALVES

A. Ball: In-line, other than zone valves in cabinets:

1. Seventy five millimeter (2 1/2 inches) and smaller: Bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1, with tubing extensions for brazed connections, full ported, three-piece or double union end connections, teflon seat seals, full

flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle and cleaned for oxygen service.

B. Check:

1. Eighty millimeter (3 inches) and smaller: brass and Bronze body, straight through design for minimum pressure drop, spring loaded, self aligning with teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, cleaned for oxygen use, 2750 kPa (400 psi) WOG minimum working pressure.

C. Zone Valve in Cabinet: Ball valve, bronze/ brass body, double seal, three piece or double union end connections, replaceable teflon seat seals, teflon stem seal, 4125 kPa (600 psi) WOG, cold, non-shock gas working pressure service to 29 inch Hg, cleaned for oxygen service, blowout proof stem, one quarter turn of handle to completely open or close. Provide tubing extensions factory brazed, pressure tested, cleaned for oxygen service. Provide 3 mm (1/8 inch) NPT gauge port for a 50mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type-K copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be products of one manufacturer, and uniform throughout in pattern, overall size and appearance.

Trim with color coded plastic inserts or color coded stick-on labels. Install valves in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
OXYGEN	White letters on green background	GREEN
MEDICAL AIR	Black or white letters on yellow background	YELLOW

2.4 VALVE CABINETS

A. Flush mounted commercially available item for use with laboratory and healthcare services, not lighter than 1.3 mm (18 gage) steel or 1.9 mm (14 gage) extruded aluminum, rigidly assembled, of adequate size to accommodate valve(s) and fittings. Punch or drill sides to receive tubing. Provide anchors to secure cabinet to wall construction. Seal

openings in cabinet to be substantially dust tight. Locate bottom of cabinet approximately 1375 mm (4 foot 6 inches) above floor.

B. Mount engraved rigid plastic identification plate on wall above or adjacent to cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate must be clearly visible at all times. Provide inscriptions on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS."

C. Cover plate: Fabricate from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or .85 mm (22 gage) stainless steel. Provide cover window of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. Permanently paint or stencil on window: "FOR EMERGENCY SHUT-OFF VALVES ONLY, SHUT-OFF VALVES FOR PIPED GASES", or equivalent wording. Configure such that it is not possible to install window with any valve in the closed position. Each valve shall have gauge upstream of valve inside valve box.

D. Cabinets and isolation valves shall be located and piped as shown, and at a minimum, so as to allow the isolation of each smoke compartment separately. No cabinet shall serve more than one smoke compartment.

2.5 GAGES

A. Pressure Gages: Includes gages temporarily supplied for testing purposes.

1. For line pressure use adjacent to source equipment: ASME B40.1, pressure gage, single, size 115 mm (4-1/2 inches), for compressed air, nitrogen and oxygen, accurate to within two percent, with metal case. Range shall be two times operating pressure. Dial graduations and figures shall be black on a white background, or white on a black background. Gage shall be cleaned for oxygen use, labeled for appropriate service, and marked "USE NO OIL". Install with gage cock.

2. For all services downstream of main shutoff valve: Manufactured expressly for oxygen use but labeled for appropriate service and marked "USE NO OIL", 40 mm (1-1/2 inch) diameter gage with dial range 1-690 kPa (1-100 psi) for air service, and 1-690 kPa (1-100 psi) for oxygen service.

2.6 STATION OUTLETS

A. For all services except ceiling hose drops and nitrogen system: For designated service, consisting of a quick coupler and inlet supply

tube. Provide coupler that is non-interchangeable with other services, and leak proof under three times normal working pressure. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet and inlet securely to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm outside diameter) (3/8-inch outside diameter) tubing for connection to supply; label stub tubing for appropriate service. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPU) are furnished under this specification but installed by manufacturer of PBPUs before initial test specified herein. Install completion kits (valve body and face plate) for the remainder of required tests.

2.7 STATION OUTLETS

For all services: Brass, stainless steel or chromed metal non-interchangeable DISS connections for appropriate service to conform to CGA V-5. Equip each station outlet with an automatic valve and a secondary check valve to conform to NFPA 99. Equip each station inlet with an automatic valve to conform to NFPA 99. Place valves in the assembly to provide easy access after installation, for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet securely to outlet rough-in to prevent floating, and provide each outlet with a capped stub length of 6 mm (1/4-inch) (10 mm (3/8-inch) outside diameter) tubing for connection to supply. Label stub tubing for appropriate service; adjustable to compensate for variations in plaster or cover thickness. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPU) are furnished under this specification but installed by manufacturer of PBPUs before initial tests specified herein. Install outlet completion kits (valve body and face plate) for the remainder of required tests.

2.8 STATION OUTLET ROUGH-IN

A. Flush mounted, protected against corrosion. Anchor rough-in securely to unit or wall construction.

B. Modular Cover Plate: Die cast plate, two-piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, secured to rough-in with stainless steel or chromium plated countersunk screws.

C. Cover Plate for Prefabricated Bedside Patient Units (PBPU): One-piece with construction and material as indicated for modular cover plate.

D. Provide permanent, metal or plastic, identification plates securely fastened at each outlet and inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked-on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
OXYGEN	White letters on green background
MEDICAL AIR	Black or white letters on yellow

2.9 ALARMS

A. Provide all low voltage control wiring, except for wiring from alarm relay interface control cabinet to ECC, required for complete, proper functioning system, in conformance with Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Run wiring in conduit, in conformance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

B. Local Alarm Functions: Provide individual local medical air compressor malfunction alarms at each compressor system main control panel.

1. Compressor Malfunction Alarm: Each compressor system receiving any of the following individual signals and sends a single combined "compressor malfunction alarm" signal to master alarm panel.
   a. Thermal Malfunction Alarm: Functions when discharge air temperature exceeds 170 °C (350 °F), shutting down affected compressor.
   b. Lead Compressor Fails to Start: Functions when lead compressor fails to start when actuated, causing lag pump to start.
   c. Lag Compressor in Use: Functions when lag compressor starts.
   d. High Water Level in Receiver. (Liquid ring unit)
   e. High Water Level in Separator (if so required). (Liquid ring unit)
2. Desiccant Air Dryer Malfunction Alarm: Dryer receives the following individual signals and sends a single consolidated dryer malfunction alarm signal to master alarm panel.
   a. Dew Point Alarm: Functions when pressure dew point rises above 4 °C (39 °F) at 380 kPa (55 psi).

3. Vacuum Pump Malfunction Alarm: Pump system receives the following individual signals and sends a single consolidated pump malfunction alarm signal to master alarm.
   a. High Temperature Shut down Alarm: Functions when exhaust air temperature exceeds 104 °C (220 °F), shutting down affected pump.
   b. Lead Pump Fails to Start Alarm: Functions when lead pump fails to start when actuated causing lag pump to start.
   c. Lag Pump In Use Alarm: Functions when lag pump starts.

C. Master Alarm Functions: Provide the following individual alarms at the master alarm panels. Conractor shall provide all labor and materials required to provide alarms in Master alarm panel and secondary master alarm panel. Master alarm panel is located in Boiler Plant, Building 27. Secondary Master Alarm Panel is in Builidng 5, EOD. Medical Gas alarms shall be tied into both of these panels.

1. Oxygen Alarms:
   a. Liquid oxygen low level alarm: Functions when stored liquid oxygen reaches a predetermined minimum level.
   b. Reserve switchover alarm: Functions when reserve oxygen supply goes in operation.
   c. Reserve low supply alarm: Functions when contents of cylinder reserve oxygen supply are reduced to one day's average supply; switch and contacts at the bulk tank control panel.
   d. Reserve low pressure alarm: Functions when the gas pressure available in the liquid reserve oxygen supply is reduced below the pressure required to function properly.
   e. Low pressure alarm: Functions when system pressure downstream of the main shutoff valve drops below 275 kPa (40 psi), plus/minus 14 kPa (two psi); operated by pressure switch or transmitters.
   f. High pressure alarm: functions when system pressure downstream of main shutoff valve increases above 415 kPa (60 psi), plus/minus 14 kPa (two psi) set points; operated by pressure switches or transmitters.
2. Medical Compressed Air Alarms:
   a. Dew point alarm: Functions when pressure dew point rises above 4 °C (39 °F) at 380 kPa (55 psi).
   b. Carbon Monoxide Alarm: Functions when the carbon monoxide levels rise above 10 parts per million; receives signal from the carbon monoxide monitor.

c. Main Bank Filter Set Alarm: Functions when the pressure drop across filter set increases more than two psi over that when filters are clean and new; operates by differential pressure switch or transmitters.
d. Desiccant Prefilter Alarm: Functions when pressure across the filter increases more than 21 kPa (three psi) over that when filters are clean and new; operates by pressure differential switch.
e. Desiccant Post Filter Alarm: Functions when pressure drop across filter increases more than 21 kPa (3 psi) over that when filters are clean and new; operates by pressure differential switch.
f. Desiccant Dryer Malfunction Alarm: Functions on any combination of failure of tower cycling and/or pressure dew point rise above 60 degrees C at 690 kPa (140 degrees F at 100 psi).
g. Aftercooler High temperature Alarm: Functions when aftercooler discharge air temperature exceeds 38 degrees C (100 degrees F).
h. Pressure Abnormal Alarm: Functions when system pressure downstream of main shutoff valve drops below 550 kPa (80 psi) (plus/minus 14 kPa (2 psi) or increases above 830 kPa (120 psi) (plus/minus 14 kPa (2 psi) set points; operated by pressure switch.
i. Compressor Malfunction Alarm: Functions when compressor system control panel signals compressor thermal malfunction alarm, lead compressor fails to start alarm or high water level in receiver or separator (if so required) receives signal from system control panel.
j. Low Lubricant Shutdown: For rotary screw compressors. Functions when lubricant level drops to a low point. Receives signal from compressor control panel.

D. Area Alarm Functions:

1. Oxygen and medical compressed air alarms: Pressure alarms: Functions when pressure in branch drops below 275 kPa (40 psi), plus/minus 14 kPa (two psi) or increases above 235 kPa (60 psi), plus/minus 14 kPa (two psi) set points; operated by pressure switches or transmitters.
2. Oxygen alarms:
   a. Reserve switchover alarm: Functions when secondary or reserve manifold supply goes in operation.

b. Pressure alarms: Function when system pressure downstream of main shutoff valve drops below kPa (psi) (plus/minus 14 kPa (2 psi) or increases above kPa (psi) (plus/minus 14 kPa (2 psi) set points; operated by pressure switches or transmitters.

3. Vacuum alarms:

a. Low vacuum alarm: Function when system vacuum upstream of main shutoff valve drops below 40 kPa (12 inches Hg); operated by vacuum switch.

b. Filter differential pressure/back pressure alarm: Functions when discharge oil filter differential rises to set level, or when back pressure is sensed; receives signal from pump control panel.

E. Alarm Panels:

1. General: Modular design, easily serviced and maintained; alarms operate on alternative current low voltage control circuit; provide required number of transformers for efficient functioning of complete system. Alarm panels shall be integral units, reporting oxygen], medical air and vacuum services, as required.

2. Box: Flush mounted, sectional or one piece, corrosion protected; size to accommodate required number of service functions for each location, and for one audible signal in each box, anchor box securely.

3. Cover plate: Designed to accommodate required number of signals, visual and audible, for each location, and containing adequate operating instructions within the operator's view. Bezel shall be extruded aluminum, chromium plated metal, or plastic. Secure to the box with chromium plated or stainless steel countersunk screws.

4. Service indicator lights: Red translucent plastic or LED with proper service identification inscribed thereon. Number of lights and service instruction shall be as required for each location. Provide each panel with a green test button of the same material, inscribed with "PUSH TO TEST" or similar message.

5. Audible signal: Provide one in each alarm panel and connect electrically with all service indicator light functions.

6. Controls:

a. Visual signal: When the condition occurs which any individual service indicator light is to report, button for particular service shall give a lighted visual signal which cannot be canceled until such condition is corrected.

b. Audible signal: Alarm shall give an audible signal upon circuit energization of any visual signal. Audible signal shall be continuous until silenced by pushing a button. This shall cancel and reset audible only, and not affect the visual signal. After silencing, subsequent alarms shall reactivate the audible alarm.

c. Signal tester: Test button or separate normal light shall be continuously lighted to indicate electrical circuit serving each individual alarm is energized. Pushing test button shall temporarily activate all visual signals and sound audible signal, thereby providing desired indications of status of system.

F. Alarm Relay Interface Control Cabinet: Design cabinet to transfer the closed circuit alarm signals through relays to a set of terminals for monitoring signals at the ECC without interrupting the closed circuit system. Construct of 1.9 mm (14 gage) steel, conforming with NEMA ICS-6, Type 1, enclosures. Provide both normally open and normally closed contacts for output signals, with number of circuits required for full alarm capability at the ECC. Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for compatibility.

G. Alarm Network Communication: Network communications board shall be installed in local alarm and connected to the facility's Ethernet. Local alarm modules can send information to the master alarm and the data can be down loaded thru the computer which connected to the facility's Ethernet. Master alarm displays the message, sound its alarm and save the information in an event log. This event log can be down loaded to a computer file for tracking data and troubleshooting.

2.10 PRESSURE SWITCHES

General purpose, pressure sensor, allowing both high and low pressure set points, with adjustable range activate when indicated by alarm requirements.

2.11 MEDICAL AIR COMPRESSOR SYSTEMS

A. System Design: The medical air system shall be of a modular base mounted design consisting of duplex compressor, dryer/control, and an air receiver. Each unit must be fully compliant with the latest edition of NFPA 99.

B. Compressors: Continuous duty rated "oil-less" type with permanently lubricated, sealed bearings. Single stage design, air cooled, reciprocating type with corrosion resistant reed type valves with stainless steel reeds. Both the compression rings and rider rings shall

be made from a long life, fluororesin material designed for continuous duty operation. The crankshaft shall be constructed of a durable nodular graphite cast iron and designed to be fully supported on both ends by heavy duty ball bearings permanently lubricated and sealed.
The crankcase shall be constructed of gray cast iron. Maximum heat dissipation shall be achieved through cast aluminum alloy cylinders treated for optimum corrosion and wear resistance. Cylinder sleeves shall not be required. Additionally, heat transmission from the piston wall to the piston pin needle bearing shall be minimized by an insulated "heat cut" piston pin. The connecting rod shall be of a one piece design for maximum reliability.

C. Compressor Drive and Motor: V-belt driven through a combination flywheel/sheave and steel motor sheave with tapered bushing and protected by an OSHA approved, totally enclosed belt guard. Belt tensioning shall be achieved by a pivoting motor mounting base that is fully adjustable through twin adjusting screws. The motor shall be a NEMA rated, open drip proof, 1800 RPM, with 1.15 service factor suitable for 208/230/460V electrical service, a specified in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT and Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

D. Intake Piping: Provide a pre-piped intake manifold with one "hospital type" inlet air filter with threaded opening for remote intake connection. Isolate filter housing from the intake manifold with a braided 304 stainless steel flex connector.

E. Discharge Piping: Provide an integral air cooled aftercooler designed for a maximum approach temperature of 12 degrees F complete with moisture separator and timed automatic solenoid drain valve with a manual drain value by-pass. Provide each cylinder head with a pre-wired high discharge air temperature shutdown switch. Include a flex connector, safety relief valve, and check valve. The compressor discharge line the piping shall be of ASTM B-819 copper tubing, brass, and/or stainless steel. The discharge flex connector shall be braided 304 stainless steel, brass or bronze.

F. Isolation System: Isolate the compressor and monitor from the main compressor module base by means of a four point, heavy duty, spring isolation system for a minimum of 95% isolation efficiency.

G. Dryer/Control: The dryer/control shall include a NEMA 12, U.L. labeled control system, duplexed desiccant drying system, duplexed final line

filters, duplexed final line regulators, and combination dew point/CO monitor. All of the above shall be pre-wired and pre-piped in accordance with NFPA 99 and include valving to allow complete air receiver by-pass, as well as air sampling port.

H. Dryer: Size each desiccant dryer for the peak calculated demand and capable of producing 10 F (-12 C) pressure dew point. Dryer purge flow shall be minimized through an on-demand purge saving control system. Include a mounted prefilter rated for 0.01 micron with automatic drain and element change indicator on the inlet of each dryer.

I. Control System: Mounted and pre-wired control system shall be NEMA 12 and U.L. labeled. This control system shall provide automatic lead/lag sequencing with circuit breaker disconnects for each compressor with external operators, one non-fused main disconnect with external operators, full voltage motor magnetic starters with overload protection, redundant 120V control circuit transformers, visual and audible reserve unit alarm with isolated contacts for remote alarm, hand-off-auto (HOA) lighted selector switches, automatic alternation of both compressors with provisions for simultaneous operation if required, automatic activation of reserve unit if required, visual alarm indication for high discharge air temperature shutdown with isolated contacts for remote alarm, and duplexed run time hour meters.

J. Final Line Filters and Regulators: Fully duplexed final line filters rated for 0.01 micron with element change indicators shall be factory mounted and pre-piped, along with duplexed factory mounted and pre-piped final line regulators and duplex safety relief valves.

K. Dew Point Hygrometer/CO Monitor: Mounted, pre-piped and wired, combination dew point hygrometer/CO monitor shall be of the ceramic type with integral chemical type CO sensor. System accuracy shall be $\pm$ 2 F for dew point and 2PPM (at 10 PPM) for carbon monoxide. Dew point alarm shall be factory set at 39 F (4 C) per NFPA 99, and the CO alarm shall be factory set at 10 PPM. Both set points shall be field adjustable.

L. Air Receiver: Vertical air receiver, galvanized ASME Coded, National Board Certified, rated for minimum 150 PSIG design pressure and includes a sight gauge glass as well as a timed automatic solenoid drain valve. Provide three valve bypass on supply.

M. Example of an acceptable product and manufacturer: Beacon Medical Products “Lifeline Medical Air Systems”.

2.12 PRESSURE REGULATORS:

A. For 690 kPa (100 psi) regulator, provide duplex in parallel, valve for maintenance shut-down without service interruption. For additional pressures, locate regulators remote from compressor near point of use, and provide with isolation valves and valve bypass.

1. For systems 5 L/s (10 scfm) and below: Brass or bronze body and trim, reduced pressure range (170 – 850 kPa 25 – 125 psi) adjustable, spring type, diaphragm operated diaphragm operated, relieving. Delivered pressure shall vary not more than one kPa (psi) for each 10 kPa (psi) variation in inlet pressure.

2.13 EMERGENCY LOW PRESSURE OXYGEN INLET

A. The Low Pressure Emergency Oxygen Inlet provides an inlet for connecting a temporary auxiliary source of oxygen to the oxygen pipeline system for emergency or maintenance situations per NFPA 99.

B. The inlet consist of a 1" (25 mm) ball valve, pressure gauge and a 1/2"/1" NPTF connection housed in a weather tight enclosure. The enclosure is labeled "Emergency Low Pressure Gaseous Oxygen Inlet", and includes a padlock staple to prevent tampering or unauthorized access. The enclosure is suitable for recess mounting on the exterior of the building being served. The enclosure is 14 gauge, cold rolled steel with a primer coat of paint. The Emergency Oxygen Inlet is connected at a point downstream of the main supply line shutoff valve.

C. Check valves are provided for installation in the emergency supply line and 'in the main supply line between the main line shutoff valve and the emergency supply line connection per by NFPA 99. Check valves have a cast bronze body and straight through design for minimum pressure drop.

D. The check valves for sizes under 3" (76 mm) are soft seated, bubble tight, self aligning, and spring loaded, and ball type check valves. Three inch (76 mm) check valves are hard seated, spring loaded, self aligning ball type checks with cone seats (3" valves may not be "bubble tight"). Check valves are fast acting.

E. A relief valve is provided for installation in the emergency supply line per NFPA 99. The relief valve has a brass body, single seat design, and is cleaned for oxygen use. It automatically reseats to provide a "bubble tight" seal after discharging excess gas. Pre-set at 75 psi.

PART 3 - EXECUTION

3.1 INSTALLATION

A. In accordance with current NFPA. Run buried oxygen piping in PVC protective pipe for entire length including enclosure of fittings and changes of direction.

B. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

C. Keep open ends of tube capped or plugged at all times or otherwise sealed until final assembly.

D. Cut piping square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. Ream tube to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. Work into place without springing or forcing. Bottom tube in socket so there are no gaps between tube and fitting. Exercise care in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease being introduced into tubing. **Where contamination has occurred, material is no longer suitable for oxygen service.**

E. Spacing of hangers: Current NFPA.

F. Rigidly support valves and other equipment to prevent strain on tube or joints.

G. While being brazed, joints shall be continuously purged with *oil* free nitrogen. The flow of purged gas shall be maintained until joint is cool to touch.

H. **Do not bend tubing; use fittings.**

I. Support ceiling column assembly from heavy sub-mounting castings furnished with the unit as part of roughing-in. Anchor with 15 mm (1/2-inch) diameter bolts attached to angle iron frame supported from structural ceiling, unless otherwise indicated.

J. Provide two 25 mm (1 inch) minimum conduits from ceiling column assembly to adjacent corridor, one for mass spectrometer tubing and wiring and one for monitor wiring, for connection to signal cabling network.

K. Install pressure transmitter and gauges to be easily accessed, and provide access panel where installed above plaster ceiling. Install pressure switch and sensors with orifice nipple between the pipe line and switches/sensors.

L. Apply pipe labeling during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.

M. Pipe compressor intake to a source of clean ambient air as indicated in current NFPA.

N. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.

O. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoked 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, with intumescent materials only. Completely fill and seal clearances between raceways and openings with the fire stopping material.

2. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

P. Provide 40mm (1 1/2 inch) diameter line pressure gage downstream of zone valve in cabinets.

Q. Provide zone valves in cabinets where indicated and outside each Operating Room and a minimum one zone valve assembly for each 18 outlet set.

3.2 TESTS

A. Initial Tests: Blow down, and high and low pressure leakage tests as required by current NFPA with documentation.

B. Healthcare testing agency shall perform the following:

1. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.

2. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.

3. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no discoloration, and shall accrue no more than 0.1 mg of matter. Test

each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.

4. Piping purity test: For each positive pressure system, verify purity of piping system. Test each zone at the most remote outlet for dew point, carbon monoxide, total hydrocarbons (as methane), and halogenated hydrocarbons, and compare with source gas. The two tests must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Perform test with the use of an inert gas as described in CGA P-9.
5. Outlet and inlet flow test:
   a. Test all outlets for flow. Perform test with the use of an inert gas as described in CGA P-9.
   b. Oxygen and air outlets must deliver 100 Lpm (3.5 scfm) with a pressure drop of no more than 35 kPa (5 psi), and static pressure of 350 kPa (50 psi).
   c. Needle valve air outlets must deliver 1.5 scfm with a pressure drop of no more than five psi, and static pressure of 50 psi.
6. Source Contamination Test: Analyze each pressure gas source for concentration of contaminants, by volume. Take samples for air system test at the intake and at a point immediately downstream of the final filter outlet. The compared tests must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Allowable concentrations are below the following:

Dew point, air	2 degrees C (35 degrees F) pressure dew point at 690 kPa (100 psi)
Carbon monoxide, air	10 mg/L (ppm)
Carbon dioxide, air	1000 mg/L (ppm)
Gaseous hydrocarbons as methane, air	5 mg/L (ppm)
Halogenated hydrocarbons, air	2 mg/L (ppm)

7. Analysis Test:
   a. Analyze each pressure gas source and outlet for concentration of gas, by volume.

b. Make analysis with instruments designed to measure the specific gas dispensed.

c. Allowable concentrations are within the following:

Oxygen	99 plus percent oxygen
Nitrous oxide	99 plus percent nitrous oxide
Nitrogen	99 plus percent nitrogen
Medical air	19.5 percent to 23.5 percent oxygen
Carbon Dioxide	99 plus percent carbon dioxide

8. Maximum Allowable Variation: Between comparative test results required are as follows:

Dew point	2 degrees C (4 degrees F)
Carbon monoxide	2 mg/L (ppm)
Total hydrocarbons as methane	1 mg/L (ppm)
Halogenated hydrocarbons	2 mg/L (ppm)

3.3 CONNECTION TO EXISTING GAS SYSTEM:

A. Contactor shall test the existing system for hydrocarbons, dew point, etc. If problems are present, the COTR (RE) would notify the facility of the results. The facility would then make the necessary repairs and/or maintenance.

B. Install shut-off valve at the connection of new line to existing line.

C. Coordinate time for shut-down of the existing laboratory and healthcare system with the VA medical center at least two weeks in advance of shutdown. Shutdown shall not last more than 4 hours.

D. Shut off all oxygen zone valves and gas riser valves if the section to be connected to cannot be totally isolated from the remainder of the system.

E. Prior to any work being done, check the new pipeline for particulate or other forms of contamination.

F. Insure that the correct type of pipe tubing and fittings are being used.

G. Make a spot check of the existing pipelines in the facility to determine the level of cleanness present.

H. Reduce the pressure to zero and make the tie-in as quickly as possible. A nitrogen purge is not required since this would require another opening in the pipe.

I. After the tie-in is made and allowed to cool, slowly bleed the source gas back into the pipeline. Test the work area for leaks with soapy water and repair any leaks.

J. When tying oxygen into the main facility's oxygen line, medical air certifier must re-certify **all** oxygen ports in Buildings 4, 6, 8, 10, and 12 immediately after tie-in, prior to turing oxygen back on to these wards. Each port on listed wards shall be purge and purity tested. If multiple certifiers are required to re-certify all ports in 4-hour time frame, contractor is responsible for this coordination and cost.

J. After all leaks, if any, are repaired and the line is fully recharged, perform blow down and testing. Open the zone that is closest to the main to the system, access the closest outlet to the work, and blow the main through the outlet. After the outlet blows clear into a white cloth, make an additional check at a zone most distant from the work. Perform all required current NFPA tests after connection.

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SECTION 22 81 04

FUEL OIL PIPING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide diesel fuel oil piping from point of connection to aboveground diesel fuel storage tank to generator.

B. Clean and test new fuel oil piping.

C. All metallic fuel vent piping shall be painted as required in Division 9.

1.2 QUALITY ASSURANCE

A. Installation shall comply with the requirements of the Division of the State Fire Marshal and local Fire Department requirements.

B. Standards: American National Standards Institute (ANSI), Underwriters Laboratories (UL), National Fire Protection Association (NFPA 30 and 31), American Society for Testing and Materials (ASTM), Georgia Environmental Protection Agency (GEPA).

C. All gaskets, packings and other non-metallic joining materials shall be rated no less than 1000 degrees F.

1.3 MAXIMUM PRESSURE RATING

A. Valves are listed for 300 lb. WOG maximum.

PART 2 - PRODUCTS

2.1 PIPING

A. Standard weight, Schedule 40, welded, plain end, wrought-steel or wrought iron pipe (ASTM A53).

1. Up to 1 1/2 Inches: Butt-welded, Schedule 40.

2.2 FITTINGS

A. 300 lb. malleable iron welded fittings.

2.3 GATE VALVES

A. 2 1/2 Inches and Smaller: 300 lb. WOG bronze, inside screw rising stem, threaded ends.

2.4 OIL FILTER

A. UL listed, replaceable filter.

2.5 VENT CAP

A. Aluminum body and cover, 40-mesh brass screen.

2.6 OIL STRAINERS

A. Cast iron body, 150 lb. W.P. simplex or duplex construction, clamped cover with handle, removable perforated brass basket.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Entire installation shall comply with the requirements of NFPA 30, and 31.

B. Ream all pipe before installing. Use pipe dope approved for diesel fuel oil service.

C. Provide unions at each final connection and at each piece of equipment.

D. All piping and valve installation shall comply with the requirements of the Georgia Rules and Regulations of the Division of the State Fire Marshal for the storage of petroleum liquids. Installation also must meet Local Fire Department requirements.

3.2 COORDINATION

A. Coordinate location of diesel fuel oil lines with General Contractor and equipment.

B. Coordinate location and rough-in requirements of equipment with respective Contractors.

3.3 TESTS

A. Test suction, supply and return piping for four hours each at 20 inches mercury vacuum and at 75 psig air pressure.

B. Tank assembly to be tested according to current installation instructions provided with tank. Any leakage found is to be immediately repaired and checked by retesting.

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SECTION 23 05 11

COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION

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: COTR
4. COTR: Contracting Officer’s Technical Representative.
5. Boiler Plant: Includes heat exchanger condensate handling and associated accessories.

1.2 RELATED WORK

I. Section 00 72 00, GENERAL CONDITIONS.

J. Section 01 00 00, GENERAL REQUIREMENTS.

K. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

D. Excavation and Backfill: Section 31 20 00, EARTH MOVING.

E. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.

F. Building Components for Attachment of Hangers: Section 05 31 00, STEEL DECKING, and Section 05 36 00, COMPOSITE METAL DECKING.

G. Section 05 50 00, METAL FABRICATIONS.

H. Section 07 84 00, FIRESTOPPING.

I. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

J. Section 07 92 00, JOINT SEALANTS.

K. Section 09 91 00, PAINTING.

L. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

M. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

N. 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 or steam boiler plant 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 and 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT. 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 then those specified. Refer any conflicts to the 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. Outside Steam Distribution Welding: Refer to Sections 23 21 11, BOILER PLANT PIPING SYSTEMS.

H. 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 COTR for resolution. Provide written hard copies or computer files of manufacturer’s installation instructions to the 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. <u>All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely</u>

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 COTR for resolution. VA will review all locations of equipment and valves, and if COTR does not deem that it is accessible to employees, contractor shall move the item at his own expense. Coordination of general contractor with VA and all trades prior to placement is critical. If one division sub-contractor installs an item that is accessible, but it is later covered or made inaccessible by another trade, it still remains the contractor's responsibility to move this item and make it easily and safely accessible.

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. Submittal "Groups" for boiler plant work are defined in the following checklist:

1. Group VI (Condensate Transfer):
   a. Condensate transfer pumps, accessories.

H. Ungrouped submittal items for boiler plants, which may be submitted individually, include, but are not limited to:

1. Pipe, valves and fittings identified as to service application.
2. Strainers.
3. Safety valves and drip pan ells.
4. Temperature control valves, sensors.
5. Steam pressure reducing valves and pilots.
6. Steam traps with orifice sizes and pressure ratings.
7. Thermometers and pressure gauges and accessories.
8. Chemical feeders.
9. Flexible connectors, hose, braided.
10. Dielectric fittings and unions.
11. Heating and ventilating equipment.
12. Condensate pump sets.
13. Vibration isolators - air, water.
14. Supports and braces for pipe, stacks, breeching; load, size, movement calculations.
15. Pressure gauge test kit.
16. Insulation, field-applied.
17. Seismic calculations and drawings indicating equipment and piping anchoring, reinforcement and bracing.

I. 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 under Article CHANGES of Section 00 72 00, GENERAL CONDITIONS.

J. Coordination and 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 Section 00 72 00, GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION.
   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.

K. 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 COTR.
   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. For piping, refer to Section 23 21 11, BOILER PLANT PIPING SYSTEMS, for additional requirements.
   6. Wall, floor, and ceiling plates.

L. 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.

M. 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):
Boiler and Pressure Vessel Code (BPVC):
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

I. National Electrical Manufacturers Association (NEMA):

MG-1-2006.....Motors and Generators

J. National Fire Protection Association (NFPA):

31-06.....Standard for Installation of Oil-Burning Equipment

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 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. 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 AND STEAM GENERATION 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.
   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.

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 and Boiler Plant: 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, PLUMBING, AND BOILER PLANT 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. Pipe Hangers and Supports for Boiler Plant: Refer to Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

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 COTR 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 COTR for each job condition.
E. Attachment to Wood Construction: Wood screws or lag bolts.
F. 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.
G. 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.
H. 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.

3. High and Medium Pressure Steam (MSS SP-58):

a. Provide eye rod or Type 17 eye nut near the upper attachment.

b. Piping 50 mm (2 inches) and larger: Type 43 roller hanger. For roller hangers requiring seismic bracing provide a Type 1 clevis hanger with Type 41 roller attached by flat side bars.

c. 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.

4. Convertor and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.

I. 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.
6. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

J. Seismic Restraint of Piping and Ductwork: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Comply with MSS SP-127.

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 COTR.

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 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 in tended service and mounted, or located, where directed by the COTR.

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 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 COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COTR for approval. All penetrations in exterior or fire-rated walls require a permit from the safety office.
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 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. 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. 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.

N. 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 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 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, in-line pumps 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.
5. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 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:
3. 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.
4. 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. Paint shall withstand the following temperatures without peeling or discoloration:
   a. Condensate -- 38 degrees C (100 degrees F) on insulation jacket surface and 120 degrees C (250 degrees F) on metal pipe surface.
   b. Steam -- 52 degrees C (125 degrees F) on insulation jacket surface and 190 degrees C (375 degrees F) on metal pipe surface.
6. 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.

3.6 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, valves, 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. Any equipment above ceiling shall be labeled on ceiling below as well with laminated plastic sign.

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.

3.7 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.

3.8 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 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.

3.9 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.

3.10 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 Section 23 08 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT, 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 for heating systems and

for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

3.11 DEMONSTRATIONS AND TESTS

A. Test prior to placing in service.

B. Demonstrate to COTR the proper operation of all equipment, instruments, operating and safety controls, and devices.

C. Develop full hot water output capacity required.

3.12 INSTRUCTIONS TO VA PERSONNEL

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS, and Section 23 08 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT.

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SECTION 23 05 41

NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

Noise criteria, seismic restraints for equipment, vibration tolerance and vibration isolation for HVAC and plumbing work.

1.2 RELATED WORK

A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural equipment

B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements and items, which are common to more than one section of Division 23.

C. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS: Requirements for optional Air Handling Unit internal vibration isolation.

D. Section 23 31 00, HVAC DUCTS AND CASINGS: requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining.

E. 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**
Bathrooms and Toilet Rooms	40
Chapels	35
Conference Rooms	35
Corridors (Nurse Stations)	40
Corridors(Public)	40
Laundries	50
Lobbies, Waiting Areas	40
Offices, small private (2 or fewer occupants)	35
Patient Rooms	35

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 20 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. Exposure to weather: Isolators, including springs, exposed to weather shall be hot dip galvanized after fabrication. Hot-dip zinc coating shall not be less than 609 grams per square meter (two ounces per square foot) by weight complying with ASTM A123.

D. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.

E. 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. Isolators shall have a minimum seismic rating of one G.
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. 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.

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.

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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															
PACKAGED HERMETIC	---	D	---	---	SP	1.0	---	SP	1.7	---	SP	1.7	R	SP	2.5
CENTRIFUGAL BLOWERS															
UP TO 50 HP:															
501 RPM & OVER	B	N	0.3	B	S	1.0	B	S	1.0	B	S	1.7	B	S	2.5
AIR HANDLING UNIT PACKAGES															
FLOOR MOUNTED:															
7-1/2 HP & OVER:															
501 RPM & OVER	---	D	---	---	S, THR	1.0	---	S, THR	1.0	R	S, THR	1.7	R	S, THR	1.7

SECTION 23 05 51

NOISE AND VIBRATION CONTROL FOR BOILER PLANT

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the application of noise and vibration control techniques to rotating equipment including pumps, fans, compressors, and motors.

1.2 RELATED WORK

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

B. Vibration isolators: Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Noise and Vibration Control Devices; include with the equipment submittals.

PART 2 - PRODUCTS

(Part 2 - (Not Used).

PART 3 - EXECUTION

3.1 BALANCING AND ALIGNMENT OF ROTATING EQUIPMENT

Statically and dynamically balance all pumps, fans, compressors and drivers. Align shafts of pumps, fans, and drivers to limit noise and vibration to specified values. Level and anchor equipment as necessary to achieve and maintain alignment.

3.2 VIBRATION TESTS ON ROTATING EQUIPMENT

A. Perform vibration tests on all pumps, fans, compressors and drivers during the pretest of the equipment. Tests shall be conducted by an experienced technician in the presence of the COTR (RE)/Contracting Officers Technical Representative (COTR).

B. Perform tests at each bearing in axial, horizontal, and vertical positions.

C. RMS vibration velocity shall not exceed 0.0025 m/s (0.10-inch per second). Correct the cause of excessive vibration and provide retest.

D. Test instruments furnished by contractor:

1. Portable, with output capability to print data.
2. Frequency range, 600-150,000 CPM minimum.
3. Amplitude range, 2.54 m/s (0-100 inches per second).
4. Sensitivity, 0.00013 m/s (0.005-inch per second).
5. Frequency filter "out" for tests.

E. Submit tabulated vibration readings to the COTR.

3.3 SOUND LEVELS

A. Sound level limitations apply to all burners, fans, blowers, pumps, compressors, control valves, pressure reducing valves, motors, turbines.

B. Sound levels shall not exceed 85 DBA when measured 1400 mm (4.5-feet) above the floor and 910 mm (3-feet) horizontally from each surface of the smallest imaginary rectangular box which could completely enclose the entire unit which contains the sound source. Sound level limitations apply to the operation of the equipment at all loads within the equipment requirements.

C. Tests will be performed by the Government using a standard sound level meter on the "A" scale, slow response. At the option and expense of the Government, a testing company may be employed to conduct tests using methods conforming to the referenced ABMA publication.

D. If sound levels exceed requirements, modify or replace the equipment as necessary to achieve required sound levels and other specified requirements.

1. Submit all proposed modifications or replacements for review prior to starting the work.
2. After completing the work, provide complete retest of equipment operation and performance.

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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 glycol chilled water and heating hot water.
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 AND STEAM GENERATION: 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, PLUMBING, AND BOILER PLANT INSULATION: Piping and Equipment Insulation.

D. Section 23 64 00, PACKAGED WATER CHILLERS: Testing Refrigeration Equipment.

E. Section 23 36 00, AIR TERMINAL UNITS: Terminal Units Performance.

F. Section 23 31 00, HVAC DUCTS AND CASINGS: Duct Leakage.

G. 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 AND STEAM GENERATION.

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 COTR 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 COTR 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 COTR. 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 10 percent.
b. Air terminal units (maximum values): Minus 2 percent to plus 10 percent.
c. Exhaust hoods/cabinets: 0 percent to plus 10 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 10 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 COTR 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 COTR 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 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, PLUMBING, AND BOILER PLANT 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 COTR 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 COTR.

3.6 TAB REPORTS

A. Submit an intermediate report for 50 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 COTR 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 COTR.

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, computer room AC units, and laboratory fume hoods and cabinets.

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 AND STEAM GENERATION.
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, convertors, coils, coolers and condensers:

1. Coordinate water chiller flow balancing with Section 23 64 00, PACKAGED WATER CHILLERS.
2. Adjust flow rates for equipment. Set coils and evaporator to values on equipment submittals, if different from values on contract drawings.
3. Primary 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.
4. 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 AND STEAM GENERATION. Provide measurements for all rotating HVAC equipment of 373 watts (1/2 horsepower) and larger, including compressors, pumps, fans and motors.

B. Record initial measurements for each unit of equipment on test forms and submit a report to the COTR. 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 COTR.

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, at least fifteen (15) percent of all rooms. The COTR may designate the specific rooms to be tested.
   2. Provide cooling tower sound measurements. Refer to Section 23 65 00, COOLING TOWERS.

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 COTR 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 COTR.

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.

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SECTION 23 07 11

HVAC, PLUMBING, AND BOILER PLANT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field applied insulation for thermal efficiency and condensation control for
   1. HVAC piping, ductwork and equipment.
   2. 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, 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 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. Unfinished attics 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. HPS: High pressure steam (415 kPa [60 psig] and above).

13. HPR: High pressure steam condensate return.
14. MPS: Medium pressure steam (110 kPa [16 psig] thru 414 kPa [59 psig].
15. MPR: Medium pressure steam condensate return.
16. PC: Pumped condensate.
17. HWH: Hot water heating supply.
18. HWHR: Hot water heating return.
19. CPD: Condensate pump discharge.
20. CW: Cold water.
21. HW: Hot water.
22. GC: Chilled glycol-water supply.
23. GCR: Chilled glycol-water return.
24. 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 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements and items, which are common to more than one section of Division 23.

C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General requirements pertaining to mechanical Boiler Plant work.

D. Section 23 21 11, BOILER PLANT PIPING SYSTEMS: Boiler plant piping.

E. 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.

F. Section 23 64 00, PACKAGED WATER CHILLERS: Compressor, evaporator and piping.

G. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING: Piping and equipment.

H. Section 23 21 13, HYDRONIC PIPING: Chilled water piping.

I. 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 AND STEAM GENERATION.

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.

4.3.10.2.6.3 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

96-04.....Standards for Ventilation Control and Fire Protection of Commercial Cooking Operations

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-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 MINERAL WOOL OR REFRACTORY FIBER

A. Comply with Standard ASTM C612, Class 3, 450 degrees C (850 degrees F).

2.3 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.

2.4 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).

2.5 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 and duct 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.

2.6 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.

2.7 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

2.8 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.

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.

2.9 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.

2.10 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.

2.11 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.

2.12 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.

2.13 FIRESTOPPING MATERIAL

Other than pipe and duct insulation, refer to Section 07 84 00 FIRESTOPPING.

2.14 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 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), 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. Ensure insulation does not get wet during installation. Protect materials from the weather. Seal up all insulation joints to protect from the elements.

H. HVAC work not to be insulated:

1. Internally insulated ductwork and 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, hot water pumps, steam condensate pumps.
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. 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.

J. Additional work not to be insulated:
   1. Equipment:
      a. Condensate return pump units
      b. Safety valves
      c. Chemical feeders
      d. All nameplates
   2. Specialties:
      a. Pressure reducing valves
      b. Control valves-water and steam
      c. Level sensors-piping, valves and blowdown
      d. Strainers under 65 mm (2-1/2 inch) pipe size
      e. Expansion bellows
      f. Flexible connectors
      g. Ball joints except piping between joints

K. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

L. 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.

M. 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

N. Provide metal jackets over insulation as follows:
   a. All piping and ducts exposed to outdoor weather.
   b. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

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.
   3. Exposed, unlined ductwork and equipment in unfinished areas, mechanical and electrical equipment rooms and attics.

a. 40 mm (1-1/2 inch) thick insulation faced with ASJ (white all service jacket): Supply air duct, unlined air handling units, and afterfilter housing.
b. 40 mm (1-1/2 inch) thick insulation faced with ASJ: Return air duct, mixed air plenums and prefilter housing.
c. Outside air intake ducts: 40 mm (1-1/2 inch) thick insulation faced with ASJ.

4. Hot equipment: 40 mm (1-1/2 inch) thick insulation faced with ASJ.
   a. Convertors, air separators, steam condensate pump receivers.
   b. Domestic water heaters and hot water storage tanks (not factory insulated).

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.

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. 122-177 degrees C (251-350 F) (HPS, MPS,)	50 (2.0)	65 (2.5)	90 (3.5)	90 (3.5)

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
b. 100-121 degrees C HPR, MPR (212-250 degrees F) (Vent piping from PRV safety valves, condensate receivers, and flash tanks)	25 (1.0)	50 (2.0)	50 (2.0)	50 (2.0)
c. 38-99 degrees C (100-211 degrees F) (LPR, PC, HWH, HWHR, GH, GHR)	25 (1.0)	40 (1.5)	50 (2.0)	50 (2.0)
1. Runouts to fan coil units	15 (0.5)	-	-	-
2. Runouts to reheat coils, air terminal unit reheat coils	15 (0.5)	-	-	-
d. Domestic hot water supply and return	15 (0.5)	20(0.75)	25 (1.0)	40 (1.5)

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
1. 100-121 degrees C (212-250 degrees F), LPS, Vent piping from receivers and flash tanks.	15 (0.5)	25 (1)	25 (1)	--	--
2. 38-99 degrees C (100-211 degrees F), LPR, PC, HWH, HWHR, GH and GHR.	15 (0.5)	20 (0.75)	25 (1)	--	--
a. Run outs to Fan Coil units, reheat coils .	15 (0.5)	--	--	--	--
3. 4-16 degrees C (40-60 degrees F), CH, CHR, GC, and GCR.	20 (0.75)	20 (0.75)	25 (1)	40 (1.5)	50 (2.0)
a. Run outs to Fan Coil Units .	15 (0.5)	--	--	--	--
b. Ice Water Piping	15 (0.5)	20 (0.75)	25 (1)	--	--
4. 10 degrees C (50 degrees F) and less, RS for DX refrigerants.	15 (0.5)	20 (0.75)	--	--	--
5. Domestic hot water supply and return.	15 (0.5)	15 (0.5)	20 (0.75)	20 (0.75)	--

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.
   b. 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) MRI quench vent piping.
5) Bedpan sanitizer atmospheric vent
6) Reagent grade water piping.
7) Cold water piping.

E. Cellular Glass Insulation:

1. Pipe and tubing, covering nominal thickness in millimeters and inches as tabulated below for chilled water and refrigerant piping.

Nominal Thickness of Cellular Glass Insulation				
Millimeters (inches)	Thru 38 (11/2)	50- 150 (2-6)	200-300 (8-12)	over 350 (14)
1. 4-16 degrees C (40-60 degrees F) (CH and CHR within chiller room and pipe chase and underground)	50 (2.0)	80 (3.0)	80 (3.0)	100 (4.0)
2. 4-16 degrees C (40-60 degrees F) (CH and CHR outside chiller room)	40 (1.5)	50 (2.0)	50 (2.0)	65 (2.5)

2. Underground Piping Other than or in lieu of that Specified in Section 23 21 13, HYDRONIC PIPING and Section 33 63 00, STEAM ENERGY DISTRIBUTION: Type II, factory jacketed with a 3 mm laminate jacketing consisting of 3000 mm x 3000 mm (10 ft x 10 ft) asphalt impregnated glass fabric, bituminous mastic and outside protective plastic film.
   a. 75 mm (3 inches) thick for hot water piping.
   b. As tabulated above for chilled water piping.
   c. Underground piping: Apply insulation with joints tightly butted. Seal longitudinal self-sealing lap. Use field fabricated or

factory made fittings. Seal butt joints and fitting with jacketing as recommended by the insulation manufacturer. Use 100 mm (4 inch) wide strips to seal butt joints.

d. Provide expansion chambers for pipe loops, anchors and wall penetrations as recommended by the insulation manufacturer.

e. Underground insulation shall be inspected and approved by the COTR as follows:

1) Insulation in place before coating.

2) After coating.

f. Sand bed and backfill: Minimum 75 mm (3 inches) all around insulated pipe or tank, applied after coating has dried.

3. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ for chilled water pumps, water filters, chemical feeder pots or tanks, expansion tanks, air separators and air purgers.

F. Polyisocyanurate Closed-Cell Rigid Insulation:

1. Polyisocyanurate closed-cell rigid insulation (PIR) may be provided for piping, equipment and ductwork for temperature up to 149 degree C (300 degree F) provided insulation thickness requirement does not exceed 38 mm (1.5 inches).

2. Install insulation, vapor retarder and jacketing per manufacturer’s recommendations. Particular attention should be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor retarder integrity.

3. Install insulation with all joints tightly butted (except expansion) joints in hot applications).

4. If insulation thickness exceeds 63 mm (2.5 inches), install as a double layer system with longitudinal (lap) and butt joint staggering as recommended by manufacturer.

5. For cold applications, vapor retarder shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall be used to attach the vapor retarder or jacketing. No wire ties capable of penetrating the vapor retarder shall be used to hold the insulation in place. Banding shall be used to attach PVC or metal jacketing.

6. 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 PVC elbow jacket is prohibited on cold applications.

7. For cold applications, the vapor retarder on elbows/fittings shall be either mastic-fabric-mastic or 2 mil thick PVDC vapor retarder adhesive tape.
8. All PVC and metal jacketing shall be installed so as to naturally shed water. Joints shall point down and shall be sealed with either adhesive or caulking (except for periodic slip joints).
9. Underground piping: Follow instructions for above ground piping but the vapor retarder jacketing shall be 6 mil thick PVDC or minimum 30 mil thick rubberized bituminous membrane. Sand bed and backfill shall be a minimum of 150 mm (6 inches) all around insulated pipe.
10. Note the NFPA 90A burning characteristic requirements of 25/50 in paragraph 1.3B. Refer to paragraph 3.1 for items not to be insulated.
11. Minimum thickness in millimeter (inches) specified in table below, for piping:

Nominal Thickness of Polyisocyanurate Rigid Insulation

Nominal Pipe Size millimeters(inches):	25(1) & below	32-75 (1 1/4-3)	100-150 (4-6)	200-300 (8-12)
1. 122-149 degree C(251-300 degree F) (HPS, MPS)	40 (1.5)	--	--	--
2. 100-121 degrees C (211-250 degrees F), HPR, MPR, LPS, Vent piping from receivers and flash tanks	20 (0.75)	40(1.5)	40(1.5)	40(1.50)
3. 38-99 degrees C (100-211 degrees F), LPR, PC, HWH, HWHR, GH and GHR	20 (0.75)	25(1.0)	40(1.5)	40(1.50)

Nominal Thickness of Polyisocyanurate Rigid Insulation				
a. Run outs to fan coil units reheat coils	20 (0.75)	--	--	--
4. 4-16 degrees C (40-60 degrees F), CH, CHR, GC and GCR for relative humidity up to 80 percent or underground location	25 (1.00	25 (1.0)	40 (1.50	40(1.5)
5. 4-16 degrees C(40-60 degrees F) CH, CHR, GC and GCR for relative humidity 80 to 90 percent or higher	40 (1.50	40 (1.5)	40 (1.5)	40 (1.5)
6. Domestic hot water supply and return	15 (0.5)	20 (0.74)	25 (1.0)	25(1.0)

12. 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.
    b. 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) MRI quench vent piping.
5) Bedpan sanitizer atmospheric vent.
6) Reagent grade water piping.
7) Cold Water Piping.

G. 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 AND STEAM GENERATION.
   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. 38-93 degrees C (100-200 degrees F) (HWH, HWHR, GH, GHR)	25 (1.0)	40 (1.5)	-	-
a. Runouts to reheat coils	20 (0.75)	40 (1.5)	-	-

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)
2. 4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR)	25 (1.0)	40 (1.5)	-	-
a. Runouts to cooling coil condensate piping	20 (0.75)	40 (1.5)	-	-
3. Domestic hot water supply and return	15 (0.50)	20 (0.75)	25 (1.0)	40 (1.50)

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
   b. Bottom and sides of metal basins for winterized cooling towers (where basin water is heated).
   c. Chillers, insulate any cold chiller surfaces subject to condensation which has not been factory insulated.
   d. Piping inside refrigerators and freezers: Provide heat tape under insulation.

H. Calcium Silicate:

1. Minimum thickness in millimeter (inches) specified below for piping other than in boiler plant. See paragraphs 3.3 through 3.7 for Boiler Plant Applications.

Nominal Thickness Of Calcium Silicate Insulation (Non-Boiler Plant)				
Nominal Pipe Size Millimeters (Inches)	Thru 25 (1)	32 to 75 (1-1/4 to 3)	100-200 (4 to 6)	Over 200 (6)
93-260 degrees C(200-500 degrees F)(HPS, HPR)	67 (2-1/2)	75(3)	100(4)	100(4)

- - - E N D - - -

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. Approved controls manufacturer:

1. Honeywell
2. Trane

C. The Engineering Control Center (ECC) is a Tridium world wide web (www) based existing system. Integration and commissioning of the new controls of this project into the existing system is in the scope of the project. Commissioning shall be completed in the field by the commissioning and integration contractor. Commissioning from a remote site shall not be allowed. The approved Tridium integration contractors are:

1. Mechanical Systems and Services (MSS)
   PO Box 32607
   Charlotte, NC 28208
   Contact: Steve McDonald 828-651-0266
2. Trane
   125 Macon West Drive
   Macon, GA 31210
   Contact: Jimmy Kirby 478-743-5429

D. 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.

E. Following control devices and systems shall be used to provide the functional requirements of HVAC/Emergency Electrical 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, Fan Coil Units, Base Board Heaters, Secondary Humidifiers 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.
3. Heat exchanger equipment.
4. Remote annunciation of Emergency Generator, in accordance with Specification Section 26 32 13.

F. Connect the new work to the existing ECC system or operator workstation manufactured by Tridium located in Building 27. 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. 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. This work to be completed by either:

1. Mechanical Systems and Services (MSS)
PO Box 32607, Charlotte NC 28208
Contact: Steve McDonald 828-651-0266
http://www.mssinconline.com
2. Trane
125 Macon West Drive
Macon, GA 31210
Contact: Jimmy Kirby 478-743-5429

G. 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).

H. 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.

I. The Top End of the NAC shall communicate using American Society of Heating and Refrigerating Engineers/American National Standards Institute (ASHRAE/ANSI) Standard 135(BACnet) protocol. The NAC shall reside on the BACnet/IP Ethernet (ISO 8802-3) local area network, and provide information via standard BACnet object types and application services. The Bottom End of the NAC, the unit level controllers and all other field devices shall reside on the LonTalk FTT-10a network, and provide data using LonMark standard network variable types and configuration properties.

J. The intent of this specification is to provide a peer-to peer networked, stand-alone, distributed control system. The ECC requires the incorporation of LonWorks Technologies using Free Topology Transceivers (FTT-10), and specific conformance to the LONMARK Interoperability Association’s v3.0 Physical and logical Layer guidelines in all (NAC) Network Area Controllers, Remote Control Unit controllers, unitary terminal unit controllers and other LonMark compliant field devices. The minimum Baud rate shall be 78,000 Baud for FTT-10 and 1,250,000 Baud for FTT-1250.

   1. LonTalk communications protocol will be used on the communication network between RCU controllers and LonWorks controllers and devices to assure interoperability between all devices within the network.
   2. The ECC shall provide communication to all LonTalk data variables as defined in input/output point schedule and as required to accomplish sequence of operation as specified.
   3. Power wiring shall not be run in conduit with communications trunk wiring or signal or control wiring operating at 100 volts or less.

K. The control system shall accommodate at least 5 users simultaneously, and the access to the system should be limited only by operator password.

1.2 RELATED WORK

A. Section 28 31 00, FIRE DETECTION AND ALARM.

B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

C. Section 21 10 00, WATER-BASED FIRE-SUPPRESSION SYSTEMS.

D. Section 23 64 00, PACKAGED WATER CHILLERS.

E. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.

F. Section 23 36 00, AIR TERMINAL UNITS.

G. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

H. Section 23 31 00, HVAC DUCTS AND CASINGS.

I. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

J. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

K. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

L. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).

M. 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, chillers, 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, chillers, fan coil units, 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 five 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 or through the VA's firewall via the internet 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. Control air-supply components, and computations for sizing compressors, receivers and main air-piping, if pneumatic controls are furnished.
6. 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.
7. Sequence of operations for each HVAC system and the associated control diagrams. Equipment and control labels shall correspond to those shown on the drawings.
8. Color prints of proposed graphics with a list of points for display.

9. 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 COTR 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. Contractor shall also video tape instruction sessions 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. American Society of Mechanical Engineers (ASME):

B16.18-01.....Cast Copper Alloy Solder Joint Pressure Fittings.

B16.22-01.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

BPVC-CC-N-04.....Boiler and Pressure Vessel Code

D. American Society of Testing Materials (ASTM):

B32-04.....Standard Specification for Solder Metal

B88-03.....Standard Specifications for Seamless Copper Water Tube

B88M-05.....Standard Specification for Seamless Copper Water Tube (Metric)

B280-03.....Standard Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service

D2737-03.....Standard Specification for Polyethylene (PE) Plastic Tubing

E. Federal Communication Commission (FCC):

Rules and Regulations Title 47 Chapter 1-2001 Part 15..Radio Frequency Devices.

F. 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

G. Instrument Society of America (ISA):

7.0.01-1996.....Quality Standard for Instrument Air

H. National Fire Protection Association (NFPA):

70-05.....National Electric Code

90A-02.....Standard for Installation of Air-Conditioning and Ventilation Systems

I. 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

1076-05.....Proprietary Burglar Alarm Units and Systems

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.
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.
   c. LonMark as per ANSI/EIA 709 (LonWorks) to LonMark FTT-10 transceivers.
2. The networks shall utilize only copper and optical fiber communication media as appropriate and shall comply with applicable codes, ordinances and regulations. They may also utilize digital wireless technologies if required by the VA.
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 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. Provide Controls Systems Application Server(s) to archive historical data including trends, alarm and event histories and transaction logs.
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 other NAC on the 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, 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 shut down 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 LonTalk FTT-10a network or provide data using LonMark standard network variable types and configuration properties.
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 shut down 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 LonTalk FTT-10a network or provide data using LonMark standard network variable types and configuration properties.
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 shut down 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.

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. 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 falls 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.
2. Night Setback/Morning Warm up Control: The system shall provide the ability to automatically adjust set points for this mode of operation.
3. 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.

4. 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.
5. 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.
6. 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.
7. 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.

8. Chilled water Plant Operation: The program shall monitor and enable operation and include the following as a minimum:
   a. Automatic start/stop of chillers and auxiliaries in accordance with the sequence of operation shown on the drawings, while incorporating requirements and restraints, such as starting frequency of the equipment imposed by equipment manufacturers.
   b. Generate chilled water load profiles for different seasons for use in forecasting efficient operating schedule.
   c. The chilled water plant program shall display the following as a minimum:
      1) Outdoor air dry bulb temperature.
      2) Outdoor air wet bulb temperature.
      3) Ton-hours of chilled water per day/month/year.
      4) On-off status for chiller.
      5) Chilled water supply and return temperature.
      6) Operating set points-temperature and pressure.
      7) Kilowatts and power factor.
      8) Current limit set point.
      9) Date and time.
      10) Operating or alarm status.
      11) Operating hours.

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. 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.

C. 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. Shall be an extension of existing system.

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 manufacturer's recommendation finish, 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: Platinum 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.

2.8 SPECIAL CONTROLLERS

A. Room Differential Pressure Controller: The differential pressure in isolation rooms shall be maintained by controlling the quantity of air exhausted from or supplied to the room. A sensor-controller shall measure and control the velocity of air flowing into or out of the room through a sampling tube installed in the wall separating the room from the adjacent space, and display the value on its monitor. The sensor controller shall meet the following as a minimum:

1. Operating range: -0.200000 to +0.20000 inches of water
2. Resolution: 5 percent of reading
3. Accuracy: +/- 10 percent of reading +/- 0.00001 inches of water
4. Analog output: 0-10 VDC or 4-20 ma

5. Operating temperature range: 32-120 degrees F

2.9 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 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. Modulating Steam Control: 80 percent of inlet gauge pressure (acoustic velocity limitation).
   b. Modulating water flow control, greater of 3 meters (10 feet) of water or the pressure drop through the apparatus.
   c. 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.

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 COTR for resolution before proceeding for installation.
2. Work Coordination: Section 00 72 00, GENERAL CONDITIONS.
3. Install equipment, piping, wiring /conduit parallel to or at right angles to building lines.
4. Install all equipment and piping in readily accessible locations. Do not run tubing and conduit concealed under insulation or inside ducts.
5. Mount control devices, tubing 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 tubing and 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. Piping Installation:

1. All piping associated with smoke control shall be hard drawn copper.
2. Tubing passing through or buried in concrete shall be installed in rigid steel conduit of sufficient strength to prevent damage to tubing.
3. Except for short apparatus connections, non-metallic tubing in all exposed locations, including mechanical rooms shall be protected from damage by installing the tubing in electric conduit or raceways. Provide protective grommet where tubing exits conduit.
4. Non-metallic tubing exposed to outdoors shall be protected by a sleeve or larger tubing.
5. In concealed but accessible locations such as above lay-in ceilings, non-metallic tubing may be run without conduit or raceway.
6. All tubing which is not run in conduit or raceway, both metallic and non-metallic, shall be neatly routed and securely fastened to building structure at not more than 36-IN. intervals.
7. Welding shall be performed in accordance with Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.

8. Label and identify control air piping in accordance with specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

C. 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.

D. 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.

E. 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. Echelon:
   a. The ECC shall employ LonTalk communications FTT-10.
   b. Echelon LAN (Flat LON): The ECC shall employ a LON LAN that will connect through an Echelon Communication card directly to all controllers on the FTT-10 LAN.
3. 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.

F. Installation of Digital Controllers and Programming:

1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, chiller, 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 chiller, cooling tower, air handling unit, fan, terminal unit, boiler, 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 (2 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 21 11

BOILER PLANT/STEAM PIPING SYSTEMS

PART 1 – GENERAL:

1.1 DESCRIPTION:

All mechanical room piping systems, except plumbing and sanitary, including piping supports. Piping located outside of the building is not included except for gas regulator and meter stations.

1.2 RELATED WORK:

A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION

C. Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT.

D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

E. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING .

1.3 QUALITY ASSURANCE:

A. Entire installation shall comply with ASME Power Piping Code, ASME B31.1 and appendices.

B. Boiler External Piping, as defined in the ASME Boiler and Pressure Vessel Code, Section I, is required to be constructed and inspected in conformance with the ASME Code.

C. Mechanics shall be skilled in their work or trade. Welders on pressure vessels or piping shall show evidence of qualification in accordance with the ASME Power Piping Code and the ASME Boiler and Pressure Vessel Code. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current. Each welder shall utilize a stamp to identify all work performed by the welder. The Government reserves the right to reject any personnel found unqualified in the performance of work for which they are employed.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Piping:

1. ASTM material specification number.
2. Grade, class or type, schedule number.
3. Manufacturer.

C. Pipe Fittings, Unions, Flanges:

1. ASTM material specification number.

2. ASME standards number.
3. Catalog cuts.
4. Pressure and temperature ratings.

D. Valves - Gate, Globe, Check, Plug, Butterfly, Ball:
1. Catalog cuts showing design and construction.
2. Pressure and temperature ratings.
3. Materials of construction.
4. Accessories.

E. Pressure Reducing and Regulating Valves, Back Pressure Relief Valves, Safety Valves, Relief Valves:
1. Catalog cuts showing design and construction.
2. Service limitations (type of fluid, maximum pressure and temperatures).
3. Materials of construction.
4. Flow capacity at required set pressure.
5. Predicted sound levels, at operating condition, for steam pressure reducing valves.

F. Strainers:
1. Catalog cuts showing design and construction.
2. Pressure and temperature ratings.
3. Materials of construction.
4. Strainer basket or liner mesh.
5. Pressure loss and flow rate data.

G. Steam Traps:
1. Catalog cuts showing design and construction.
2. Service limitations (maximum pressures and temperatures).
3. Materials of construction.
4. Flow rates at differential pressures shown on drawings.
5. Orifice size for each trap.

H. Pipe Support Systems:
1. Credentials of technical personnel who will design the support systems.
2. Validation of computer program for pipe support selection.
3. Input and output data for pipe support selection program for all piping systems with pipe sizes 60 mm (2-1/2 inches) and above.
4. Hanger load calculation methods and results for piping systems with pipe sizes 50 mm (2 inches) and below.
5. Piping layouts showing location and type of each hanger and support.

6. Catalog cuts showing design and construction of each hanger and support and conformance of hangers and supports to MSS standards.
7. Drawings showing arrangement and sizes of all components comprising each spring-type hanger and support assembly.
8. Load rating and movement tables for all spring hangers, and seismic shock absorbing devices.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

All piping shall be stored and kept free of foreign material and shall be internally and externally cleaned of all oil, dirt, rust and foreign material. Deliver and store valves and pipe hangers in sealed shipping containers with labeling in place. Storage must be in dry, protected location.

1.6 INFORMATION ON PRESSURE-TEMPERATURE DESIGN OF PIPING SYSTEMS:

A. Steam distribution systems protected by safety valves following pressure reducing stations or protected by safety valves on the steam converters shall be governed by the pressure/temperature relationship developed by the maximum setting of the safety valve on that system.
B. Condensate collection and transfer systems to boiler plant are designed for maximum temperatures to 100 °C (212 °F), and pressures 276 kPa (40 psi).
C. Water service pressures are 80 psi maximum. Systems are designed to operate under conditions of maximum available pressure.
D. Drips, drains, blowdown, water sampling, and chemical treatment are designed, and materials and equipment are applied in accordance with the maximum pressure and temperature of the system with which they are associated.
E. Low pressure steam, condensate, vacuum and vents are designed for service pressures and temperatures equivalent to 103 kPa (15 psi) saturated steam.

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. ASTM International (ASTM):

A47/A47M-99(2004).....Ferritic Malleable Iron Castings
A48/A48M-03.....Gray Iron Castings
A53/A53M-06a.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A105/A105M-05.....Carbon Steel Forgings for Piping Applications
A106-06a.....Seamless Carbon Steel Pipe For High Temperature Service
A126-04.....Gray Iron Castings for Valves, Flanges and Pipe Fittings
A193/A193M-07.....Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service
A194/A194M-07a.....Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
A197/A197M-00(2006).....Cupola Malleable Iron
A216/A216M-07.....Steel Castings, Carbon, Suitable for Fusion Welding, For High Temperature Service
A234/A234M-07.....Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
A269-07.....Seamless and Welded Austenitic Stainless Steel Tubing for General Service
A395/A395M-99(2004).....Ferritic Ductile Iron Pressure-Retaining Castings for use at Elevated Temperatures
A536-84(2004).....Ductile Iron Castings
B61-02.....Steam or Valve Bronze Castings
B62-02.....Composition Bronze or Ounce metal Castings
B88/B88M-05.....Seamless Copper Water Tube

C. American Society of Mechanical Engineers (ASME):
Boiler and Pressure Vessel Code: 2007 Edition with current Addenda
Section I.....Power Boilers
Section IX.....Welding and Brazing Qualifications
B16.3-2006.....Malleable Iron Threaded Fittings
B16.4-2000.....Gray Iron Threaded Fittings
B16.5-2003.....Pipe Flanges and Flanged Fittings: NPS ½ Through 24
B16.9-2003.....Factory Made Wrought Buttwelding Fittings
B16.11-2005.....Forged Fittings, Socket-Welding and Threaded
B16.22-2001.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B31.1-2004.....Code for Pressure Piping: Power Piping with current Addenda

D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):

SP-45-2003.....Bypass and Drain Connections

SP-58-2002.....Pipe Hangers and Supports-Materials, Design and Manufacturing

SP-69-2003.....Pipe Hangers and Supports-Selection and Application

SP-80-2003.....Bronze, Gate, Globe, Angle and Check Valves

SP-89-2003.....Pipe Hangers and Supports-Fabrication and Installation Practices

SP-90-2000.....Guidelines on Terminology for Pipe Hangers and Supports

SP-97-2006.....Integrally Reinforced Forged Branch Outlet Fittings – Socket Welding, Threaded and Buttwelding Ends

SP-127-2001.....Bracing for Piping Systems Seismic – Wind – Dynamic Design, Selection, Application

E. National Fire Protection Association (NFPA):

30-2008.....Flammable and Combustible Liquids

31-2006.....Installation of Oil Burning Equipment

F. American Welding Society (AWS):

B2.1-05.....Welding Procedure and Performance Qualification

G. Pipe Fabrication Institute (PFI):

ES24-RA04.....Pipe Bending Methods, Tolerances, Process and Material Requirements

PART 2 – PRODUCTS:

2.1 STEAM PIPING:

A. Pipe: Carbon steel, ASTM A53 Grade B or ASTM A106 Grade B, seamless or electric resistance welded (ERW). Schedule 40 for piping with welded ends, Schedule 80 for piping with threaded ends, standard weight permitted for pipe sizes 300 mm (12 inches) and above.

B. Joints:

1. Pipe sizes 65 mm (2-1/2 inches) and above: Butt-welded
2. Pipe sizes 50 mm (2 inches) and below: Threaded, butt-welded, or socket-welded.

C. Fittings:

1. Welded joints: Steel, ASTM A234, Grade B, ASME B16.9, same schedule as adjoining pipe, all elbows long radius.

2. Threaded joints: Forged steel, ASME B16.ll, 13,790 kPa (2000 psi class; or malleable iron, ASTM A47 or A197, ASME B16.3, 2050 kPa (300 psi) class.
3. Socket-welded joints: Forged steel, ASME B16.11, 13,790 kPa (2000 psi) class.

D. Unions on Threaded Piping: Forged steel, 13,800 kPa (2000 psi) class or 20,680 kPa (3000 psi) class; or malleable iron, 2050 kPa (300 psi) on piping 50 mm (2 inches) and under.

E. Flanges and Bolts: Forged steel weld neck, ASME B16.5, ASTM A105, 1025 kPa (150 psi) pressure class, except 2050 kPa (300 psi) class required adjacent to 1725 kPa (250 psi) and 2050 kPa (300 psi) class valves. Bolts shall be high strength steel ASTM A193, Class 2, Grade B8. Nuts shall be ASTM A194.

2.2 STEAM CONDENSATE PIPING:

A. Includes all gravity, drip return, pumped and vacuum systems. Does not include piping system between boiler feed pumps and boilers.

B. Pipe: Carbon steel, ASTM A53 Grade B or ASTM A106 Grade B, seamless or ERW, Schedule 80.

C. Joints:
1. Pipe sizes 50 mm (2 inches) and below: Threaded, butt-welded or socket-welded.

D. Fittings:
1. Welded joints: Steel, ASTM A234, Grade B, ASME B16.9, same schedule as adjoining pipe.
2. Threaded joints: Forged steel, ASME B16.ll, 13,790 kPa (2000 psi class; or malleable iron, ASTM A47 or A197, ASME B16.3, 2050 kPa (300 psi) class.
3. Socket-welded joints: Forged steel, ASME B16.11, 13,800 kPa (2000 psi) class.

E. Unions on Threaded Piping: Forged steel, 13,800 kPa (2000 psi) class or 20,680 kPa (3000 psi) class; or malleable iron, 2050 kPa (30 psi). On piping 50 mm (2 inches) and under.

F. Flanges: Forged steel weld neck, ASTM A105, ASME B16.5, 1025 kPa (150 psi).

2.3 VENT LINES FROM TANKS AND SAFETY AND RELIEF VALVES:

A. Pipe: Carbon steel, ASTM A53 Grade B or A106 Grade B, seamless or ERW, Schedule 40.

B. Joints:

1. Pipe sizes 65 mm (2-l/2 inches) and above: Butt-welded.
2. Pipe sizes 50 mm (2 inches) and below: Threaded or butt-welded.

C. Fittings:
1. Welded Joints: Steel, ASTM A234 Grade B, ASME B16.9, same schedule as adjoining pipe.
2. Threaded Joints: Cast iron, ASME B16.4, 850 kPa (125 psi).

D. Unions: Forged steel, 13,800 kPa (2000 psi) class or 20,680 kPa (3000 psi) class; or malleable iron, 1025 kPa (150 psi) class.

E. Flanges: Forged steel weld neck, ASME B16.5, ASTM A105, 1025 kPa (150 psi).

2.4 COLD WATER PIPING:

A. City Water: See Section 22 11 00, FACILITY WATER DISTRIBUTION.

2.5 CHEMICAL FEED PIPING:

A. Pipe: Stainless steel tubing, ASTM A269, Type 316.

B. Fittings: Stainless steel Type 316 welding fittings.

2.6 MISCELLANEOUS PIPING:

A. Instrument and Control Piping (Sensing Point to Transmitter, Controller, or Other Instrument): Construction shall be same as specified for main service.

B. Drain Piping (All Drain Piping Discharging to Floor Drain-From Drain Valve to Floor Drain):
1. Pipe: Carbon steel, ASTM A53 Grade B or ASTM A106 Grade B, seamless or ERW, Schedule 40.
2. Fittings and Unions: Forged steel, ASME B16.ll, 13,790 kPa (2000 psi class); or malleable iron, 1025 kPa (150 psi), threaded.

C. Pump Recirculation:
1. Pipe: Carbon steel, ASTM A53 Grade B or ASTM A106 Grade B, seamless or ERW, double extra strong. Schedule 40 permitted on all lines 1500 mm (5 feet) or more from the recirculation orifice.
2. Joints: Threaded.
3. Fittings: Forged steel, ASME B16.ll, 13,790 kPa (2000 psi class); or malleable iron, ASTM A47 or A197, ASME B16.3, 2050 kPa (300 psi) class, except 1025 kPa (150 psi) class permitted on all lines 1500 mm (5 feet) or more from the recirculation orifice.
4. Unions: Forged steel, 13,800 kPa (2000 psi) class or 20,680 kPa (3000 psi) class; or malleable iron, ASTM A47 or A197, same pressure class as nearest fittings.

2.7 DIELECTRIC FITTINGS:

Provide threaded dielectric unions for pipe sizes 50 mm (2 inches) and under. For 65 mm (2-1/2 inches) and above, provide copper and steel flanges electrically isolated at gasket and by sleeves at bolts. Fittings on cold water and soft water lines shall be rated for 690 kPa (100 psi), 27 °C (80 °F). Fittings on steam condensate lines shall be rated at 510 kPa (75 psi), 120 °C (250 °F). Fittings on other services shall be rated for the maximum pressure and temperature conditions of the service.

2.8 VALVES; GATE, GLOBE, PLUG, CHECK, BALL, BUTTERFLY, VENT COCKS:

A. Valves for particular services are generally specified as Type Numbers. The Type Numbers are defined below. All valves of the same type shall be the products of a single manufacturer. Comply with MSS SP-45, MSS SP-80, and ASME B31.1. Design valves for the service fluids and conditions. Pressure-temperature ratings listed are minimum requirements. Packing and gaskets shall not contain asbestos.

B. Valve Type Designations:

1. Gate Valves:

a. Type 101: Cast steel body ASTM A216 WCB, rated for 1025 kPa at 260 °C (150 psi at 500 °F), 11-1/2 to 13 percent chromium stainless steel flexible wedge and hard faced (stellite) or nickel copper alloy seats, 1025 kPa (150 psi) ASME flanged ends, OS&Y, rising stem, bolted bonnet.

1) Provide factory installed globe-valved warm-up bypass when main valve is 75 mm (3 inch) pipe size or greater and serves steam main longer than 6 m (20 feet). Conform to MSS SP-45.

2) Drill and tap bosses for connection of drains. Conform to MSS SP-45.

b. Type 102: Cast iron body ASTM A126 Class B, rated for 1725 kPa (250 psi) saturated steam, 3440 kPa (500 psi) WOG, bronze wedge and seats, 1725 kPa (250 psi) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings.

1) Provide factory installed globe-valved bypass when main valve is 75 mm (3 inch) pipe size or greater and serves steam main longer than 6 m (20 feet). Conform to MSS SP-45.

2) Drill and tap bosses for connection of drains if valve is in steam service. Conform to MSS SP-45.

c. Type 103: Cast iron body ASTM A126 Class B, rated for 850 kPa (125 psi) saturated steam, 1375 kPa (200 psi) WOG, bronze or bronze faced wedge and seats, 850 kPa (125 psi) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings.
   1) Provide factory installed globe-valved bypass when main valve is 75 mm (3 inch) pipe size or greater and serves steam main longer than 6 m (20 feet). Conform to MSS SP-45.
   2) Drill and tap bosses for connection of drains if valve is in steam service. Conform to MSS SP-45.
d. Type 104: Bronze body ASTM B61, rated for 1375 kPa (200 psi) saturated steam, 2750 kPa (400 psi) WOG, bronze wedges and Monel or stainless steel seats, threaded ends, rising stem, union bonnet.
e. Type 105: Forged steel body ASTM A105, rated for 2050 kPa at 216 °C (300 psi at 420 °F) minimum, Class 4130 kPa (600 psi) or Class 5500 kPa (800 psi), hardened stainless steel or stellite wedge and seats, threaded ends, OS&Y, rising stem, bolted bonnet.

2. Globe Valves:
   a. Type 201: Cast steel body ASTM A216 WCB, rated for 1025 kPa at 260 °C (150 psi at 500 °F), 11-1/2 to 13 percent chromium stainless steel or stellite disc and seat, 1025 kPa (150 psi) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings. Drill and tap bosses for connection of drains where shown. Conform to MSS SP-45.
   b. Type 202: Cast iron body ASTM A126 Class B, rated for 1725 kPa (250 psi) saturated steam, 3440 kPa (500 psi) WOG, bronze or bronze faced disc and seat, 1725 kPa (250 psi) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings. Drill and tap bosses for connection of drains where shown. Conform to MSS SP-45.
   c. Type 203: Cast iron body ASTM A126 Class B, rated for 850 kPa (125 psi) saturated steam, 1375 kPa (200 psi) WOG, bronze or bronze-faced disc (Teflon or composition facing permitted) and seat, 850 kPa (125 psi) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings.
   d. Type 204: Bronze body ASTM B61, rated for 1375 kPa (200 psi) saturated steam, 2750 kPa (400 psi) WOG, hardened stainless steel

disc and seat, threaded ends, rising stem, union bonnet, renewable seat rings.

e. Type 205: Forged steel body ASTM A105, rated for 2050 kPa at 216 °C (300 psi at 420 °F) minimum, Class 4130 kPa (600 psi) or Class 5500 kPa (800 psi), stainless steel disc, stellite seat, threaded ends, OS&Y, rising stem, bolted bonnet.

3. Check Valves:

a. Type 401: Not used.

b. Type 402: Swing-type, cast iron body ASTM A126 Class B, rated for 1725 kPa (250 psi) saturated steam, 3440 kPa (500 psi) WOG, bronze or bronze-faced disc and seat, 1725 kPa (250 psi) ASME flanged ends, bolted cover, renewable disc and seat.

c. Type 403: Swing-type, cast iron body ASTM Al26 Class B, rated for 850 kPa (l25 psi) saturated steam, 1375 kPa (200 psi) WOG, bronze or bronze-faced disc and seat, 850 kPa (l25 psi) ASME flanged ends, bolted cover, renewable disc and seat.

d. Type 404: Swing-type, bronze body ASTM B61, rated for 1375 kPa (200 psi) saturated steam, 2750 kPa (400 psi) WOG, bronze disc, threaded ends, regrinding disc.

e. Type 405: Lift-type, forged steel body ASTM A105, rated for 2050 kPa at 216 °C (300 psi at 420 °F) minimum (Class 4130 kPa (600 psi) or 5500 kPa (800 psi)), hardened stainless steel disc, hard faced seat, bolted cover, threaded ends.

f. Type 406: Swing-type, Type 316 stainless steel body, disc and hanger, rated for 1725 kPa at 182 °C (250 psi at 360 °F) minimum.

g. Type 407: Silent spring-loaded wafer type, cast iron body ASTM A48 or A126 Class B, rated for 850 kPa (125 psi) water, 121 °C (250 °F).

h. Type 408: Silent spring-loaded wafer type, cast steel ASTM A216 WCB or cast iron ASTM A48 or A126 body, rated for 2050 kPa (300 psi) water, 121 °C (250 °F), stainless steel trim. Mfgrs: Metraflex, Spence Engineering, or equal.

4. Ball Valves: Reduced port permitted for bypass (throttling) service; full port required for all other services, one-fourth turn to open.

a. Type 501: Type 316 stainless steel body, ball and stem, rated for 1025 kPa at 185 °C (150 psi at 365 °F), 4130 kPa at 93 °C (600 psi

at 200 °F); reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends.

b. Type 502: Bronze body, rated for 1025 kPa at 185 °C (150 psi at 365 °F), 1725 kPa at 121 °C (250 psi at 250 °F), 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.

c. Type 503: Carbon steel or ASTM B61 bronze body, steam service, rated for 1380 kPa at 200 °C (200 psi at 390 °F), stainless steel ball and stem, Polyfil seat, live-loaded or adjustable stem seal, threaded ends. Manufacturer: Worcester, Nibco or equal.

d. Type 504: Carbon steel or ASTM A536 ductile iron body, saturated steam service, rated for 1030 kPa (150 psi), stainless steel ball and stem, Polyfil seat, live-loaded stem seal, ASME flanged ends. Manufacturer: American, Worcester or equal.

5. Butterfly Valves:

a. Type 601: Ductile iron body ASTM A395 or A536, wafer style, rated for 850 kPa at 120 °C (125 psi at 250 °F), bronze disc, stainless steel stem, EPDM liner, EPDM stem seal and body seal, neck extending beyond pipe insulation, lever operator.

b. Type 602: Carbon steel body, triple-offset design, lug or flanged type, rated for steam service at 1025 kPa at 260 °C (150 psi at 500 °F), stainless steel nitrided disc, stainless steel seat, stainless steel shaft, stainless steel/graphite laminated seal ring, neck extending beyond pipe insulation, geared handwheel operator for valves 100 mm (4 inch) pipe size and over, lever operator for valves 75 mm (3 inch) pipe size and under. Manufacturer: Flowseal MS (Crane Co.) or equal.

C. Steam above 100 kPa (15 psi), all valves in steam pressure reducing stations:

1. Gate valves, 50 mm (2 inches) and under: Type 105.
2. Gate valves, 65 mm (2-1/2 inches) and above: Type 101.
3. Globe valves, 50 mm (2 inches) and under: Type 205.
4. Globe valves, 65 mm (2-1/2 inches) and above: Type 201.
5. Butterfly valves, 75 mm (3 inches) and above: Type 602.
6. Ball valves, 50 mm (2 inches) and under: Type 503.
7. Ball valves, 65 mm (2-1/2 inches) and above: Type 504.

D. Steam 100 kPa (15 psi) and under:

1. Gate Valves, 50 mm (2 inches) and under: Type 104.
2. Gate valves, 65 mm (2-1/2 inches) and above: Type 103.
3. Globe valves, 50 mm (2 inches) and under: Type 204.
4. Globe valves, 65 mm (2-1/2 inches) and above: Type 203.
5. Butterfly valves, 75 mm (3 inches) and above: Type 602.
6. Ball valves, 50 mm (2 inches) and under: Type 503.
7. Ball valves, 65 mm (2-1/2 inches) and above: Type 504.

E. Condensate, Condensate Transfer:

1. Gate valves, 50 mm (2 inches) and under: Type 104.
2. Gate valves, 65 mm (2-1/2 inches) and above: Type 103.
3. Globe valves, 50 mm (2 inches) and under: Type 204.
4. Globe valves, 65 mm (2-1/2 inches) and above: Type 203.
5. Butterfly valves, 65 mm (2-1/2 inches) and above Type 601.
6. Ball valves, 50 mm (2 inches) and under: Type 502.
7. Ball valves, 65 mm (2-1/2 inches) and above: Type 504.
8. Check valves 50 mm (2 inches) and under: Type 404.
9. Check valves, 65 mm (2-1/2) inches and above: Type 403.
10. Check valves on pump discharge, all sizes: Type 407.

F. Chemical Feed System (including inlet and drain valves on shot type chemical feeders):

1. Ball valves, 50 mm (2 inches) and under: Type 501.
2. Check valves, 50 mm (2 inches) and under: Type 406.

G. City (Cold) Water: See Section 22 11 00, FACILITY WATER DISTRIBUTION.

2.9 SAFETY VALVES, RELIEF VALVES, SAFETY RELIEF VALVES AND ACCESSORIES:

A. Provide valves and accessories to protect piping systems and pressure vessels from over-pressure. All valves shall comply with ASME Boiler and Pressure Vessel Code (Section I and VIII). Flow capacities shall be certified by National Board of Boiler and Pressure Vessel Inspectors (NB).

B. Steam Service (Pressure Vessels and Piping Systems): Refer to schedules on drawings for set pressures and capacities. Provide lifting levers, stainless steel trim, lapped seats on cast iron valves, EPDM o-rings on bronze valves.

C. Drip Pan Ells: Cast iron factory-built safety valve discharge fitting with pipe-within-pipe slip-type connection to vertical vent pipe, basin for collecting condensate from vent pipe, drain connections on basin and at base of ell.

2.10 STEAM PRESSURE REDUCING VALVES

A. Type: Single-seated, diaphragm operated, spring-loaded, steam pilot-controlled, normally closed, packless, adjustable set pressure. Pilot shall sense controlled pressure downstream of main valve.

B. Service: Provide controlled reduced pressure to steam piping systems. Design for saturated steam at pressures shown on drawings or equipment requirements.

C. Performance: Pressure control shall be smooth, continuous. Maximum 10 percent deviation from set pressure over an 18/1 turndown. Refer to schedules on drawings for flow and pressure requirements. Maximum flow capability of each valve shall not exceed capacity of downstream safety valves.

D. Construction:

1. Main Valve: Cast iron body rated for 1725 kPa (250 psi), threaded ends, for pipe sizes 50 mm (2 inches) and under. Cast steel body rated for 1025 kPa (150 psi) ASME flanged ends, or cast iron body 1725 kPa (250 psi) ASME flanged ends, for pipe sizes above 50 mm (2 inches). Valve plug and seat shall be replaceable, Type 316 stainless steel or Monel. Stainless steel stem.
2. Pilot Valve: Valve plug and seat shall be replaceable, stainless steel or Monel.

E. Sound Levels: Refer to requirements in Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT.

2.11 STRAINERS, Y-TYPE

A. Provide as shown on steam, water and compressed air piping systems.

B. Type: Open-end removable cylindrical screen. Threaded blow-off connection.

C. Construction:

1. Steam Service 420 to 1025 kPa (61 to 150 psi): Cast steel rated for 1025 kPa (150 psi) saturated steam with 1025 kPa (150 psi) ASME flanged ends, or cast iron with 1725 kPa (250 psi) ASME flanged ends, for pipe sizes above 50 mm (2 inches). Cast iron or bronze, rated for saturated steam at 1025 kPa (150 psi) threaded ends, for pipe sizes 50 mm (2 inches) and under.
2. Steam Service 415 kPa (60 psi) and under, water (except boiler feed between feedwater pumps and boilers), compressed air: Cast iron rated for 850 kPa (125 psi) saturated steam, 1200 kPa (175 psi) WOG, with 850 kPa (125 psi) ASME flanged ends for pipe sizes above 50 mm

(2 inches). Cast iron or bronze, threaded ends, rated for 850 kPa (125 psi) saturated steam, 1200 kPa (175 psi) WOG, for pipe sizes 50 mm (2 inches) and under.

D. Screen: Monel or stainless steel, free area not less than 2-1/2 times flow area of pipe. For strainers 80 mm (3 inch) pipe size and smaller, diameter of openings shall be 0.8 mm (0.033 inch) or less on steam service, 1.3 mm (0.05 inch) or less on water service, 0.3 mm (0.01-inch) or less on compressed air service. For strainers 100 mm (4 inch) pipe size and greater, diameter of openings shall be 1.3 mm (0.05 inch) on steam service, 3 mm (0.125 inch) on water service. Provide 80 mesh stainless steel screen liner on all strainers installed upstream of water meters or control valves.

E. Accessories: Gate or ball valve and quick-couple hose connection on all blowoff connections. These items are specified elsewhere in this section.

2.12 STEAM TRAPS

A. Application: Steam line drip points and heat exchangers. Each type furnished by a single manufacturer.

B. Type: Inverted bucket type with thermostatic vent in bucket except closed float-thermostatic on discharge side of pressure reducing stations and on all heat exchangers. Refer to the drawings for trap locations, capacity and size, differential operating pressures, and design pressure. Thermostatic at end of mains.

C. Bodies: Cast iron or stainless steel. Construction shall permit ease of removal and servicing working parts without disturbing connected piping.

D. Floats: Stainless steel.

E. Valves: Hardened chrome-steel.

F. Mechanism and Thermostatic Elements: Stainless steel mechanisms. Bimetallic strip air vent on inverted bucket traps.

G. Provision for Future Trap Monitoring System: All traps shall include ports for future installation of monitoring devices such as the "Armstrong SteamEye" or equal. Ports shall be plugged. To facilitate future removal of the plugs, install them with Teflon tape on the threads.

H. Identification: Label each trap at the factory with an identification number keyed to number that is shown on the drawings. Label shall be a metal tag permanently affixed to the trap.

I. Factory-Packaged Trap Station: As an option for drip points requiring isolating valves, strainer, trap, trap monitoring device or ports for future monitoring device, and valved test ports, provide factory-packaged trap station including these features. Manufacturer: Armstrong International or equal.

2.13 PIPING SUPPORT SYSTEMS

A. Provide an engineered piping support system with all hangers, supports and anchors designed and located by experienced technical pipe support specialists, utilizing piping system design and analysis software. The system design must be completely documented and submitted for review.

B. All pipe hangers and supports, and selection and installation shall comply with MSS SP-58, SP-69, SP-89, SP-90, SP-127.

C. All pipe hanger and support devices must be in compliance with specified MSS SP-58 type numbers, have published load ratings, and be products of engineered pipe support manufacturers. Manufacturers include: Anvil International, Bergen-Power, Lisega, Piping Technology and Products, or equal.

D. All pipe stresses and forces and moments on connecting equipment and structures shall be within the allowances of the ASME B31.1 code, applicable building codes, and equipment manufacturer’s design limits.

E. Piping that expands and contracts horizontally including steam, steam condensate, boiler feed, condensate transfer, shall be supported by roller or sliding type hangers and supports except when long vertical hanger rods permit sufficient horizontal movement with the vertical angles of the rods less than 4 degrees.

F. Piping that expands and contracts vertically including steam, steam condensate, boiler feed, condensate transfer, shall be supported by engineered variable spring and spring cushion hangers. Utilize MSS SP-69 selection requirements and guidelines. Vibration isolator hanger types are not permitted.

G. Seismic braces and shock absorbers shall be provided. Comply with MSS SP-127 design requirements and guidelines. Piping shall remain fully connected and supported under the design seismic events. Piping and connected equipment shall not be overstressed beyond code limits during seismic events.

H. Piping system anchors shall be engineered and located to control movement of piping that is subject to thermal expansion.

I. Prior to construction, submit complete engineering calculation methods and results, descriptions of all devices with MSS numbers, sizes, load capabilities and locations. Submit calculations on all moments and forces at anchors and guides, all hanger loads, all pipe stresses that are within 20% of the code allowable or exceed the ASME B31.1 code allowable, all pipe movements at supports.

J. Detailed Design Requirements:

1. Piping system design and analysis software shall be current state of the art that performs B31.1 Code analyses, and shall be utilized to analyze pipe movement and deflection, pipe stresses, pipe support forces and moments, and for selection of pipe support types and sizes. Seismic restraint calculations shall utilize the applicable shock spectra for the type of building structure, type of supported system, and the locality. Comply with MSS SP-127.
2. Each support for piping 60 mm (2-1/2 inches) and above shall be completely engineered to include location, type and size, hot and cold loads and movement. Submit layout drawings showing precise support locations and submit individual drawings for each support assembly showing all components, sizes, loadings.
3. Supports for piping 50 mm (2 inches) and below shall be engineered in general terms with approximate locations, typical support types and sizes, approximate movements. Submit layout drawings showing general locations and support types and sizes.
4. Obtain permissible loadings (forces and moments) for equipment nozzles (pipe connections) from the manufacturer of the boilers, the feedwater deaerator and any other equipment as necessary. Professional structural engineer shall verify capability of building structure to handle piping loads.
5. The project drawings may show locations and types of resilient supports including rollers and springs, and may also show special supports including anchors, guides and braces. Comply with the drawing requirements unless it is determined that piping may be overstressed or supports overloaded. Refer conflicts to the COTR.
6. Variable spring hangers conforming the MSS SP-58, Type 51, shall support all piping that expands vertically from thermal effects which may include connected equipment, such as boilers. Spring rates must be selected to avoid excessive load transfer to the connected equipment as the piping expands vertically. Vibration-type spring

isolators are not acceptable. Light duty spring hangers, MSS SP-58, Type 48, may be utilized on loads of 90 kg (200 lb) or less, and vertical movement of 3 mm (0.125 inches) or less. Spring cushion hangers, MSS SP-58, Type 49, may be utilized for vertical movement of 3 mm (0.125 inches) or less.

7. Locate supports to permit removal of valves and strainers from pipelines without disturbing supports.
8. If equipment and piping arrangement differs from that shown on the drawings, support locations and types shall be revised at no cost to the Government.

K. Hangers and Supports - Products:

1. Factory-built products of a manufacturer specializing in engineered pipe supports. All components must have published load ratings. All spring type supports shall have published spring rates and movement limits. All support assemblies shall include threaded connections that permit vertical position adjustment. Supports shall comply with MSS SP-58 Type Numbers as listed below.
2. Upper Attachments to Building Structure: Types 18, 20, 21, 22, 23, 29, and 30.
3. Roller Supports: Types 41, 43, and 46. Provide vertical adjustment for Type 41 with threaded studs and nuts adjacent to the roller.
4. Variable Spring Hanger Assembly:
   a. Type 51 variable spring, with Type 3 pipe clamp or Type 1 clevis. Type 53 variable spring trapeze may also be used. Locate Type 51 variable spring within 300 mm (1 foot) above pipe attachment. Attach rod to top of variable spring with Type 14 clevis.
   b. Typical features of variable spring hangers include spring rates under 150 lb/in, enclosed spring, load and travel indicator, sizes available with load capabilities ranging from 50 lb to multiples of 10,000 lb.
5. Spring Cushion Hanger Assembly: Double Rod: Type 41 and 49.
6. Light Duty Spring Hanger Assembly: Type 48 light duty spring, with Type 3 pipe clamp or Type 1 clevis. Locate Type 48 light duty spring within 300 mm (1 foot) above pipe attachment.
7. Clevis Hangers: Type 1.
8. Wall Brackets: Type 31, 32, and 33.
9. Pipe Stands: Type 38.
10. Riser Clamps: Type 42.

11. Roller Guides: Type 44. Construct guides to restrain movement perpendicular to the long axis of the piping. All members shall be welded steel.
12. Trapeze Supports: May be used where pipes are close together and parallel. Construct with structural steel channels or angles. Bolt roller supports to steel to support piping subject to horizontal thermal expansion. Attach other piping with U-bolts.
13. Pipe Covering Protection Saddles: Type 39. Provide at all support points on insulated pipe except where Type 3 pipe clamp is provided. Insulation shields are not permitted. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
14. Sliding Supports: Type 35. Welded steel attachments to pipe and building structure with Teflon or graphite sliding surfaces bonded to the attachments. Provide steel guides, except at expansion bends, to prevent lateral movement of the pipe.
15. Piping Anchors: Provide engineered designs to accommodate the calculated loads.
16. Seismic Restraints:
    a. Comply with MSS SP-127.
    b. Bracing: Provide as determined by engineering calculations.
    c. Shock Absorbers: Type 50. Mechanical or hydraulic type rated for shock loads. Pipe attachments shall be Type 3.

2.14 PIPE AND VALVE FLANGE GASKETS

Non-asbestos, designed for the service conditions. On steam service utilize 3 mm (1/8 inch) thick Class 300 spiral-wound with Type 304 stainless steel and mica/graphite filler and carbon steel gauge ring.

2.15 THREAD SEALANTS:

As recommended by the sealant manufacturer for the service. Utilize Hercules “GRIPP”, or equal, for oil and gas piping.

2.16 PIPE SLEEVES:

A. Service: For pipes passing through floors, walls, partitions.
B. Construction: Steel pipe, schedule 10 minimum.
C. Sleeve Diameter: Not less than 25 mm (1 inch) larger than the diameter of the enclosed pipe and thermal insulation, vapor barrier, and protective covering for insulated pipe; sleeves for un-insulated pipe shall be not less than 25 mm (1 inch) larger than the diameter of the enclosed pipe.

PART 3 - EXECUTION

3.1 ARRANGEMENT OF PIPING

A. The piping arrangement shown is a design based on currently available equipment. The plans show typical equipment to scale and show practical arrangement. Modification will be necessary during construction, at no additional cost to the Government, to adapt the equipment layout and piping plans to the precise equipment purchased by the Contractor. Accessibility for operation and maintenance must be maintained.

B. All piping shall be installed parallel to walls and column centerlines (unless shown otherwise). Fully coordinate work of each trade to provide the designed systems without interference between systems. All piping shall be accurately cut, true, and beveled for welding. Threaded piping shall be accurately cut, reamed and threaded with sharp dies. Copper piping work shall be performed in accordance with best practices requiring accurately cut clean joints and soldering in accordance with the recommended practices for the material and solder employed.

C. All piping shall be pitched for drainage at a constant slope of 25 mm in 12 m (1 inch in 40 feet). Steam, condensate, trap discharge, drip, drain, air, gas and blowdown piping shall pitch down in direction of flow. Service water, pumped condensate, pumped boiler feedwater, oil, shall pitch up in direction of flow. Provide valved air vents at top of rise and valved drains at low points. Gas piping may be run level as it is presumed to be dry, but dirt pockets shall be provided at base of risers.

D. Valves shall be located and stems oriented to permit proper and easy operation and access to valve bonnet for maintenance of packing, seat and disc. Valve stems shall not be below centerline of pipe. Refer to plans for stem orientation. Where valves are more than 2100 mm (7 feet) above the floor or platform, stems shall be horizontal unless shown otherwise. Gate and globe valves more than 3 m (10 feet) above floor or platform, shall have chain wheel and chain for operation from floor or platform. Provide hammer-blow wheel on any valve that cannot be opened or tightly closed by one person. Steam line gate and butterfly type isolation valves 750 mm (3 inch) pipe size and above shall have factory or field-fabricated 20 mm or 25 mm (3/4 or one inch) globe-valved warm-up bypasses if the steam line length is 6 m (20 feet) or longer.

E. Provide union adjacent to all threaded end valves.

F. Bolt wafer-type butterfly valves between pipe flanges.

G. Provide valves as necessary to permit maintenance of a device or sub-system without discontinuing service to other elements of that service or system.

H. Do not install any piping within 600 mm (2 feet) of water tube boiler side or top casings.

3.2 WELDING

A. The contractor is entirely responsible for the quality of the welding and shall:

1. Conduct tests of the welding procedures used by his organization, determine the suitability of the procedures used, determine that the welds made will meet the required tests, and also determine that the welding operators have the ability to make sound welds under standard conditions.
2. Comply with ASME B31.1 and AWS B2.1.
3. Perform all welding operations required for construction and installation of the piping systems.

B. Qualification of Welders: Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1, and AWS B2.1, and also as outlined below.

C. Examining Welder: Examine each welder at job site, in the presence of the COTR (RE)/Contracting Officer’s Technical Representative (COTR), to determine the ability of the welder to meet the qualifications required. Test welders for piping for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall be allowed to weld only in the position in which he has qualified and shall be required to identify his welds with his specific code marking signifying his name and number assigned.

D. Examination Results: Provide the COTR with a list of names and corresponding code markings. Retest welders who fail to meet the prescribed welding qualifications. Disqualify welders, who fail the second test, for work on the project.

E. Beveling: Field bevels and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.

F. Alignment: Utilize split welding rings or approved alternate method for joints on all pipes above 50 mm (two-inches) to assure proper

alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe.

G. Erection: Piping shall not be split, bent, flattened, or otherwise damaged before, during, or after installation. If the pipe temperature falls to 0 degrees C (32 degrees F) or lower, the pipe shall be heated to approximately 38 degrees C (100 degrees F) for a distance of 300 mm (one foot) on each side of the weld before welding, and the weld shall be finished before the pipe cools to 0 degrees C (32 degrees F).

H. Non-Destructive Examination of Piping Welds:

1. The COTR may require up to ten percent of the welded piping joints to be examined using radiographic testing. If defective welds are discovered the COTR may require examination of all pipe joint welds.
2. An approved independent testing firm regularly engaged in radiographic testing shall perform the radiographic examination of pipe joint welds. All radiographs shall be reviewed and interpreted by an ASNT Certified Level III radiographer, employed by the testing firm, who shall sign the reading report.
3. Comply with ASME B31.1. Furnish a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project. The COTR reserves the right to review all inspection records.

I. Defective Welds: Replace and reinspect defective welds. Repairing defective welds by adding weld material over the defect or by peening will not be permitted. Welders responsible for defective welds must be requalified.

J. Electrodes: Electrodes shall be stored in a dry heated area, and be kept free of moisture and dampness during the fabrication operations. Discard electrodes that have lost part of their coating.

3.3 PIPING JOINTS

A. All butt-welded piping shall be welded at circumferential joints, flanges shall be weld neck type; slip-on flanges, screwed flanges may be applied only with written approval of the COTR.

B. Companion flanges at equipment or valves shall match flange construction of equipment or valve. Raised face shall be removed at all companion flanges when attached to flanges equipped for flat face construction.

C. Gaskets and bolting shall be applied in accordance with the recommendations of the gasket manufacturer and bolting standards of ASME B31.1. Strains shall be evenly applied without overstress of bolts. Gaskets shall cover entire area of mating faces of flanges.

D. Screw threads shall be made up with Teflon tape except gas and oil piping joints shall utilize specified "GRIPP" joint compound.

E. Solder joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.

3.4 BRANCH INTERSECTION CONNECTIONS

A. Factory-built reinforced tees and laterals are required.

B. Factory-built integrally-reinforced forged steel branch outlet fittings may be used on reduced size connections upon approval of COTR. They must comply with MSS-SP-97.

3.5 EXPANSION AND FLEXIBILITY

The design includes provision for piping expansion due to pressure, thermal, weight and seismic (where applicable) effects. It is the Contractor's responsibility to avoid reduction in flexibility and increase in stress in piping systems. Major deviation will be shown by submittal for review of scale working drawings and stress calculations for the piping systems. Contractor shall provide any necessary additional construction and materials to limit stresses to safe values as directed by the COTR and at no additional cost to the Government.

3.6 PIPE BENDING

Pipe bending shall be in accordance with the recommended practices of PFI ES24. Only ASTM A106 seamless pipe may be bent. Sizes below 50 mm (2 inches) may be bent in field; sizes 65 mm (2-1/2 inches) and larger shall have factory fabricated bends. Minimum radii and tangent lengths for field bent piping are shown in the following table:

Size	Minimum Radius	Minimum Tangent
1/2 inch	2-1/2 inches	1-1/2 inches
3/4 inch	2-3/4 inches	1-3/4 inches
1-inch	5-inches	2-inches
1-1/4 inches	6-1/4 inches	2-inches
1-1/2 inches	7-1/2 inches	2-1/2 inches

3.7 SIZE CHANGES

Piping size changes shall be accomplished by use of line reducers, reducing ell, reducing tee. Apply eccentric reduction in all piping requiring continuous drainage; steam, condensate, vacuum, blowdown. Concentric reduction may be applied in run of piping involving pressure water systems except at pump inlets. Use concentric increasers where flow is in direction of increased size. Eccentric reduction, top flat, at all pump connections.

3.8 ADDITIONAL DRIPS AND TRAPS

Where additional rises or drops in steam or gas lines are provided, provide additional drip pockets with steam trap assemblies on steam lines and additional dirt pockets on gas lines. It is the contractor's responsibility to coordinate and layout these drips and traps. All end of mains shall have a thermostatic trap installed.

3.9 MINOR PIPING

Minor piping associated with instrumentation and control is generally not shown. Interconnection of sensors, transducers, control devices, instrumentation panels, combustion control panel, burner control panels is the responsibility of the contractor. Small piping associated with water cooling, drips, drains and other minor piping may not be shown to avoid confusion in the plan presentation but shall be provided as part of contract work.

3.10 DIELECTRIC CONNECTION

Where copper piping is connected to steel piping provide dielectric connections.

3.11 INSTALLATION - PRESSURE AND TEMPERATURE REGULATORS, CONTROL VALVES, SAFETY SHUT-OFF VALVES

Provide sufficient clearance on all sides of valve to permit replacement of working parts without removing valve from pipeline.

3.12 INSTALLATION - SAFETY VALVES, RELIEF VALVES AND SAFETY-RELIEF VALVES

A. Orient valves so that lifting levers are accessible from nearest walkway or access platform. Valves must be removable without requiring disassembling of vents, except where otherwise specifically provided.

B. Provide a drip pan elbow at discharge of each steam or economizer valve with slip joint in vent discharge line, arranged to prevent vent line from imposing any force on valve and to prevent any moisture accumulation in valve. Connected drip pan ell drains to drain piping to

floor drain. Provide flexible connector on drain line, adjacent to drip pan ell.

C. Support vent line from above. Each steam valve must have separate vent line to atmosphere unless shown otherwise.

3.13 INSTALLATION – Y-TYPE STRAINERS ON STEAM SERVICE

Install with basket level with the steam pipe so that condensate is not trapped in the strainer.

3.14 INSTALLATION - VIBRATION ISOLATORS IN PIPING

A. Install on all air lines and water supply lines to air compressors.

B. Also install on pump connections as shown.

3.15 INSTALLATION - PIPE SLEEVES

A. Accurately locate and securely fasten sleeves to forms before concrete is poured; install in walls or partitions during the construction of the walls.

B. Sleeve ends shall be flush with finished faces of walls and partitions.

C. Pipe sleeves passing through floors shall project 25 mm (1 inch) minimum above the finished floor surface and the bottom of the sleeve shall be flush with the underside of the floor slab.

3.16 INSTALLATION – PIPE SUPPORT SYSTEMS

A. Coordinate support locations with building structure prior to erection of piping. Also refer to approved shop drawings of equipment and approved piping layout and hanger layout drawings when locating hangers. Arrangement of supports shall facilitate operating, servicing and removal of valves, strainers, and piping specialties. Hanger parts must be marked at the factory with a numbering system keyed to hanger layout drawings. Layout drawings must be available at the site.

B. Upper attachments to Building Structure:

1. New Reinforced Concrete Construction: Concrete inserts.
2. Existing Reinforced Concrete Construction: Upper attachment welded or clamped to steel clip angles (or other construction shown on the drawings) which are expansion-bolted to the concrete. Expansion bolting shall be located so that loads place bolts in shear.
3. Steel Deck and Structural Framing: Upper attachments welded or clamped to structural steel members.

C. Expansion Fasteners and Power Set Fasteners: In existing concrete floor, ceiling and wall construction, expansion fasteners may be used for hanger loads up to one-third the manufacturer's rated strength of the expansion fastener. Power set fasteners may be used for loads up to

one-fourth of rated load. When greater hanger loads are encountered, additional fasteners may be used and interconnected with steel members combining to support the hanger.

D. Special Supports:
   1. Secure horizontal pipes where necessary to prevent vibration or excess sway.
   2. Where hangers cannot be adequately secured as specified, (for example, support for flow metering sensing lines, pneumatic tubing, control piping) special provisions shall be made for hanging and supporting pipe as directed by the COTR.
   3. Pipe supports, hangers, clamps or anchors shall not be attached to equipment unless specifically permitted by the specifications for that equipment or unless COTR gives written permission. No attachments to boiler casings permitted.

E. Spring Hangers: Locate spring units within one foot of the pipe, breeching or stack attachment except in locations where spring assemblies interfere with pipe insulation. Adjust springs to loads calculated by hanger manufacturer.

F. Seismic Braces and Restraints: Do not insulate piping within one foot of device until device has been inspected by COTR.

3.17 CLEANING OF PIPING AFTER INSTALLATION

Flush all piping sufficiently to remove all dirt and debris. Fill piping completely. Velocity shall be equivalent to that experienced during normal plant operation at maximum loads. During flushing, all control valves, steam traps and pumps must be disconnected from the system. After cleaning is complete, remove, clean and replace all strainer baskets and elements. Reconnect all equipment. Provide safe points of discharge for debris blown from pipes.

3.18 TESTING

A. Testing of piping components is not required prior to installation. Valves and fittings shall be capable of withstanding hydrostatic shell test equal to twice the primary design service pressure except as modified by specifications on fittings, ASME B16.5. This test capability is a statement of quality of material. Tests of individual items of pipe, fittings or equipment will be required only on instruction of COTR or RE and at Government cost.

B. After erection, all piping systems shall be capable of withstanding a hydrostatic test pressure of 1.5 times design pressure, as stipulated

in ASME B31.1. Hydrostatic tests will be required only on boiler external steam piping, utilizing water as the test medium. Hydrostatic tests will be required on other piping when operating tests described are unsatisfactory, or when inspection of welds shows poor workmanship and is subject to question by the COTR. When hydrostatic tests show leaks, the COTR will require necessary welding repairs, in accordance with ASME B31.1, at the Contractor's cost.

C. Perform operating test as follows:
   1. All steam piping prior to insulation shall be subjected to steam at final operating pressure. Inspect all joints for leaks and workmanship. Corrections shall be made as specified.
   2. Make corrections and retests to establish systems that have no leaks. Replace or recut any defective fittings or defective threads. Soldered material shall be thoroughly cleaned prior to resoldering. Back welding of threads will not be permitted.

D. Hydrostatically test external steam piping in approved manner with water of same time boiler is hydrostatically tested under the supervision of COTR. Prior to hydrostatic test, remove all valves not rated for hydrostatic test pressure. Replace valves after tests are satisfactorily completed. Hydrostatic test pressure shall be 1.5 times design pressure and performed in accordance with ASME Boiler and Pressure Vessel Code, Section I.

E. Generally, insulation work should not be performed prior to testing of piping. Contractor may, at own option and hazard, insulate piping prior to test, but any damaged insulation shall be replaced with new quality as specified for original installation at Contractor's cost and time.

F. Safety, Safety-Relief, Relief Valves: After installation, test under pressure in presence of COTR. Test operation, including set pressure, flow, and blowdown in accordance with ASME Boiler and Pressure Vessel Code. Any deficiencies must be corrected and retest performed.

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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. Glycol-water piping.
4. Factory prefabricated (preinsulated) chilled water piping for underground service.

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.

E. Section 33 10 00, WATER UTILITIES: Underground piping.

F. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for piping.

G. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements and items, which are common to more than one section of Division 23.

H. Section 23 21 23, HYDRONIC PUMPS: Pumps.

I. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Piping insulation.

J. Section 23 21 11, BOILER PLANT PIPING SYSTEMS: Boiler piping.

K. Section 23 25 00, HVAC WATER TREATMENT: Water treatment for open and closed systems.

L. Section 23 21 13, HYDRONIC PIPING: Underground chilled water piping.

M. Section 23 82 00, CONVECTION HEATING AND COOLING UNITS: VAV and CV units, fan coil units, and radiant ceiling panels.

N. 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 AND STEAM GENERATION, which includes welding qualifications.

B. Design Working Pressure for Preinsulated Chilled Water Piping: 861 kPa (125 psig).

C. 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.

D. 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.

E. 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 COTR: 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. Pipe alignment guides.
8. Expansion joints.
9. Expansion compensators.
10. All specified hydronic system components.
11. Water flow measuring devices.
12. Gages.
13. Thermometers and test wells.
14. Electric heat tracing systems.
15. Seismic bracing details for piping.
16. Factory preinsulated piping components and installation instructions.
17. Pipe fittings, and mechanical couplings, if used, for preinsulated chilled water piping.
18. Anchors and thrust blocking for preinsulated chilled water piping.

C. Manufacturer's certified data report, Form No. U-1, for ASME pressure vessels:
   1. Convertors.
   2. Air separators.
   3. Expansion 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 AND STEAM GENERATION.

H. As-Built Piping Diagrams: Provide drawing as follows for chilled water, condenser 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

C478-03 ..... Precast Reinforced Concrete Manhole Sections

C533 03 ..... Calcium Silicate Block and Pipe Thermal Insulation

C552 03 ..... Cellular Glass Thermal Insulation

D 3350-02 ..... Polyethylene Plastics Pipe and Fittings Materials

C591-01 ..... Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

D1784 03 ..... Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

D1785 03 ..... Poly (Vinyl Chloride0 (PVC) Plastic Pipe, Schedules 40, 80 and 120

D2241 04 ..... Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)

D2464 99 ..... Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

D3139 98 ..... Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

F439-06 ..... Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

F441/F441M-02 ..... Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

F477-02 ..... Elastomeric Seals Gaskets) for Joining Plastic Pipe

E. American Water Works Association (AWWA):

C110/03.....Ductile Iron and Grey Iron Fittings for Water

C203 00.....Coal Tar Protective Coatings and Linings for Steel Water Pipe Lines Enamel and Tape Hot Applied

F. 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

G. Copper Development Association, Inc. (CDA):

CDA A4015-95.....Copper Tube Handbook

H. Expansion Joint Manufacturer’s Association, Inc. (EJMA):

EMJA-2003.....Expansion Joint Manufacturer’s Association Standards, Eighth Edition

I. 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

J. National Sanitation Foundation (NSF):

14 03.....Plastic Piping System Components and Related Materials

K. Tubular Exchanger Manufacturers Association: TEMA 8th Edition, 2000

L. 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, Glycol-Water 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. Soft drawn tubing, 20 mm (3/4 inch) and larger, may be used for runouts to floor mounted fan coil units.
3. Chilled water piping underground: Factory prefabricated (preinsulated chilled water piping).

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. Pipe supports, including insulation shields, for above ground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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 FITTINGS FOR PLASTIC PIPING

A. Schedule 80, socket type for solvent welding.

B. Polypropylene drain piping: Flame retardant, drainage pattern.

C. Chemical feed piping for condenser water treatment: Chlorinated polyvinyl chloride (CPVC), Schedule 80, ASTM F439.

2.6 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).

2.7 SCREWED JOINTS

A. Pipe Thread: ANSI B1.20.

B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.8 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 2760 kPa (400 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.

K. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of at least 10 times the minimum required for control. Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:
   1. Gray iron (ASTM A126) or brass body rated 1205 kPa (175 psig) at 93 degrees C (200 degrees F), with stainless steel piston and spring.
   2. Brass or ferrous body designed for 2067 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
   3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.
   4. Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.

L. Manual Radiator/Convector Valves: Brass, packless, with position indicator.

2.9 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. Venturi Type: Bronze, steel, or cast iron with bronze throat, with valved pressure sensing taps upstream and at the throat.

C. Wafer Type Circuit Sensor: Cast iron wafer-type flow meter equipped with readout valves to facilitate the connecting of a differential pressure meter. Each readout valve shall be fitted with an integral check valve designed to minimize system fluid loss during the monitoring process.

D. Self-Averaging Annular Sensor Type: Brass or stainless steel metering tube, shutoff valves and quick-coupling pressure connections. Metering tube shall be rotatable so all sensing ports may be pointed down-stream when unit is not in use.

E. 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 integral high regain venturi 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.

F. 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).

2.10 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.

   2. 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.

2.11 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.

2.12 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 WATER FILTERS AND 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.

1. For condenser water suction (compound): Minus 100 kPa (30 inches Hg) to plus 700 kPa (100 psig).

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 COTR:

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 and Glycol-Water 0 to 38 degrees C (32-100 degrees F)	Hot Water and Glycol-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 AND STEAM GENERATION.

2.18 FACTORY PREFABRICATED (PREINSULATED) CHILLED WATER PIPING

A. Inner Carrier Pipe:

1. Steel pipe: ASTM A53 black steel. Pipe up through 300 mm (12 inch) diameter shall be standard weight. Wall thickness for pipe larger than 300 mm (12 inch) diameter shall be not less than 10 mm (0.375 inch). Pipe larger than 50 mm (2 inches) shall be joined by welding.
2. Copper tubing: Shall conform to ASTM B88, Type L, joined by solder fittings.
3. Polyvinylchloride (PVC) Pipe: PVC pipe shall conform to ASTM D 2241 with a Standard Thermoplastic Pipe Dimension Ratio (SDR) of 26 and PVC 1120 or 1220 as the material. Pipe shall be NSF approved based on NSF 14 and shall be joined by integral bell and spigot joints or fittings, using rubber ring gaskets.

B. Outer Casing: Outer casing shall be galvanized sheet metal, polyvinylchloride, Polyethylene or Reinforced Thermosetting Resin Pipe as specified below:

1. Metal jacket (Above ground only): Spiral wound galvanized (G90) steel sheet, 0.70 mm (24 gage) minimum thickness, conforming to SMACNA HVAC Duct Construction Standards. Provide sheet metal covers for joints and fittings permanently attached by bands and rivets. Seal all lap seams in metal covers and weatherproof with silicone sealant or flexible polyurethane sealant strips. Shape covers to allow for insulation of mechanical coupling joints if used.
2. Polyvinyl chloride (PVC): Made of clean, virgin, NSF approved (based on Standard No. 14) Class 12454-B PVC compound conforming to ASTM D1785 and ASTM D1784, Type 1, Grade 1, with thickness as follows:

Casing Diameter	Minimum Thickness
150 mm (6 inches) and smaller	60 mils

For sizes not shown above, the minimum casing thickness in mils shall be equal to the numerical value of the casing diameter expressed in inches times a factor of 10.

3. Polyethylene (PE): Shall conform to ASTM D 3350, Type III, Class C, Category 3 or 4, Grade P 34 with thickness as follows:

Casing Diameter mm (inches)	Minimum Thickness (in mils)
200 (8) and smaller	75

Sizes larger than those shown above shall be approved in accordance with the Article, SUBMITTALS.

C. Factory Applied Insulation:

1. Foam insulation for prefabricated insulated pipe and fittings shall be polyurethane foam having a density not less than 32 kcm (2 pcf).
   a. Polyurethane foam shall conform to ASTM 591, Type II, formed for conduit, density not less than 32 kg/cubic meter (2 pcf).
   b. The insulation "k" factor shall not exceed the numerical value of 0.025 W/(m.k) (0.17 Btu-inch/h. square feet degree F) at 24 degrees C (75 degrees F) mean temperature in accordance with ASTM C177.
2. Insulation thickness for carrier pipe 75 mm (3 inches) nominal diameter and smaller: Not less than 18 mm (0.70 inch) or the standard manufactured thickness exceeding 18 mm (0.70 inch).
3. Insulation thickness for carrier pipe larger than 75 mm (3 inches) nominal diameter: 50 mm (2 inches) nominal, but not less than 38 mm (1-1/2 inches).
4. The polyurethane foam shall completely fill the annular space between the carrier pipe and the casing. Manufacturer shall certify that the insulated pipe is free of insulation voids and describe quality control procedure followed to meet this requirement.

D. Field Applied Insulation:

1. Insulation for valves, fittings, field casing closures, if required, and other piping system accessories shall be cellular glass conforming to ASTM C552, calcium silicate conforming to ASTM C533 or polyurethane matching the pipe insulation. Insulation shall be premolded, precut or job fabricated to fit and shall be removable and reusable. Thickness shall match adjacent piping.
2. Metal jackets shall be provided for all pipe insulation in manholes. Insulation bands shall be 19 mm (3/4-inch) wide [0.13 mm (0.005-inch)] thick stainless steel or [0.02 mm (0.0007-inch) aluminum].

3. Buried fittings and accessories shall be factory fabricated and may have field foamed polyurethane insulation to match adjacent piping and shall be protected with a covering matching the pipe casing. Shrink sleeves shall be provided over casing connection joints.

E. End Seals:

1. General: Each preinsulated section of piping shall have a complete sealing of the insulation to provide permanent water and vapor seal at each end of the preinsulated section of piping. Preinsulated sections of piping modified in the field shall be provided with an end seal which is equivalent to the end seals furnished with the preinsulated section of piping. Provide complete sealing of the insulation at each end of each preinsulated conduit section by one of the following methods:
   a. Carrying the outer casing over tapered pipe insulation ends and extending it to the carrier pipe. Provide sufficient surface bonding area between the casing and the carrier pipe to ensure a permanent water and vapor-resistant seal.
   b. Using specially designed prefabricated caps made of the same material and not less than the same thickness as the casing. Provide sufficient surface bonding area between the cap, and both the casing and carrier pipe, to ensure permanent water and vapor-resistant seal.
   c. Using rubber ring gaskets designed and dimensioned to fit in the annular space between the casing and carrier pipe in such a manner as to ensure a permanent water and vapor-resistant seal.
   d. Using shrink sleeves that shall be either heat shrinkable high temperature rubber or polyethylene material that can be bound to the carrier pipes and casing to ensure a permanent water and vapor-resistant seal.
2. Factory casing and end seal testing and certification:
   a. Testing and certification procedures by an independent testing laboratory shall demonstrate that casings and end seals are capable of resisting penetration of water into the casing and insulation at 60 kPa (20 feet) of head pressure, measured above the highest point of the test sample, subjected over the entire surface of an 2.5 m (8-feet) test sample of prefabricated pipe for not less than 48 hours. Test shall use 24 degrees C (75 degree F) water for chilled water service, while the sample is

either buried or encased in dry bedding sand with a minimum of 305 mm (12 inches) of sand all around sample. The carrier pipe size in the test section shall be 75 mm (3 inches) in diameter and shall be restrained during the test period. The insulation thickness shall not exceed the maximum thickness provided for the piping in the project.

b. Test results for Federal Agency Committee on Underground Heat Distribution System, or similar results may be substituted.

F. Couplings:

1. Insulated pipe couplings for copper tubing: Insulated pipe couplings for copper tubing shall be cast bronze containing an 0-ring seal on each end and shall be jacketed and sealed to act as an expansion joint.
2. Bell and spigot joints: Rubber ring joining system. Bell and spigot joints may also be of the bonded type where the joint is made up utilizing a suitable adhesive for the service specified. Adhesive shall be furnished by the pipe manufacturer.
3. Mechanical couplings for steel pipe: Mechanical couplings for steel pipe shall be the sleeve type or the type for grooved end pipe and shall provide a tight, flexible joint under all conditions including movements caused by expansion, contraction, slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Coupling strength shall not be less than the connecting pipe sections. Sleeve-type couplings shall be used for joining plain end pipe sections. The sleeve couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets. Grooved end pipe couplings shall consist of identical coupling sections fastened in place, using track head bolts, ASTM A183, to confine a molded gasket over the pipe and gap. Couplings shall be malleable iron or ductile iron.

G. Joints:

1. Welded joints: Welded joints between sections of pipe and between pipe and fittings shall be provided where specified or indicated. Branch connections shall be made with either welding tees or forged branch outlet fittings attached to the main and reinforced against external strains.

2. Flanged joints: Flanged joints shall be provided with gaskets and made perfectly square and tight. Full-faced gaskets shall be used with cast-iron flanges and all gaskets shall be as thin as the finish of the flange face permits. Gaskets shall be 5 mm (3/16-inch) thick for 25 through 300 mm (1 through 12 inch) flanges and 6 mm (1/4-inch) thick for flanges 350 mm (14 inches) and larger.
3. Threaded joints: Joints shall be made tight with polytetrafluoroethylene tape applied to the male threads only. Not more than three threads shall show after the joint is made up.
4. Brazed and soldered joints: Brazed and soldered joints for copper pipe and fittings shall conform to CDA A 4015. Silver solder or brazing alloys, ASTM B32, melting above 593 degrees C (1100 degrees F) shall be utilized.
5. Mechanical joints: Sleeve and grooved pipe couplings shall be installed and protected against corrosion as recommended by the coupling manufacturer. Joints between nonmetallic and metallic carrier pipe shall be designed and furnished by the piping system manufacturer. The transition pieces shall be factory fabricated and shall be designed so that no field chemical welding of the carrier pipe will be required. Transitional joint connections to manhole steel piping shall be made inside the manhole except for prefabricated, pre-piped manholes where joints shall be outside the manhole wall.
6. Insulating joints and dielectric fittings: Shall be installed where shown.
7. Nonmetallic pipe joints: Nonmetallic pipe joints shall be installed in accordance with the written instructions of the manufacturer.

H. Direct Buried Underground Chilled Water Piping

1. Insulation Requirements: Factory insulate all chilled water supply piping, and all chilled water return piping 300 mm (12 inches) in diameter and smaller. Joints and fittings in chilled water piping shall be field insulated.
2. Coating for uninsulated steel carrier piping: Field prime and wrap all uninsulated fittings and joints with polyethylene tape.
3. Steel pipe fittings:
   a. All steel welding fittings shall conform to ASTM A234.
      1) Butt-weld fittings shall conform to ANSI B16.9.
      2) Socket-weld fittings shall conform to ANSI B16.11.

3) Long radius butt-weld elbows conforming to ANSI B16.9 shall be used unless specifically waived by the COTR.
4) Threaded fittings shall conform to ANSI B16.3, Class 150.

4. Copper fittings: Wrought copper or copper alloy solder joint pressure fittings shall conform to ANSI B16.22. Cast copper alloy solder-joint pressure fittings shall conform to ANSI B16.18.
5. Pipe fittings for PVC pipe: PVC or cast iron. Make PVC fittings of the same type and grade material as the piping to which they will be connected. PVC fittings shall be furnished by the manufacturer who supplies the pipe with approval based on NSF Standard No. 14. All fittings shall have temperature and pressure ratings not less than the adjoining piping and shall be designed and fabricated with bells for use with rubber ring gaskets. Cast iron fittings shall conform to AWWA C110. Adapter fittings for other piping materials shall be furnished by the manufacturer who supplies the pipe.
6. Flanges and flanged fittings: All flanges shall be flat faced.
   a. Cast-iron threaded flanges shall conform to ANSI B16.1, 125 pound.
   b. Welded steel flanges shall conform to ANSI B16.5, Class 150.
   c. Bronze flanges shall conform to ANSI B16.24, 150 pound.
   d. PVC flanges shall conform to the dimensions of ANSI B16.5, Class 150.
7. Transitional joints: Carrier pipe joints between nonmetallic and metallic pipe shall be furnished by the piping system manufacturer and shall conform to the manufacturer's specifications. The transition pieces shall be factory prefabricated and be designed so that no field chemical welding of the carrier pipe will be required. Make carrier pipe joints between steel and copper with solder-threaded adapters and dielectric unions. Transitional joint connections to steel piping in manholes shall be made outside of the exterior wall surfaces of the manhole.
8. Gaskets: Elastomeric seals shall conform to ASTM F477.

2.19 THRUST BLOCKING FOR UNDERGROUND PREINSULATED CHILLED WATER PIPING

A. Thrust Blocking: Provide in all systems using the rubber ring method of joining the carrier pipe sections.
   1. Thrust Blocks shall be installed at the locations shown on the drawings or recommended by the pipe system manufacturer. Thrust blocks may not be required on all systems, and the need for thrust

blocks shall be as recommended by the system manufacturer. Thrust blocks, if necessary, shall be installed at all changes in direction, changes in size, valves and terminal ends, such as plugs, caps and tees. Thrust blocks shall be concrete having a compressive strength of not less than 13780 kPa (2000 psi) after 28 days and shall be in accordance with Section 03 30 00, CAST-IN-PLACE CONCRETE. Thrust blocks shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and the thrust bearing sides of the thrust blocks shall be poured directly against undisturbed earth. The sides of the thrust blocks not subject to thrust may be poured against forms. Thrust blocks shall be placed so that the joints for all fittings will be accessible for repair wherever possible. No pipe joint shall be embedded in concrete. The thrust blocks shall provide for transfer of thrusts and reactions without exceeding the allowable stress of the concrete and shall be installed in accordance with pipe manufacturer's instructions. In muck or peat, all thrusts shall be resisted by piles or tie rods to solid foundations or by removal of peat or muck shall be replaced with ballast of sufficient stability to resist thrusts.

2. The area of backing required for reaction backing of both supply and return piping shall be calculated in accordance with Tables 1 and 2. The safe soil bearing load shall be determined for each site. Calculations covering these determinations shall be submitted to the Contracting Officer for approval prior to placing any reaction backing on the job.

Table 1: Thrust (Two Pipes), 1550 kPa (225 psig), and Class 1033 kPa (150 psig):

Pipe Size	Tees	90 Degree Bends	45 Degree Bends	22-1/2 Degree Bends
75 mm (3-inch)	5,670	8,050	4,360	2,180

Table 2: Safe Soil Bearing Loads:

Soil	kPa	(psf)
*Muck, peat	0	0
Soft clay	47.9	1,000
Sand	95.8	2,000
Sand and gravel	143.7	3,000
Sand and gravel in clay matrix	191.6	4,000
Hard shale	479.0	10,000

*In muck or peat, all thrusts shall be resisted by piles or tie rods to solid foundations or by removal of peat or muck which will be replaced with ballast of sufficient stability to resist thrusts.

SPEC WRITER NOTE: Show and identify the types of manholes on drawings. If traffic rated, specify so. Also, show how the manholes are drained.

2.20 ANCHORS FOR PREINSULATED CHILLED WATER PIPING

Anchor design shall be in accordance with the published data of the manufacturer and for prefabricated systems shall be factory fabricated by the system manufacturer. In all cases, the design shall be such that water penetration, condensation, or vapor transmission will not wet the insulation.

2.21 REINFORCING STEEL

Reinforcing steel shall be deformed bars, ASTM 615, Grade 40, unless otherwise noted.

2.22 BURIED UTILITY WARNING TAPE

Tape shall be 0.1 mm (0.004 inch) thick, 150 mm (6 inches) wide, yellow polyethylene with a ferrous metallic core, acid and alkali-resistant and shall have a minimum strength of 12,000 kPa (1750 psig) lengthwise and 10,300 kPa (1500 psig) crosswise with an elongation factor of 350 percent. Provide bold black letters on the tape identifying the type of system. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material.

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, fan-coils, coils, radiators, 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 AND STEAM GENERATION. Install convertors and other heat exchangers 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 and condenser water treatment systems.
   2. Flow elements (orifice unions), 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, PLUMBING, AND BOILER PLANT 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 AND STEAM GENERATION.

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 INSTALLATION OF PREINSULATED CHILLED WATER PIPING

A. Handling and Storage: Handle and store conduits, pipes, and all accessories to ensure complete installation in a sound undamaged condition. Unloading, tacking, moving, and storing of materials shall be in strict accordance with the manufacturer's requirements. Take special care to ensure that materials which have exceeded their specified shelf life are not used in the installation of the system. Before installation all materials shall be inspected for defects. Materials found to be defective before or after installation shall be repaired or replaced with sound material, with no additional expense to the Government.

B. Installation of Piping Systems:

1. Piping system furnished shall be installed in accordance with the piping system manufacturer's instructions. Piping shall be installed without springing or forcing other than what has been calculated for thermal expansion and contraction. Pipe ends shall have burrs removed by reaming and shall be installed to permit free expansion and contraction without damage to joints or hangers. Nonmetallic pipe cut in the field shall be machined to fit couplings or joints and shall be coated or treated to match standard factory coated ends. Copper tubing shall not be installed in the same trench with ferrous piping materials. When nonferrous metallic pipe (e.g., copper tubing) crosses any ferrous piping material, a minimum vertical separation of 300 mm (12 inches) shall be maintained between pipes. Connections between different types of pipe and accessories shall be made with transition fittings approved by the manufacturer of the piping system.
2. Pitching of horizontal piping: Horizontal piping shall be pitched at a grade not less than 25 mm (1 inch) in 12 m (40 feet) toward the drain points unless otherwise indicated.
3. Install vacuum and air relief valves, as required, for filling and draining of the system.

C. Pipe Sleeves:

1. Pipe shall be continuous through sleeves. Set in place before concrete is poured.
2. Seal between sleeve and core opening with modular mechanical type link seal.

3. Provide where water lines pass through retaining walls and foundation walls.

D. Cutting of Prefabricated Conduit Sections: Prefabricated conduit sections shall be cut in strict accordance with the manufacturer's recommendations and standards. The cut section shall be treated as required to result in the cut section being identical in every respect to a standard conduit section produced at the factory.

E. Field Casing Closures: Field insulation and encasement of joints shall be accomplished after the visual and pressure tests specified are completed. Field insulation and encasement shall be in accordance with the manufacturer's written instructions. Thickness dimensions of the insulation and casing materials shall not be less than those of the adjoining prefabricated section. Insulating material may be foamed in place polyurethane or premolded polyurethane foam sections. Care should be taken to ensure that field closures are made under conditions of temperature and cleanliness required to produce a sound continuous vapor barrier. A standard polyethylene heat shrink sleeve shall be installed over the casing and shall have a 150 mm (6-inch minimum) overlap at each end.

F. Insulation and Encasement of Pipe Accessories: Flanges, couplings, unions, valves, fittings, and other pipe accessories, unless otherwise shown or approved, shall be insulated with removable factory premolded, prefabricated or field fabricated insulation. For accessories buried underground, the casing material and thickness shall be identical to that of the adjoining casing material and thickness shall be identical to that of the adjoining casing except that for polyethylene casing larger than 300 mm (12-inch) size, the casing material over fittings shall be reinforced thermosetting resin (RTRP). For accessories in manholes, the casing material shall be steel or aluminum sheet applied over the insulation. Where accessories are designated not to be insulated, the adjoining insulation and jacket shall terminate neatly and in a manner to provide a complete vapor seal.

G. Trenching and Backfilling: Trench bottoms for underground prefabricated conduit systems shall be smooth and free of sharp objects, stones, and debris that could puncture the casing. Where this is a problem, the trench should be over excavated and stabilized by using sand, fine dirt, or similar material. Partial backfilling is required immediately after installation of the pipe. Selected backfill shall be tamped in

not more than 150 mm (6 inch) layers under and around the conduit to a height of not less than 150 mm (6-inch) above the top of the casing. During this process, joints shall be left exposed for visual inspection during field tests.

H. Open Ends: Open ends of pipe lines and equipment shall be properly capped or plugged during installation to keep dirt and other foreign matter out of the system.

I. Vapor Barrier: Install materials to provide and preserve the integrity of the vapor barrier.

3.4 SEISMIC BRACING ABOVEGROUND PIPING

Provide in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 LEAK TESTING ABOVEGROUND PIPING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COTR. Tests may be either of those below, or a combination, as approved by the COTR.

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.

3.6 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 COTR.

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.

3.7 TESTING UNDERGROUND PREINSULATED CHILLED WATER PIPING

A. First Hydrostatic Test:

1. All distribution piping shall be tested hydrostatically, before backfilling, with the joints of the water carrier pipe exposed. Installation of thrust blocks prior or after hydrostatic testing shall be as recommended by the pipe manufacturer's installation instructions.
2. Each test cycle shall consist of a 10 minute period at 1034 kPa (150 psig) followed by a 5 minute period at a pressure less than 345 kPa (50 psig). The next cycle shall begin immediately following the completion of the previous cycle. Pressure rise and drop shall not exceed 690 kPa (100 psig) per minute. The pressure gage shall be located and the pressure measured at the opposite end of the system from where the pressure is applied. After completion of the

hydrostatic pressure cycling the first hydrostatic pressure test may be performed.

C. Final Hydrostatic Test: After successful completion of the first hydrostatic test, the system shall be pressurized to 1-1/2 times the working pressure up to 1034 kPa (150 psig). This pressure shall be held for a minimum of 4 hours. The method of pressurizing the piping system is to disconnect it from the system prior to the start of the 4-hour pressure holding period. If the pressure cannot be held for the specified length of time, the cause of the pressure loss shall be determined, corrected, and all the tests be repeated.

D. Repair joints, replace damaged or porous pipe and fittings and repeat the test without additional cost to the Government until the system can be demonstrated to have no leakage.

3.8 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 COTR, for instructing VA operating personnel.

3.9 OPERATING AND PERFORMANCE TEST AND INSTRUCTION

A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

B. Adjust red set hand on pressure gages to normal working pressure.

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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 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

E. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

F. Section 23 21 13, HYDRONIC PIPING.

G. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.

H. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

I. Section 26 32 13, ENGINE GENERATORS.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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.
5. 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.
6. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard and other accessories specified. Statically and dynamically balance all rotating parts.
7. 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.
8. Test all pumps before shipment. The manufacturer shall certify all pump ratings.
9. After completion of balancing, provide replacement of impellers or trim impellers to provide specified flow at actual pumping head, as installed.
10. Furnish one spare seal and casing gasket for each pump to the COTR.

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.
3. Variable speed motor controllers.

C. Manufacturer's installation, maintenance and operating instructions, in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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 Type, Base Mounted End Suction or Double 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 AND STEAM GENERATION 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.

M. Variable Speed Pumps:

1. The pumps shall be the type shown on the drawings and specified herein flex coupled to an open drip-proof motor. Provide motors 30 kW (40 horsepower) and larger with thermal overload switches.
2. Variable Speed Motor Controllers: Refer to Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS and to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION paragraph, Variable Speed Motor Controllers. Furnish controllers with pumps and motors.
3. Pump operation and speed control shall be as shown on the drawings.

2.2 VERTICAL TURBINE PUMP

A. Pump Bowls: Close-grained cast iron, flanged and bolted type, reinforced with four ribs (minimum), which are at least one-half the flange metal thickness.

B. Impellers: Bronze, enclosed type, secured to the shaft with steel tempered keys.

C. Replaceable Wear Rings: Bronze.

D. Pump Shaft: AISI Type 416, stainless steel.

E. Suction Bell: Cast iron, belled to reduce entrance losses.

F. Suction Strainer: Bronze, basket type, with net open area at least twice the calculated area at the suction bell lip.

G. Sleeve Bearings: Bronze provided in each bowl and in the suction bell, to be lubricated by the pumped fluid. Suction bell bearing shall be packed permanently with non-soluble grease and fitted with a bronze sand collar.

H. Discharge Column Pipe: Steel with threaded or flanged connections.

I. Lineshaft: AISI Type 1045, steel connected through steel threaded couplings. Shaft (and column) sections shall not exceed 3 m (ten feet) in length.

J. Replaceable Shaft Sleeves: Stainless steel "shrunkfit" on the line-shaft at each bearing location.

K. Column Connection Bearings: Fluted rubber supported by non-threaded "spider" type retainers butted between the machined faces of the discharge column. "Spider" shall be made of nickel-iron with a minimum brinell of 170.

L. Surface Discharge Head Assembly: Close-grained cast iron with integral 850 kPa (125 psig) flat face flange, ANSI B16.1. Provide two lifting lugs with capacity to support the weight of the entire pump. Provide steel base plate and hardware for securing the discharge head to the base plate.

M. Stuffing Box: Manufacturer’s standard, two Teflon sealcages, and split type packing gland.

N. Stuffing Box Bearing Housing: Cast iron, one piece, with bronze sleeve bearings.

O. Motor: Vertical, hollow shaft type, direct connected.

2.3 FUEL OIL PUMPS

Refer to Section 26 32 13, ENGINE GENERATORS.

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.

- - - E N D - - -

SECTION 23 22 13

STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Steam, condensate and vent piping inside buildings. Boiler plant and outside steam distribution piping is covered in specification Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

1.2 RELATED WORK

A. Excavation and backfill: Section 31 20 00, EARTH MOVING.

B. Seismic restraints for piping: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

C. 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 AND STEAM GENERATION.

D. Pumps: Section 23 22 23, STEAM CONDENSATE PUMPS.

E. Piping insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

F. Boiler piping: Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

G. Water treatment for open and closed systems: Section 23 25 00, HVAC WATER TREATMENT.

H. Heating and cooling radiant panels: Section 23 82 00, CONVECTION HEATING AND COOLING UNITS.

I. Temperature and pressure sensors and valve operators: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

1.3 QUALITY ASSURANCE

Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, which includes welding qualifications.

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.
8. Pipe alignment guides.
9. Expansion joints.
10. Expansion compensators.
11. Flexible ball joints: Catalog sheets, performance charts, schematic drawings, specifications and installation instructions.
12. All specified steam system components.
13. Gages.
14. Thermometers and test wells.
15. Electric heat tracing systems.
17. Seismic bracing details for piping.

C. Manufacturer's certified data report, Form No. U-1, for ASME pressure vessels:
   1. Convertors.
   2. Air separators.
   3. Expansion tanks.

D. Coordination Drawings: Refer to Article, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

E. As-Built Piping Diagrams: Provide drawing as follows for steam and steam condensate piping and other central plant equipment.
   1. One wall-mounted stick file for prints. Mount stick file in the chiller plant or adjacent control room along with control diagram stick file.
   2. One set of reproducible drawings.

F. Steam trap manufacturer representative of steam traps shall review and approve steam trap selection and layout.

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 National Institute Standard (ANSI):
   B1.20.1-01.....Pipe Threads, General Purpose (Inch)

C. American Society of Mechanical Engineers (ASME):
   B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
   B16.3-98.....Malleable Iron Threaded Fittings
   B16.4-98.....Gray Iron Threaded Fittings
   B16.9-01.....Factory-Made Wrought Buttwelding Fittings
   B16.11-02.....Forged Fittings, Socket-Welding and Threaded

B16.14-91.....Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads

B16.22-98.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.23-92.....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

B31.1-01.....Power Piping

B31.9-96.....Building Services Piping

B40.100-98.....Pressure Gauges and Gauge Attachments

Boiler and Pressure Vessel Code: SEC VIII D1-2001, Pressure Vessels, Division 1

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

A47-99.....Ferritic Malleable Iron Castings

A53-01.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106-99.....Seamless Carbon Steel Pipe for High-Temperature Service

A126-01.....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A181-01.....Carbon Steel Forgings, for General-Purpose Piping

A183-98 ..... Carbon Steel Track Bolts and Nuts

A216-98 ..... Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service

A285-01 ..... Pressure Vessel Plates, Carbon Steel, Low-and-Intermediate-Tensile Strength

A307-00 ..... Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

A516-01 ..... Pressure Vessel Plates, Carbon Steel, for Moderate-and- Lower Temperature Service

A536-99 ..... Standard Specification for Ductile Iron Castings

B32-00 ..... Solder Metal

B61-93 ..... Steam or Valve Bronze Castings

B62-93 ..... Composition Bronze or Ounce Metal Castings

B88-99 ..... Seamless Copper Water Tube

F439-01 ..... Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

F441-99 ..... Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

E. American Welding Society (AWS):

A5.8-92.....Filler Metals for Brazing and Braze Welding

B2.1-00.....Welding Procedure and Performance Qualifications

F. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:

SP-67-95.....Butterfly Valves

SP-70-98.....Cast Iron Gate Valves, Flanged and Threaded Ends

SP-71-97.....Gray Iron Swing Check Valves, Flanged and Threaded Ends

SP-72-99.....Ball Valves with Flanged or Butt-Welding Ends for General Service

SP-78-98.....Cast Iron Plug Valves, Flanged and Threaded Ends

SP-80-97.....Bronze Gate, Globe, Angle and Check Valves

SP-85-94.....Cast Iron Globe and Angle Valves, Flanged and Threaded Ends

G. Military Specifications (Mil. Spec.):

MIL-S-901D-1989.....Shock Tests, H.I. (High Impact) Shipboard Machinery, Equipment, and Systems

H. National Board of Boiler and Pressure Vessel Inspectors (NB): Relieving Capacities of Safety Valves and Relief Valves

I. Tubular Exchanger Manufacturers Association: TEMA 18th Edition, 2000

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. Steam Piping: Steel, ASTM A53, Grade B, seamless or ERW; A106 Grade B, Seamless; Schedule 40.

B. Steam Condensate Piping:

1. Copper water tube ASTM B88, Type K, hard drawn; or steel, ASTM A53, Grade B, Seamless or ERW, or A106 Grade B Seamless, Schedule 80.

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. Steam service: Weld neck or slip-on, raised face, with non-asbestos gasket. Non-asbestos gasket shall either be stainless steel spiral wound strip with flexible graphite filler or compressed inorganic fiber with nitrile binder rated for saturated and superheated steam service 750 degrees F and 1500 psi.
   c. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.

B. 50 mm (2 inches) and Smaller: Screwed or welded.

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, except for steam and steam condensate piping. Provide 300 pound malleable iron, ASME B16.3 for steam and steam condensate piping. Cast iron fittings are piping is not acceptable for steam and steam condensate piping. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
4. Unions: ASME B16.39.
5. Steam line drip station and strainer quick-couple blowdown hose connection: Straight through, plug and socket, screw or cam locking type for 15 mm (1/2 inch) ID hose. No integral shut-off is required.

C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and thredolets 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.

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.

B. Bronze Flanges and Flanged Fittings: ASME B16.24.

2.5 FITTINGS FOR PLASTIC PIPING

A. Schedule 80, socket type for solvent welding.

B. Polypropylene drain piping: Flame retardant, drainage pattern.

2.6 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, 121 degrees C (250 degrees F) for steam condensate and as required for steam service.

2.7 SCREWED JOINTS

A. Pipe Thread: ANSI B1.20.

B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.8 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. High pressure steam 413 kPa (60 psig) and above nominal MPS system): Cast steel body, ASTM A216 grade WCB, 1034 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel solid disc and seats. Provide factory installed bypass with globe valve on valves 100 mm (4 inches) and larger.

b. All other services: 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:
   a. Globe valves for high pressure steam 413 kPa (60 psig) and above nominal MPS system): Cast steel body, ASTM A216 grade WCB, flanged, OS&Y, 1034 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
   b. All other services: 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. Manual Radiator/Convector Valves: Brass, packless, with position indicator.

2.9 STRAINERS

A. Y Type. Tee type is acceptable for water service.

B. High Pressure Steam: Rated 1034 kPa (150 psig) saturated steam.

1. 65 mm (2-1/2 inches) and larger: Flanged cast steel or 1723 kPa (250 psig) cast iron.
2. 50 mm (2 inches) and smaller: Iron, ASTM A116 Grade B, or bronze, ASTM B-62 body with screwed connections (250 psig).
3. Mechanical coupled pipe: Grooved end, ductile iron.

C. All Other Services: Rated 861 kPa (125 psig) saturated steam.

1. 65 mm (2-1/2 inches) and larger: Flanged, iron body.
2. 50 mm (2 inches) and smaller: Cast iron or bronze.

D. 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. 75 mm (3 inches) and smaller: 20 mesh for steam and 1.1 mm (0.045 inch) diameter perforations for liquids.

2.10 STEAM SYSTEM COMPONENTS

A. Steam Pressure Reducing Valves in PRV Stations:

1. Type: Single-seated, diaphragm operated, spring-loaded, external or internal steam pilot-controlled, normally closed, adjustable set pressure. Pilot shall sense controlled pressure downstream of main valve.
2. Service: Provide controlled reduced pressure to steam piping systems.
3. Pressure control shall be smooth and continuous with maximum drop of 10 percent. Maximum flow capability of each valve shall not exceed capacity of downstream safety valve(s).

4. Main valve and pilot valve shall have replaceable valve plug and seat of stainless steel, monel, or similar durable material.
   a. Pressure rating for high pressure steam: Not less than 1034 kPa (150 psig) saturated steam.
   b. Connections: Flanged for valves 65 mm (2-1/2 inches) and larger; flanged or threaded ends for smaller valves.
5. Select pressure reducing valves to develop less than 85 dbA at 1500 mm (5 feet) elevation above adjacent floor, and 1500 mm (5 feet) distance in any direction. Inlet and outlet piping for steam pressure reducing valves shall be Schedule 80 minimum for required distance to achieve required levels or sound attenuators shall be applied.

B. Safety Valves and Accessories: Comply with ASME Boiler and Pressure Vessel Code, Section VIII. Capacities shall be certified by National Board of Boiler and Pressure Vessel Inspectors, maximum accumulation 10 percent. Provide lifting lever. Provide drip pan elbow where shown.

C. Steam Trap: Each type of trap shall be the product of a single manufacturer. Provide trap sets at all low points and at 61 m (200 feet) intervals on the horizontal main lines.
   1. Floats and linkages shall provide sufficient force to open trap valve over full operating pressure range available to the system. Unless otherwise indicated on the drawings, traps shall be sized for capacities indicated at minimum pressure drop as follows:
      a. For equipment with modulating control valve: 1.7 kPa (1/4 psig), based on a condensate leg of 300 mm (12 inches) at the trap inlet and gravity flow to the receiver.
      b. For main line drip trap sets and other trap sets at steam pressure: Up to 70 percent of design differential pressure. Condensate may be lifted to the return line.
   2. Trap bodies: Bronze, cast iron, or semi-steel, constructed to permit ease of removal and servicing working parts without disturbing connecting piping. For systems without relief valve traps shall be rated for the pressure upstream of the PRV supplying the system.
   3. Balanced pressure thermostatic elements: Phosphor bronze, stainless steel or monel metal.
   4. Valves and seats: Suitable hardened corrosion resistant alloy.
   5. Mechanism: Brass, stainless steel or corrosion resistant alloy.
   6. Floats: Stainless steel.

7. Inverted bucket traps: Provide bi-metallic thermostatic element for rapid release of non-condensables.

D. Pressure Powered Condensate Pump: Cast iron body and cover, stainless steel valve mechanism and linkage, bronze body check valves, rated 861 kPa (125 psig) operating pressure, for lifting steam condensate using steam or compressed air pressure.

E. Thermostatic Air Vent (Steam): Brass or iron body, balanced pressure bellows, stainless steel (renewable) valve and seat, rated 861 kPa (125 psig) working pressure, 20 mm (3/4 inch) screwed connections. Air vents shall be balanced pressure type that responds to steam pressure-temperature curve and vents air at any pressure.

2.11 GAGES, PRESSURE AND COMPOUND

A. ASME B40.1, Accuracy Grade 1A, (pressure, vacuum, or compound), 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. Provide brass pigtail syphon for steam gages.

C. Range of Gages: For services not listed provide range equal to at least 130 percent of normal operating range:

Low pressure steam to 103 kPa(15 psig)	0 to 207 kPa (30 psig).
Medium pressure steam nominal 413 kPa (60 psig)	0 to 689 kPa (100 psig).
High pressure steam nominal 620 kPa to 861 kPa (90 to 125 psig)	0 to 1378 kPa (200 psig).

2.12 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 COTR:
   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, , 762 mm (30 inches) Hg to 689 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.

2.13 FIRESTOPPING MATERIAL

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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, fan-coils, coils, radiators, 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 AND STEAM GENERATION. Install convertors and other heat exchangers 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 steam, condensate and 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. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:

1. Water treatment pot feeders and condenser water treatment systems.
2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

I. 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.

J. Where copper piping is connected to steel piping, provide dielectric connections.

K. Pipe vents to the exterior. Where a combined vent is provided, the cross sectional area of the combined vent shall be equal to sum of individual vent areas. Slope vent piping one inch in 40 feet (0.25 percent) in direction of flow. Provide a drip trap elbow on relief valve outlets if the vent rises to prevent backpressure. Terminate vent mimimum 0.3 m (12 inches) above the roof or through the wall minimum 2.5 m (8 feet) above grade with down turned elbow.

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 AND STEAM GENERATION.

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. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.

D. Solvent Welded Joints: As recommended by the manufacturer.

3.3 STEAM TRAP PIPING

Install to permit gravity flow to the trap. Provide gravity flow (avoid lifting condensate) from the trap where modulating control valves are used. Support traps weighing over 11 kg (25 pounds) independently of connecting piping.

3.4 DRIPS AND TRAPS

A. All drops, elbows, and low points in steam lines shall contain drip pockets with steam trap assemblies, dirt legs, and drains on dirt legs. It is the contractor’s responsibility to coordinate and layout these drips and traps. Steam trap layout shall be approved by steam trap manufacturer.

B. All end of steam mains shall have a thermostatic trap installed.

C. All high points in steam system shall have a thermostatic air vent installed.

3.5 SAFETY VALVES, RELIEF VALVES AND SAFETY-RELIEF VALVES

A. Orient valves so that lifting levers are accessible from nearest walkway or access platform. Valves must be removable without requiring disassembling of vents, except where otherwise specifically provided.

B. Provide a drip pan elbow at discharge of each steam or economizer valve with slip joint in vent discharge line, arranged to prevent vent line from imposing any force on valve and to prevent any moisture accumulation in valve. Connected drip pan ell drains to drain piping to floor drain. Provide flexible connector on drain line, adjacent to drip pan ell.

C. Support vent line from above. Each steam valve must have separate vent line to atmosphere unless shown otherwise.

3.6 Y-TYPE STRAINERS ON STEAM SERVICE

A. On steam piping, install with basket level with the steam pipe so that condensate is not trapped in the strainer. Strainers for steam piping shall be on the side of the pipe.

B. Strainers for condensate piping shall be on the bottom of the pipe and oriented properly.

3.4 SEISMIC BRACING

Provide is accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 LEAK TESTING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COTR. Tests may be either of those below, or a combination, as approved by the COTR.

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. Avoid excessive pressure on mechanical seals and safety devices.

3.6 FLUSHING AND CLEANING PIPING SYSTEMS

A. Steam, Condensate and Vent Piping: No flushing or chemical cleaning required. Accomplish cleaning by pulling all strainer screens and cleaning all scale/dirt legs during start-up operation.

3.7 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 COTR, for instructing VA operating personnel.

3.8 OPERATING AND PERFORMANCE TEST AND INSTRUCTION

A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

B. Adjust red set hand on pressure gages to normal working pressure.

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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.

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 AND STEAM GENERATION.

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 AND STEAM GENERATION.

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.

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.

1.5 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. National Fire Protection Association (NFPA):

70-05 .....National Electric Code (NEC)

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 EQUIPMENT AND MATERIALS IDENTIFICATION

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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. Install PVC injection nozzles with corporation stops in the water piping serving the cooling tower downstream of the heat source.

5. Provide Schedule 80 PVC piping for corrosion monitor rack per manufacturer's installation instructions. Provide PVC ball valves to isolate and service rack.
6. Provide Schedule 80 PVC piping for erosion chemical feeder per manufacturer's installation instructions. Provide PVC ball valves to isolate and service feeder.
7. 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.

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. Seismic Reinforcing: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

D. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

E. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

F. Duct Insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION

G. Plumbing Connections: Section 22 11 00, FACILITY WATER DISTRIBUTION

H. Air Flow Control Valves and Terminal Units: Section 23 36 00, AIR TERMINAL UNITS.

I. Duct Mounted Coils: Section 23 82 16, AIR COILS.

J. Supply Air Fans: Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

K. Return Air and Exhaust Air Fans: Section 23 34 00, HVAC FANS.

L. Air Filters and Filters' Efficiencies: Section 23 40 00, HVAC AIR CLEANING DEVICES.

M. Duct Mounted Instrumentation: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

N. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

O. 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 AND STEAM GENERATION.

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. Duct liner.
   c. Sealants and gaskets.
   d. Access doors.
2. Round and flat oval duct construction details:
   a. Manufacturer's details for duct fittings.
   b. Duct liner.
   c. Sealants and gaskets.
   d. Access sections.
   e. Installation instructions.
3. Volume dampers, back draft dampers.
4. Upper hanger attachments.
5. Fire dampers, fire doors, and smoke dampers with installation instructions.
6. Sound attenuators, including pressure drop and acoustic performance.

7. Flexible ducts and clamps, with manufacturer's installation instructions.
8. Flexible connections.
9. Instrument test fittings.
10. 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 AND STEAM GENERATION.

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

96-01.....Ventilation Control and Fire Protection of Commercial Cooking Operations

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

6th Edition - 1992.....Fibrous Glass Duct Construction Standards

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: 750 Pa (3 inch) W.G.

C. Seal Class: As shown on the drawings and in accordance with SMACNA HVAC Air Duct Leakage Test Manual.

D. Round 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 COTR.

E. Casings and Plenums: Construct in accordance with SMACNA HVAC Duct Construction Standards Section 6, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 500 mm (20 inches) wide by 1200 - 1350 mm (48 - 54 inches) high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.

F. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA Detail Figure 2-12 for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.

G. Duct Hangers and Supports: Refer to SMACNA Standards Section IV. Avoid use of trapeze hangers for round duct.

2.3 DUCT LINER

A. Duct liner shall not be used.

2.4 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 and humidifier.
2. Each fire damper (for link service), smoke damper and automatic control damper.
3. Each duct mounted smoke detector.
4. For cleaning operating room supply air duct and kitchen hood exhaust duct, locate access doors at 6 m (20 feet) intervals and at each change in duct direction.

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).

2.5 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 in wet air exhaust shall be of stainless steel construction, all others may be 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.

2.6 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 pneumatic or electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

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 SEISMIC RESTRAINT FOR DUCTWORK

Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

2.11 THERMOMETER (AIR)

Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

2.12 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.

2.13 AIR FLOW CONTROL VALVES (AFCV)

Refer to Section 23 36 00 / 23 82 00, AIR TERMINAL UNITS / CONVECTION HEATING AND COOLING UNITS.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, 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. Duct hangers shall be in strict accordance with Figure 4.4 of SMACNA HVAC Duct Construction standards metal & flexible, 2nd Edition except that hanger wire shall not be used to support duct or equipment and hangers that require penetration of duct with bolts, rivets, screws, wires, or an other fastener shall not be used.

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. Low Pressure Duct Liner: Install in accordance with SMACNA, Duct Liner Application Standard.

K. 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 COTR. 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.

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.

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 COTR and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the COTR 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 COTR.

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 AND STEAM GENERATION

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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 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

E. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

F. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

G. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.

H. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

I. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

1.3 QUALITY ASSURANCE

A. Refer to paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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:

1. 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:

1. The fan schedule shows cubic meters per minute (CFM) and design static pressure. Scheduled fan motors, 0.37 kW (l/2 horsepower) and larger, are sized for design cubic meters per minute (CFM) at ll0 percent design static pressure, but not to exceed 185 Pa (3/4-inch) additional pressure.

2. Provide fans and motors capable of stable operation at design conditions and at ll0 percent pressure as stated above.

3. Lower than design pressure drop of approved individual components may allow use of a smaller fan motor and still provide the safety factor. When submitted as a deviation a smaller motor may be approved in the interest of energy conservation. The contractor shall be responsible for making necessary changes to the electrical system.
4. Select fan operating point as follows:
   a. Forward curved and axial fans: Right hand side of peak pressure point.
   b. Airfoil, backward inclined or tubular: Near the peak of 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:
1. 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 meters per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation and at 110 percent of design static pressure. Include product application data to indicate the effect of capacity control devices such as inlet vane dampers on flow, pressure and kW (horsepower).

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. Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA):

9-00.....Load Ratings and Fatigue Life for Ball Bearings

C. Air Movement and Control Association International, Inc. (AMCA):

99-86.....Standards Handbook

210-01.....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

261-98.....Directory of Products Licensed to bear the AMCA Certified Ratings Seal - Published Annually

300-96.....Reverberant Room Method for Sound Testing of Fans

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

B117-03.....Standard Practice for Operating Salt Spray (Fog) Apparatus

D1735-02.....Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus

D3359-02.....Standard Test Methods for Measuring Adhesion by Tape Test

G152-01.....Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Non-Metallic Materials

G153-01.....Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Non-Metallic Materials

E. National Fire Protection Association (NFPA):

NFPA 96-02.....Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

F. National Sanitation Foundation (NSF):

37-02.....Air Curtains for Entrance Ways in Food and Food Service Establishments

G. Underwriters Laboratories, Inc. (UL):

181-96.....Factory Made Air Ducts and Air Connectors

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. Construction: Wheel diameters and outlet areas shall be in accordance with AMCA standards.

1. 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") 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 B10 life of not less than 40,000 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. Furnish one additional complete set of belts for each belt-driven fan.
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 AND STEAM GENERATION 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 AND STEAM GENERATION for controller/motor combination requirements.

C. In-line Centrifugal Fans: In addition to the requirements of paragraphs A and C, provide inlet and outlet flanges, bolted access door and arrangement 1, 4 or 9 supports as required.

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. 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 proper operation of motor, drive system and fan wheel.

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, air flow control valves.

1.2 RELATED WORK

A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for equipment.

B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements and items, which are common to more than one section of Division 23.

C. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise requirements.

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 AND STEAM GENERATION.

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.
2. Air flow control valves.

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):

880-98.....Air Terminals

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 Section 00 72 00, GENERAL CONDITIONS.

PART 2 - PRODUCTS

2.1 AIR TERMINAL UNITS (BOXES)

A. General: Factory built, pressure independent units, factory set-field adjustable air flow rate, suitable for single or dual duct applications, as indicated. 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 assume 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.

B. Rating and Performance Certification: ARI Industry Standard 880.

1. Maximum pressure drop: As shown on the drawings.
2. Maximum room sound levels: Not to exceed criteria stated in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT unless shown otherwise on drawings. Provide terminal sound attenuators where necessary to comply with the noise criteria. Sound tests and correction of deficiencies is specified in Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

C. Casing: Unit casing shall be constructed of galvanized steel not lighter than 0.85 mm (22 gauge) or aluminum sheet not lighter than 1 mm (0.040 IN). Casing of units serving surgery area shall be of aluminum. 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. Insulation shall consist of 13mm (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. Comply with UL Standard 181 for erosion. Surfaces, including all edges, shall be faced with perforated metal or coated so that the air stream will not detach material. No lining material is permitted in the boxes serving surgery areas.

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 747 pa (3 IN WG), with all outlets sealed shut and inlets fully open.

D. Construct dampers and other internal devices of corrosion resisting materials which do not require lubrication or other periodic maintenance. The dampers and other internal or external devices for boxes serving surgery area shall be of stainless steel or aluminum:
   1. Damper Leakage: Not greater than 2 percent of maximum rated capacity, when closed against inlet static pressure of 1kPa (4-inch WG).

E. Provide multi-point velocity pressure sensors with external pressure taps.
   1. Provide direct reading air flow rate table pasted to box.

F. Provide static pressure tubes.

G. Factory calibrate air terminal units to air flow rate indicated. All settings including maximum and minimum air flow shall be field adjustable.

H. Provide sound attenuators where scheduled. Attenuators to be as specified in Section 23 31 00, HVAC DUCTS AND CASINGS.

I. Heating coils for air terminal units: ARI certified, continuous plate or spiral fin type, leak tested at 2070 kPa (300 PSI).
   1. Capacity: As indicated, based on scheduled entering water temperature.
   2. Headers: Copper or Brass.
   3. Fins: Aluminum, maximum 315 fins per meter (8 fins per IN).

4. Tubes: Copper, arrange for counter-flow of heating water.
5. Water velocity: 2.4 m/s (8 FPS) maximum with head loss not greater than indicated.
6. Provide vent and drain connection at high and low point, respectively of each coil.
7. Coils shall be guaranteed to drain.

J. 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.

K. Terminal Sound Attenuators: Construction shall be similar to sound attenuators in Section 23 31 00, HVAC DUCTS AND CASINGS.

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.

3.2 OPERATIONAL TEST

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Air outlets and inlets, including the following:

1.2 RELATED WORK

A. Outdoor and Exhaust Louvers: Section 08 90 00, LOUVERS AND VENTS.

B. Seismic Reinforcing: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

C. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

D. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

E. 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 AND STEAM GENERATION.

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 AND STEAM GENERATION.

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):

ASCE7-98.....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

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. Underwriters Laboratories, Inc. (UL):

33-93.....UL Standard for Safety Heat Responsive Links for Fire Protection Service

PART 2 - PRODUCTS

2.1 EQUIPMENT SUPPORTS

Refer to Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

2.2 AIR OUTLETS AND INLETS

A. Materials:

1. Steel or aluminum. 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. Louver face type: Square or rectangular, removable core for 1, 2, 3, or 4 way directional pattern. Provide equalizing or control grid and opposed blade damper.
   c. 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.
   d. Slot diffuser/plenum:
      1) Galvanized steel boot lined with 13 mm (1/2 inch) thick fiberglass conforming to NFPA 90A and complying with UL 181 for erosion. Form slots or use adjustable pattern controllers, to provide stable, horizontal air flow pattern over a wide range of operating conditions.
      2) Provide inlet connection diameter equal to duct diameter shown on drawings or provide transition coupling if necessary.
      3) Maximum pressure drop at design flow rate: 37 Pa (0.15 inch) W.G.
2. Linear Grilles and Diffusers: Extruded aluminum, manufacturer's standard finish, and positive holding concealed fasteners.
   a. Margin: 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. 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. 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. 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. Grid Core Type: 13 mm by 13 mm (1/2 inch by 1/2 inch) core with 30 mm (1-1/4 inch) margin.
5. Linear Type: To match supply units.
6. Door Grilles: Are furnished with the doors.
7. Filter Grilles: Standard face hinged to a mounting frame with space for a 25 mm (one inch) throwaway filter. Hold face closed by a locking screw. Provide retaining clips to hold filter in place. Provide one inch thick fiberglass throwaway filter.
8. Operating Room: Stainless steel return registers, material and finish to match supply side.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, particularly regarding coordination with other trades and work in existing buildings.

B. 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 COTR. 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 AND STEAM GENERATION

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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 AND STEAM GENERATION.

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 COTR, 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. 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 in any of the 12 channels 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 Supplier Warranty for Extended Surface Filters: Guarantee the filters against leakage, blow-outs, and other deficiencies during their normal useful life. Defective filters shall be replaced at no cost to the Government.

C. Comply with UL Standard 586 for flame test.

D. Filters shall maintain minimum initial efficiency after 6 weeks in service.

E. Nameplates: Each filter shall bear a label or name plate indicating manufacturer's name, filter size, rated efficiency, UL classification.

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. Magnehelic gages.

C. Air Filter performance reports.

D. Suppliers warranty.

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):

52.1-92.....Gravimetric and Dust-Spot procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter

52.2-99.....Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

C. American Society of Mechanical Engineers (ASME):
NQA-1-02.....Quality Assurance Requirements for Nuclear Facilities Applications

D. Underwriters Laboratories, Inc. (UL):
586-00.....High-Efficiency, Particulate, Air Filter Units
900-99.....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 additional (replacement) filter elements.

B. The COTR 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:

1. Grade A: 90-95 after-filter, when handling 0.3 to 1.0 micron particles.
2. Grade B: 80-85 after-filter, when handling 0.3 to 1.0 micron particles.
3. Grade D: 25-30 pre-filter, when handling 3.0 to 10.0 micron particles.

D. Filter Media:

1. Grade A, B and C 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. Grade D (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. Atmospheric dust spot efficiency and synthetic dust weight arrestance shall not be less than the following:

Filter Efficiency, Arrestance and MERV Value				
	Percentage of Initial Efficiency	Percentage of Average Efficiency	Percentage of Average Arrestance	MERV Value
Grade A	75.4	86.4	99.0	14
Grade B	58.0	79.0	98.0	13
Grade D	Less than 20.0	22.0	89.0	7

F. Maximum initial and final resistance, Pa (inches of water), for each filter cartridge when operated at 150 m/min (500 feet per minute) face velocity:

Filter Initial and Final Resistance		
	Initial Resistance	Final Resistance
Grade A (Rigid Pleated)	185 (0.74)	300 (1.20)
Grade B (Rigid Pleated)	150 (0.60)	300 (1.20)
Grade D (2-inch deep)	80 (0.32)	250 (1.0)

G. Minimum Media Area: The minimum net effective media area in square meter (square feet) for each 600 mm by 600 mm (24 inches by 24 inches) (face area) filter at 150 m/min (500 fpm) face velocity shall be at least the values listed below. For other filter sizes the net effective media area shall be proportionally higher or lower.

Filter Media Area	
Grade A (Rigid Pleated), 300 mm (12 inch) deep	5.3 (57.0)

Grade B (Rigid Pleated) 300 mm (12 inch) deep	5.3 (57.0)
Grade D 50 mm (2 inch deep)	1.4 (14.8)

H. Side Servicing Housings:
   1. Minimum 1.6 mm (16 gage 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 skin insulated, at each end of the housing with continuous gasketing on the perimeter and positive locking devices. Design doors to withstand a minimum positive/negative 1.0 kPa (four inches of water) static pressure.
   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.

I. Magnehelic Differential Pressure Filter Gages: Nominal 100 mm (four inch) diameter, zero to 500 Pa (zero to two inch water gage) range, flush mounted in aluminum panel board, complete with static tips, copper or aluminum tubing, and accessory items to provide zero adjustment. Provide one gage for each extended surface filter section. Provide Petcocks for each gauge.

J. Equipment Identification: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supports, filters and gages in accordance with manufacturer's instructions.

3.2 START-UP AND TEMPORARY USE

A. Clean and vacuum air handling units and plenums to the satisfaction of the COTR prior to starting air handling systems.

B. Install or deliver replacement filter units as directed by the COTR.

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SECTION 23 64 00
PACKAGED WATER CHILLERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scroll air-cooled chillers with complete accessories.

1.2 RELATED WORK

A. Section 00 72 00, GENERAL CONDITIONS.

B. Section 01 00 00, GENERAL REQUIREMENTS.

C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

F. Section 23 21 23, HYDRONIC PUMPS.

G. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

H. Section 23 21 13, HYDRONIC PIPING.

I. Section 23 31 00, HVAC DUCTS AND CASINGS

J. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.

K. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 DEFINITION

A. 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.

B. BACNET: Building Automation Control Network Protocol, ASHRAE Standard 135.

C. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.

D. FTT-10: Echelon Transmitter-Free Topology Transceiver.

E. 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.

F. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication.

G. LonWorks: Network technology developed by the Echelon Corporation.

1.4 QUALITY ASSURANCE

A. Refer to Paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, and comply with the following.

B. Refer to PART 3 herein after and Section 01 00 00, GENERAL REQUIREMENTS for test performance.

C. Comply with ARI requirements for testing and certification of the chillers.

D. Refer to paragraph, WARRANTY, Section 00 72 00, GENERAL CONDITIONS, except as noted below:

1. A 5-year motor/transmission/compressor warranty shall be provided based upon the RPM of the compressor as follows:

Compressor RPM	Warranty Term
0-5000	1 year from start up
5001-10,000	5 years from start up
10,001 and above	5 years plus annual oil analysis

2. A 5-year parts and labor warranty shall be provided on any reciprocating compressor.

E. Refer to OSHA 29 CFR 1910.95(a) and (b) for Occupational Noise Exposure Standard.

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 Refrigeration Institute (ARI):

210/ 240-03 .....Unitary Air Conditioning and Air-Source Heat Pump Equipment

370-01 .....Sound Rating of Large Outdoor Refrigerating and Air-Conditioning Equipment

495-99 .....Refrigerant Liquid Receivers

550/590-03 .....Standard for Water Chilling Packages Using the Vapor Compression Cycle

575-94 .....Methods for Measuring Machinery Sound within Equipment Space

C. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

15-02 .....Safety Standard for Mechanical Refrigeration Systems

3-96 .....Guidelines for Reducing Emission of Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems

D. American Society of Mechanical Engineers (ASME):

1998 .....ASME Boiler and Pressure Vessel Code, Section VIII, "Rules for Constructive Pressure Vessels"

E. American Society of Testing Materials (ASTM):

C 534-03.....Preformed, Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

C 612-04.....Mineral-fiber Block and Board Thermal Insulation

F. National Electrical Manufacturing Association (NEMA):

250-03 .....Enclosures for Electrical Equipment (1000 Volts Maximum)

G. National Fire Protection Association (NFPA):

70-05 .....National Electrical Code

H. Underwriters Laboratories, Inc. (UL):

1995-99 ..... Heating and Cooling Equipment

1.6 SUBMITTALS

A. Submit in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data.

1. Scroll water chillers, including motor starters, control panels, and vibration isolators, and remote condenser data shall include the following:
   a. Rated capacity.
   b. Pressure drop.
   c. Efficiency at full load and part load without applying any tolerance indicated in the ARI 550/590/Standard.
   d. Refrigerant.
   e. Fan performance.
   f. Accessories.
   g. Installation instructions.
   h. Start up procedures.
   i. Wiring diagrams, including factor-installed and field-installed wiring.
   j. Noise data report. Manufacturer shall provide noise ratings. Noise warning labels shall be posted on equipment.
   k. Water storage tank volume and flow diagram.
   l. Duplex pump performance, flow rate, head pressure vs. flow curve.

C. Maintenance and operating manuals for each piece of equipment in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

D. Run test report for all chillers.

E. Product Certificate: Signed by chiller manufacturer certifying that chillers furnished comply with ARI requirements. The test report shall include calibrated curves, calibration records, and data sheets for the instrumentation used in factory tests.

F. Provide seismic restraints for refrigeration equipment to withstand seismic forces.

PART 2 - PRODUCTS

2.1 SCROLL WATER CHILLERS

A. General: Factory- assembled and-tested reciprocating, rotary-screw, or scroll water chillers, complete with evaporator, compressors, motor, starters, integral condenser, integral baffled storage tank, integral operating and stand by circulating pumps, digital control interface for interaction with central ECC, GFI convenience outlet, low sound package option, and controls mounted on a welded steel base. The chiller unit shall consist of two compressors minimum, but not more than eight, mounted on a single welded steel base. Where compressors are paralleled, not more than two shall be so connected and not less than two independent refrigerant circuits shall be provided. Chiller shall be capable of operating with any of the refrigerants, HCFC-134a, HCFC-407c, or HCFC-410a.

B. Applicable Standard: Chillers shall be rated and certified according to ARI 550/590, and shall be stamped in compliance with ARI certification.

C. Compressor (Scroll Type): Three dimensional, positive-displacement, hermetically sealed design, with suction and discharge valves, crankcase oil heater and suction strainer. Compressor shall be mounted on vibration isolators. Rotating parts shall be factory balanced. Lubrication system shall consist of reversible, positive displacement pump, strainer, oil level sight glass, and oil charging valve. Capacity control shall be by on-off compressor cycling of single and multiple compressors and turndown with a digital scroll.

D. Refrigerants Circuit: Each circuit shall contain include an expansion valve, refrigerant charging connections, hot-gas muffler, compressor suction and discharge shutoff valves, replaceable-core filter drier, sight glass with moisture indicator, liquid-line solenoid valve and insulated suction line.

E. Refrigerant and Oil: Sufficient volume of dehydrated refrigerant and lubricating oil shall be provided to permit maximum unit capacity

operation before and during tests. Replace refrigerant charge lost during the warranty period, due to equipment failure, without cost to the Government.

F. Condenser: Air-cooled as shown on the drawings and specified hereinafter.

G. Evaporator: Shell and tube design with seamless copper tubes roller expanded into tube sheets. Designed, tested, and stamped in accordance with applicable portions of ASME Boiler and Pressure Vessel Code, Section VIII, for working pressure produced by the water system, but not less than 1035 kPa (15 psig). Refrigerant side working pressure shall comply with ASHRAE Standard 15. Shell shall be constructed of carbon steel. For the waterside of liquid cooler the performance shall be based on a water velocity not less than 1 m/s (3 fps) and a fouling factor 0.0000176 m^2 degrees C (0.0001 hr. sq. ft.) degrees F/Btu. Evaporator shall be factory insulated. Evaporator for packaged air-cooled chiller units designed for outdoor installation shall be protected against freeze-up in ambient temperature down to -30 degrees C (-20 degrees F) by a resistance heater cable under insulation with thermostat set to operate below 3 degrees C (37 degrees F) ambient.

H. Refrigerant Receiver: Provide a liquid receiver for chiller units when system refrigerant charge exceeds 80 percent of condenser refrigerant volume. Liquid receivers shall be horizontal-type, designed, fitted, and rated in conformance with ARI 495. Receiver shall be constructed and tested in conformance with Section VIII D1 of the ASME Boiler and Pressure Vessel Code. Each receiver shall have a storage capacity not less than 20 percent in excess of that required for fully charged system. Each receiver shall be equipped with inlet, outlet drop pipes, drain plug, purging valve, and relief devices as required by ASHRAE Standard 15.

I. Controls: Chiller shall be furnished with unit mounted, stand-alone, microprocessor-based controls in NEMA 4 enclosure, hinged and lockable, factory wired with a single point power connection and separate control circuit. The control panel provide chiller operation, including monitoring of sensors and actuators, and shall be furnished with light emitting diodes or liquid-crystal display keypad.

1. Following shall display as a minimum on the panel:
    a. Date and time.
    b. Outdoor air temperature.
    c. Operating and alarm status.
    d. Entering and leaving water temperature-chilled water.

e. Operating set points-temperature and pressure.
f. Refrigerant temperature and pressure.
g. Operating hours.
h. Number of starts.
i. Current limit set point.
j. Maximum motor amperage (percent).

2. Control Functions:
   a. Manual or automatic startup and shutdown time schedule.
   b. Condenser water temperature.
   c. Entering and leaving chilled water temperature and control set points.
   d. Automatic lead-lag switch.
   e. Cooler heater for freeze protection.
3. Safety Functions: Following conditions shall shut down the chiller and require manual reset to start:
   a. Loss of chilled water flow.
   b. Low chilled water temperature.
   c. Compressor motor current-overload protection.
   d. Starter fault.
   e. High or low oil pressure.
   f. Recycling pumpdown.

J. The chiller control panel shall provide leaving chilled water temperature reset based on signal from Energy Control Center (ECC) based on leaving chilled water coil air temperature.

K. Provide contacts for remote start/stop, alarm for abnormal operation or shutdown, and for Engineering Control Center (ECC).

L. Chiller control panel shall either reside on the "LonTalk FTT-10a network", and provide data using LonMark standard network variable types and configuration properties, or BACnet interworking using ARCNET or MS/TP physical data link layer protocol for communication with building automation control system.

M. Auxiliary hydronic system and the chiller(s) shall be interlocked to provide time delay and start sequencing as indicated on control drawings.

N. Motor: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Compressor motor furnished with the chiller shall be in accordance with the chiller manufacturer and the electrical specification Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT. Starting torque of motors shall be suitable for driven machines.

O. Motor Starter: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Provide a starter in NEMA I enclosure, designed for floor or unit mounted chiller using multiple compressors, with the lead compressor starting at its minimum capacity may be provided with across-the-line starter. See Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for additional requirements.

P. Integral baffled storage tank: A baffled storage tank located within the footprint of the chiller unit shall have a volume of at least 200 gallons. It shall have baffles to ensure proper mixing within tank.

Q. Integral duplex circulating pumps: Two circulating pumps shall be integral to the chiller unit footprint. These pumps shall be operating and standby with internally controlled lead/lag operation with the lead pump switching on a regular schedule to even out run times. The power for the pumps shall be integral to the single power point connection for the chiller.

R. Integral expansion tank: The expansion tank for the chilled water system shall have the volume and acceptance at least equal to or greater than indicated on the Drawings. The tank shall be located within the footprint of the chiller unit.

S. Cooler Heater: For freeze protection shall be factory installed and not require a separate power feed.

PART 3 – EXECUTION

3.1 EXAMINATION

Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, piping and electrical to verify actual locations and sizes before chiller installation and other conditions that might effect chiller performance, maintenance, and operation.

Equipment locations shown on drawings are approximate. Determine exact locations before proceeding with installation.

3.2 EQUIPMENT INSTALLATION

A. Install chiller on concrete base with isolation pads or vibration isolators.

1. Concrete base is specified in Section 03 30 00, CAST-IN-PLACE CONCRETE
2. Vibration isolator types and installation requirements are specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT

3. Anchor chiller to concrete base according to manufacturer's written instructions and for seismic restraint on vibration isolators.
4. Charge the chiller with refrigerant, if not factory charged.
5. Install accessories and any other equipment furnished loose by the manufacturer, including remote starter, remote control panel, and remote flow switches, according to the manufacturer written instructions and electrical requirements.
6. Chillers shall be installed in a manner as to provide easy access for tube pull and removal of compressor and motors etc.

B. Install thermometers and gages as recommended by the manufacturer and/or as shown on drawings.

C. Piping Connections:

1. Make piping connections to the chiller for chilled water, with vibration eliminators and isolation valves and other connections as necessary for proper operation and maintenance of the equipment.

3.3 STARTUP AND TESTING

A. Engage manufacturer's factory-trained representative to perform startup and testing service.

B. Inspect, equipment installation, including field-assembled components, and piping and electrical connections.

C. After complete installation startup checks, according to the manufacturers written instructions, do the following to demonstrate to the VA that the equipment operate and perform as intended.

1. Check refrigerant charge is sufficient and chiller has been tested for refrigerant leak.
2. Check bearing lubrication and oil levels.
3. Verify proper motor rotation.
4. Verify pumps associated with chillers are installed and operational.
5. Verify thermometers and gages are installed.
6. Operate chiller for run-in-period in accordance with the manufacturer's instruction and observe its performance.
7. Check and record refrigerant pressure, water flow, water temperature, and power consumption of the chiller.

8. Test and adjust all controls and safeties. Replace or correct all malfunctioning controls, safeties and equipment as soon as possible to avoid any delay in the use of the equipment.
9. Prepare a written report outlining the results of tests and inspections, and submit it to the VA.

D. Engage manufacturer's certified factory trained representative to provide training for 2 hours for the VA maintenance and operational personnel to adjust, operate and maintain equipment.

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SECTION 23 72 00

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

This Section specifies rotary air-to-air heat exchanger, air-to-air plate heat exchanger.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS: Requirements for pre-test of equipment.

B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural equipment.

C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements and items, which are common to more than one section of Division 23.

D. Section 23 31 00, HVAC DUCTS AND CASINGS: Requirements for sheet metal ducts and fittings.

E. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Requirements for controls and instrumentation.

F. Section 23 05 93, TESTING, ADJUSTING AND BALANCING FOR HVAC: Requirements for testing, adjusting and balancing of HVAC system.

1.3 QUALITY ASSURANCE

A. Refer to paragraph, GUARANTEE in specification Section 00 72 00, GENERAL CONDITIONS.

B. Refer to specification Section 01 00 00, GENERAL REQUIREMENTS for performance tests and instructions to VA personnel.

C. Refer to paragraph QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

D. Performance Criteria: Heat recovery equipment shall be provided by a manufacturer who has been manufacturing such equipment and the equipment has a good track record for at least 5 years.

E. Performance Test: In accordance with PART 3.

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. Rotary Heat Exchanger

C. Certificate: Submit, simultaneously with shop drawings, an evidence of satisfactory service of the equipment on three similar installations.

D. Submit type, size, arrangement and performance details. Present application ratings in the form of tables, charts or curves.

E. Provide installation, operating and maintenance instructions, in accordance with Article, 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)

ARI 1060-2005.....Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Heat Equipment

C. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

15-07.....Safety Standard for Refrigeration Systems (ANSI)

52.1-92.....Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

52.2-07.....Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

84-91.....Method of Testing Air-to-Air Heat Exchangers

D. American Society for Testing and materials (ASTM)

D635-06.....Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

E84-07.....Standard Test Method for Surface Burning Characteristics of Building Materials

E. Underwriters Laboratories, Inc (UL)

1812-95 (Rev. 2006).....Standard for Ducted Heat Recovery Ventilators

PART 2 - PRODUCTS

2.1 ROTARY AIR-TO-AIR HEAT EXCHANGER:

A. Exchanger Rotor or Wheel: Aluminum transfer media with a flame spread rating of not more than 25 and smoke developed rating of not more than 50 and independently tested in accordance with ASTM standard E-84. Rotor media shall be independently tested in accordance with ASHRAE

Standard . It shall allow laminar flow (but not radial) at usual velocities and prevent leakage, bypassing and cross contamination by cross flow within wheel. Size the transfer media to allow passage of 300 micrometers particles without fouling or clogging. Treat media with non-degrading silica-gel desiccant coating that is bacteriostatic, non-corroding and non-toxic. No asbestos material will be allowed. Wheel shall not condense water directly or require a condensate drain for summer or winter operation. Performance rating shall be in accordance with ARI Standard 1060.

B. Rotor: Polymer segmented wheel strengthened with radial spokes impregnated with non-migrating, water-selected, molecular-sieve desiccant coating.
   1. Maximum Solid Size for media to pass: 500 micrometers.

C. Casings shall be sealed on periphery of rotor as well as on duct divider and purge section. Seals shall be adjustable, of extended life materials and effective in limiting air leakage.

D. Wheel shall be supported by ball or roller bearings and belt driven by a fractional horsepower, totally enclosed, NEMA Standard motor through a close coupled positively lubricated speed reducer, or gear/chain speed reduction.
   1. Motors for constant speed wheel shall be an AC motor.
   2. Variable-speed exchanger wheels shall have exchanger wheel speed and leaving-air temperature controlled by means of a variable-speed motor controller. Operation shall be from 115/1/60 and by a proportioning temperature controller which shall vary output voltage of a silicon controlled rectifier (SCR) to a rectified power motor which will change speed in proportion to changes of voltage to its armature. Automatic changeover for summar-winter operations shall be controlled by an adjustable thermoswitch. Set point of adjustable proportioning temperature controller and thermoswitch shall be indicated on visible scale. System shall be capable of speed reduction down to 5 percent of capacity while maintaining adequate torque at any point of operation to rotate wheel.

E. An automatic, factory-fabricated, field-adjustable purge unit shall limit exhaust air carry-over to less than 1.0 percent of rated volume. Purge shall be effective when static pressure difference between supply and exhaust is 125 Pa (one-half, inch wg) or greater, and it shall have provision for restriction or adjustment to limit purge air volume to

not over five percent of rated air flow when a static pressure difference up to 2.5 kPa (10 inch wg) exists.

F. Unit shall be constructed of heavy gage steel to insure rigidity and stability. Casing side panels shall be removable to insure easy access to internal parts and have integral flanges for flanged duct connection and lifting holes or lugs.

G. Controls starting relay shall be factory mounted and wired, and include a manual motor starter for field wiring.

H. Filters Disposable Panel Filters: Comply with NFPA 90A.

1. Minimum Arrestance: According to ASHRAE 52.1
2. Minimum Efficiency Reporting Value (MERV): According to ASHRAE 52.2.
3. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
4. Flat-Panel Type: Factory-fabricated, viscous-coated, 50 mm (2 inches).
5. MERV (According to ASHRAE 52.2): 7.
6. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
7. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

2.2 AIR FILTERS

Air Filters: MERV rating of 7, as indicated on the drawings. Comply with requirements in specification Section 23 40 00, HVAC AIR CLEANING DEVICES.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow the equipment manufacturer's instructions for handling and installation, and setting up of ductwork for makeup and exhaust air steamers for maximum efficiency.

B. Rotary Air-to-Air Exchanger: Adjust seals and purge as recommended by the manufacturer. Verify correct installation of controls.

C. Seal ductwork tightly to avoid air leakage.

D. Install units with adequate spacing and access for cleaning and maintenance of heat recovery coils as well as filters.

E. Brace heat recovery equipment installed in projects in the Seismic area according to specification Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.2 FIELD QUALITY CONTROL

A. Operational Test: Perform tests as per manufacturer’s written instructions for proper and safe operation of the heat recovery system.
   1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Adjust seals and purge.
   3. Test and adjust controls and safeties.

B. Replace damaged and malfunctioning controls and equipment.

C. Set initial temperature set points. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Prepare test and inspection reports to the Senior COTR in accordance with specification Section 01 00 00, GENERAL REQUIREMENTS.

3.3 INSTRUCTIONS

Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of heat recovery equipment.

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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 assembly consisting of fan, coils, filters, and other necessary equipment to perform one or more of the following functions of circulating, cleaning, heating, cooling, humidifying, dehumidifying, and mixing of air. Design capacities of units shall be as scheduled on the drawings.

1.2 RELATED WORK

A. Seismic restraints for equipment: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

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 AND STEAM GENERATION.

C. Sound and vibration requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

D. Piping and duct insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

E. Piping and valves: Section 23 21 13 / 23 22 13, HYDRONIC PIPING / STEAM AND CONDENSATE HEATING PIPING.

F. Heating and cooling coils and pressure requirements: Section 23 82 16, AIR COILS.

G. Return and exhaust fans: Section 23 34 00, HVAC FANS.

H. Requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining, and air leakage: Section 23 31 00, HVAC DUCTS AND CASINGS .

I. Air filters and filters' efficiency: Section 23 40 00, HVAC AIR CLEANING DEVICES.

J. HVAC controls: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

K. Testing, adjusting and balancing of air and water flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

L. Types of motors: Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.

M. 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 AND STEAM GENERATION.

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 cubic meter per minute (cubic feet per minute) and design static pressure. Scheduled fan motors, 375 watts (1/2 horsepower) and larger, are sized for the maximum of design cubic meter per minute (cubic feet per minute) at 110 percent design static pressure, but not to exceed 187 Pa (3/4 inch water gage) additional pressure.
2. Fans and motors shall be capable of stable operation at design conditions cubic meters per minute (cubic feet per minute) and 110 percent pressure as stated above.
3. Lower than design pressure drop of approved individual components may allow use of a smaller fan motor and still provide the safety factor. When submitted as a deviation, a smaller motor may be approved in the interest of energy conservation. Such a deviation shall not qualify for any value engineering incentive claim or reward.
4. Select fan operating point to right hand side of peak static pressure point and near the peak of static efficiency.
5. 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.

F. 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. Shipping splits can be provided as required for installation. Lifting lugs will be supplied on each side of the split to facilitate rigging and joining of segments.

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, 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) and rigging points. 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; and 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.
2. Submit sound power levels in each octave band for fan and at entrance and discharge of AHUs at scheduled conditions. Include sound attenuator capacities and itemized internal component attenuation. Internal lining of supply air ductwork with sound absorbing material is not permitted. In absence of sound power ratings refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
3. Provide fan curves showing cubic meters per minute (cubic feet per minute), static pressure, efficiency, and horsepower for design point of operation and at maximum design cubic meters per minute (cubic feet per minute) and 110 percent of design static pressure.
4. 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.

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):

260-01.....Sound Rating of Ducted Air Moving and Conditioning Equipment

410-01.....Standard for Forced-Circulation Air-Heating and Air-Cooling Coils

430-89.....Standard for Central Station Air Handling Units

ARI-DCAACP.....Directory of Certified Applied Air Conditioning Products

C. Air Moving and Conditioning Association (AMCA):

210-00.....Laboratory Methods of Testing Fans for Rating

D. Anti-Friction Bearing Manufacturer's Association, Inc. (AFBMA):

9-90.....Load Ratings and Fatigue life for Ball Bearings

E. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):

51-01.....Standard, Laboratory Methods of Testing Fans for Rating

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

A653/653M-02.....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

B117-97.....Salt Spray (Fog) Testing

C1071-00.....Thermal and Acoustical Insulation (Mineral Fiber, Duct Lining Material)

D1654-00.....Standard Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

D1735-97.....Water Resistance of Coatings Using Water Fog Apparatus

D3359-95.....Standard Test Methods for Measuring Adhesion by Tape Test

E84-01.....Surface Burning Characteristics of Building Materials

G. Anti-Friction Bearing Manufacturer's Association, Inc. (AFBMA):

9-90.....Load Ratings and Fatigue life for Ball Bearings

H. Military Specifications (Mil. Spec.):

DOD-P-21035A-77.....Paint, High Zinc Dust Content, Galvanizing Repair

I. National Fire Protection Association (NFPA):

90A-99.....Installation of Air Conditioning and Ventilating Systems

PART 2 - PRODUCTS

2.1 AIR HANDLING UNITS

A. General:

1. AHUs shall be entirely of double wall galvanized steel construction. 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 inches water gage) or higher.

B. Base:

1. Provide a heavy duty steel base for supporting all AHU major 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 trap.
2. AHUs shall be completely self supporting for installation on concrete housekeeping pad, steel support pedestals, or suspended as shown on drawings.
3. The AHU bases not constructed of galvanized material 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 entirely double wall insulated panels, integral of or attached to a structural frame. Construction shall be such that removal of any panel shall not affect the structural integrity of the unit. Casing finished shall meet ASTM B117 125-hour or better salt-spray test (5 percent solution). All casing and panel sections shall be tightly butted and gasketed. No gaps of double wall construction will be allowed where panels bolt to air handling unit structural member. Structural members, not covered by the double wall panels, shall have equivalent insulated double wall construction.
2. Double wall galvanized steel panels shall be minimum 51 mm (2 inches) thick, constructed of minimum 1.3 mm (18 gauge) outer skin and 1.0 mm (20 gauge) solid or perforated inner skin. Perforated panels (inner skin) are not allowed in cooling coil sections, floors, door panels and where solid sheet is required to avoid air bypass.
3. Blank-Off: Provide where required to insure no air bypass between sections, through perforated panels or around coils or filters. Blank-Off shall be installed at each component of the air handling unit and also at the internal panels to prevent recirculation of the air through perforated panels. Seal any holes where bypass occurs.
4. Insulation: High density, insulation shall be encased in double-wall casing between exterior and interior panels such that no insulation can erode to the air stream. Insulation shall be 50 mm (2 inch) thick, 24 kg/m^3 and (1.5 lb/ft^3) with a thermal conductivity R of approximately 13.8 W/m.K (8.0 BTU/hr-ft^2 ^oF). Air handling units with less than 50 mm (2 inch) of insulation in any part of the walls, floor, roof or drain pan shall not be acceptable. The insulation shall comply with NFPA 90-A for the flame and smoke generation requirements. Also, refer to specification Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
5. Condensation through metal connections between inner and outer panels shall be kept to an absolute minimum.
6. 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.

7. Access Doors: Provide in each access section and where shown on drawings. Doors shall be a minimum of 50 mm (2 inches) 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, humidifier 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 pound) 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 inches water gage).
   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.
8. 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. Painted Exterior Finish: Galvanized steel (G90) exterior shall be mill prepared for painting by bonderizing and factory prepared for prime coat of paint by acid etch cleaning, as required, to assure paint adhesion. Provide factory applied prime coat and enamel finish coat of paint of color selected by owner. Paint corrosion resistance and adhesion shall have satisfactorily passed ASTM B117, D1654, D1735, D3359 and G23 for a minimum of 500 hours. Rating of failure at the scribe mark shall be not less than 6, average creepage not greater than 3 mm (1/8 inch). Rating of the inscribed area shall not be less than 10, no failure. Refer to Section 09 91 00, PAINTING.

E. Floor:

1. Unit floor shall be level without offset space or gap and designed to support a minimum of 488 kg/square meter (100 pounds 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.

F. 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 of double wall construction of 304 stainless steel and have a minimum of 50 mm (2 inch) insulation, and shall be sloped to drain. 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. Drain pan shall be piped to the exterior of the unit, to the nearest sanitary sewer line. Drain pan shall be readily cleanable.
2. Installation, including frame, shall be designed and sealed to prevent blow-by.

G. Fans Sections:

1. Fans shall be minimum Class II construction, plenum fan 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 40,000 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.

H. 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 energy efficient type with efficiencies as shown 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 AND STEAM GENERATION, for additional motor and drive specifications. Where variable speed drives are required they shall be compatible with fan and motor. 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.

I. 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 water gage) and 2.8 cubic meters/min/square meter (9 cfm per square foot) at 995 Pa (4 inches water gage). Electronic damper 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-DIGITAL CONTROL SYSTEM FOR HVAC.

J. 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.

K. 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. Glycol-water 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, including Glycol-Water.

L. Discharge Section: Provide aerodynamically designed framed discharge openings or spun bellmouth fittings to minimize pressure loss.

M. 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 300mm (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. A factory-trained service representative of the manufacturer shall supervise the unit startup and application specific calibration of control components.

B. 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.

C. After the air handling unit is installed and tested, provide startup and operating instructions to VA personnel.

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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. Electrical service entrance equipment (arrangements for temporary and permanent connections to the VA's system) shall conform to the VA's requirements. Coordinate fuses, circuit breakers and relays with the utility’s system, and obtain utility approval for sizes and settings of these devices.

D. 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. 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.
2. 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.
3. 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.
4. 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 VA 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 eight 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 VA 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 VA.

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 switchboards, panelboards, transformers, motor controllers, enclosures, 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 COTR, 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 COTR and VA 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 COTR.

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 VA 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 VA.

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, ballasts, 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 panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, motor control assemblies, control devices 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 Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 1/2 inch [12mm] high. Nameplates shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

1.12 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The VA'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 VA 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. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and/or attached to the equipment.
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 300 mm (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 COTR 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 the high voltage cables.

1.2 RELATED WORK

A. Bedding of conduits: Section 31 20 00, EARTH MOVING.

B. General electrical requirement and items that are common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

C. Conduits for high voltage cables: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES and 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 splice and termination kit information prior to purchase and installation.
3. Provide cable minimum bend radius, and flammability data.

C. Samples:

1. After approval and prior to installation, furnish the COTR with a 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the samples were taken. The sample shall contain the manufacturers markings.

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 COTR. Certified copies of test data shall show conformance with the referenced standards and shall be approved prior to delivery of cable.

2. Field Test Reports: Test Reports on the following shall be in accordance with the paragraph entitled "Field Tests for High Voltage Cables" and include the following tests:
   a. High Potential Tests
   b. Dielectric Absorption Tests
   c. Radiographic Tests

   After testing, submit four certified copies of each of the graphs specified under field testing, to the COTR. Adequate information shall be included identifying the cable locations, types, voltage rating and sizes.
3. Splices and terminations, after having been installed and tested, deliver four copies of a certificate by the Contractor to the COTR 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 splice and each termination was completely installed without any overnight interruption.
   c. A statement that field made splices and 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 will 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 of the materials purchased and installed for the splices and terminations for this contract including the material descriptions, manufacturer's names, catalog numbers and total quantities.

E. VA Approval: Prior to construction, obtain written approval from the VA for the following items:
   1. Service entrance cables. Obtain the VA's written approval on the submittal papers for the cables before submitting them for VA approval.
   2. Employees who will splice and terminate the service entrance cables.
F. Installer Approval:
   1. Employees who install the splices and terminations and test the cables shall have not less than five years of experience splicing and terminating cables which are equal 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.
G. Cable Voltage Ratings
   1. Medium voltage power cables shall include multiple and single-conductor cable rated as follows:
      a) 15000 Volts shall be used on 4160 3-phase 60hz distribution systems.
H. Shipment:
   1. Cable shall be shipped on reels such that cable will be protected from mechanical injury. Each end of each length of cable shall be hermetically sealed and securely attached to the reel.

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 designation only:
   1. American Society for Testing and Materials (ASTM):
   B3-2001.....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
   400.2-2005.....Guide for Field Testing of Shielded Power Cable Systems
   404-2000.....Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500-500,000 Volts
C. National Electrical Manufacturers Association (NEMA):

WC 71-1999.....Standard for Non-Shielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electrical Energy (ICEA S-96-659)

WC 74-2000.....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):

70-2005.....National Electrical Code (NEC)

E. Underwriters Laboratories (UL):

1072-2006 ..... Medium-Voltage Power Cables

PART 2- PRODUCTS

2.1 MATERIAL HIGH VOLTAGE CABLE

A. High voltage cable shall be in accordance with the NEC and NEMA WC71, WC74 and UL 1072.

B. Shall be single conductor stranded copper conforming to ASTM B3.

C. Insulation:

1. Insulation level shall be 133 percent.
2. Types of insulation:
   a. Cable type abbreviation, EPR: Ethylene propylene rubber insulation shall be thermosetting, light and heat stabilized.
   b. Cable type abbreviation, CCLP: Polyethylene insulation shall be thermosetting, light and heat stabilized, chemically crosslinked.
   c. In wet locations, anti-tree CCLP or EPR shall be used.
   d. Cable type abbreviation, XLPE cross-linked polyethylene insulated shielded shall be thermosetting, light and heat stabilized chemically cross-linked.

D. Conductors and insulation shall be wrapped separately with semiconducting tape.

E. Insulation shall be wrapped with non-magnetic, metallic shielding except for cables for series type lighting systems.

F. Heavy duty, overall protective jackets of chlorosulphonated polyethylene, neoprene or polyvinyl chloride shall enclose every cable.

G. Cable temperature ratings for continuous operation, emergency overload operation and short circuit operation shall be not less than the NEC, NEMA WC71 or NEMA WC74 Standard for the respective cable.

H. Manufacturer's name and other pertinent information shall be marked or molded clearly on the overall outside surface of the jackets, or incorporated on marker tapes within the cables at reasonable intervals.

2.2 MATERIAL, SPLICES AND TERMINATIONS

A. The materials shall be compatible with the conductors, insulations and protective jackets on the cables and wires.

B. The splices shall insulate and protect the conductors not less than the insulation and protective jackets on the cables and wires that protect the conductors. In locations where moisture might be present, the splices shall be watertight. In manholes and handholes the splices shall be submersible.

C. Splicing and Terminating Fittings: Shall be in accordance with IEEE 386, 404.

1. Shall be heavy duty, pressure type fittings, which will assure satisfactory performance of the connections under conditions of temperature cycling and magnetic forces from available short circuit currents.
2. The fittings shall be suitably designed and the proper size for the cables and wires being spliced and terminated. Terminations to bus shall be with two hole lugs.
3. Where the VA determines that unsatisfactory fittings have been installed, contractor shall replace the unsatisfactory installations with approved fittings at no additional cost to the VA.

D. Splicing and Terminating Kits:

1. General:
   a. Shall be assembled by the manufacturer or supplier of the materials and shall be packaged for individual splices and terminations or for groups of splices and terminations.
   b. Shall consist of materials designed for the cables being spliced and terminated and shall be suitable for the prevailing environmental conditions.
   c. Shall include detail drawings and printed instructions for each type of splice and termination being installed, as prepared by the manufacturers of the materials in the kits.
   d. Detail drawings, and printed instructions shall indicate the cable type, voltage rating, manufacturer's name and catalog numbers for the materials indicated.

e. Voltage ratings for the splices and terminations shall be not less than the voltage ratings for the cables on which they are being installed.

f. Shall include shielding and stress cone materials.

2. Taped splices and terminations with insulating and semi-conducting rubber tapes shall withstand 200 percent elongation without cracking, rupturing or reducing their electric and self-bonding characteristics by more than 5 percent.

3. Epoxy resin kits shall be as follows:

a. Compatible with the cable insulations and jackets and make the splices watertight and submersible.

b. Thermosetting and generate its own heat so that external fire or heat will not be required.

c. Set solid and cure in approximately 60 minutes in 21 degree C (70 degree F) ambient temperature.

d. Not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.

e. Furnished in pre-measured quantities, sized for each splice and each termination, with two resin components in an easy mixing plastic bag which will permit mixing the resin without entrapping air or contaminants. Other methods of packaging and mixing the epoxy resin components will be considered for approval, provided they include adequate safeguards to assure precise proportioning of the resin components and to prevent entrapping air and contaminants.

f. Use snap-together, longitudinally-split, interlocking seam, transplant mold bodies or taped frameworks, injection fittings and injection gun or pouring equipment. Completely fill voids within the splices and terminations.

E. Pre-molded Rubber Splices and Terminations:

1. Splices and terminations shall be in accordance with IEEE 386, and 404.

2. Pre-molded rubber devices shall have a minimum of 3 mm (0.125 inch) semi-conductive shield material covering the entire housing. Test each rubber part prior to shipment from the factory.

3. Grounding of metallic shields shall be accomplished by a solderless connector enclosed in a watertight rubber housing covering the entire assembly. The grounding device and splice or terminator shall

be of same manufacturer to insure electrical integrity of the shielded parts.

4. The pre-molded parts shall be suitable for indoor, outdoor, submersible, or direct-burial applications.

2.3 MATERIAL, FIREPROOFING TAPE

A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc proof and fireproof.

C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus. It shall be resistant to sunlight and ultraviolet light.

D. The finished application shall withstand a 200 ampere arc for not less than 30 seconds.

E. Securing tape: Shall be glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

2.4 MATERIAL, WARNING TAPE

A. The tape shall be standard, 76 mm (3 inch) wide, 4-Mil polyethylene detectabletype with aluminum backing.

B. The tape shall be red with black letters indicating “CAUTION BURIED ELECTRIC LINE BELOW”.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, and as shown on the drawings.

B. Contractor shall ensure that radii of bends fittings, cable risers, and other conditions are suitable for the cable and conform with the recommendations of the cable manufacturer.

C. Cable shall be installed in underground duct banks, in conduit above and below grade; inside buildings, on insulator hooks; wall in manholes; and by direct burial.

D. Cables shall be secured with heavy duty cable ties in existing or new trays mounted horizontally, where cable rests on tray bottom.

E. Cables shall be secured with PVC coated metallic non-metallic cable clamps, straps, hangers, or other approved supporting devices to manhole walls, ceilings, and in new or existing cable trays mounted vertically, where tray bottom is in a vertical plane.

F. Contractor shall ensure that all cable tray is properly secured and supported prior to installing new armored cable. Contractor shall add new permanent and/or temporary tray support devices as required to preclude cable tray failure during cable pulling or after cable is installed.

G. Cable or conductors of a primary distribution system shall be rejected when installed openly in cable trays or openly racked along interior walls; in the same raceway or conduit with AC/DC control circuits or ac power circuits operating at less than 600 volts; or in a manner allowing cable to support its own weight.

H. Use suitable lubricating compounds on the cables and wires to prevent damage to them during pulling-in. Provide compounds that are not injurious to the cable and wire jackets and do not harden or become adhesive.

I. Splice the cables and wires only in manholes and accessible junction boxes. Ground shields in accordance with Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

J. In manholes, install the cables on suitable porcelain insulators with steel cables racks. Ground cable racks in accordance with Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

K. In manholes, underground raceways and other outdoors locations:

1. Seal the cable ends prior to pulling them in to prevent the entry of moisture.
2. For ethylene propylene rubber and polyethylene insulated cables, use bags of epoxy resin that are not less than 6 mm (1/4 inch) larger in diameter than the overall diameter of the cable. Clean each end of each cable before installing the epoxy resin over it.

3.2 PROTECTION DURING SPLICING OPERATIONS

Blowers shall be provided to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed. Waterproof protective coverings shall be available on the work site to provide protection against moisture while a splice is being made. Pumps shall be used to keep manholes dry during splicing operations. Under no conditions shall a splice or termination be made with the interior of a cable exposed to moisture. Conductor insulation paper shall be moisture-tested before the splice is made. A manhole ring at least 150 mm (6 inches) above ground shall be used around the manhole entrance to keep surface water from entering the manhole. Unused ducts

shall be plugged and water seepage through ducts in use shall be stopped before the splice is started.

3.3 PULLING CABLES IN DUCTS AND MANHOLES

A. Medium-voltage cables shall be pulled into ducts with equipment designed for this purpose, including power-driven winch, cable-feeding flexible tube guide, cable grips, 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 reel shall be set up at the side of the manhole and above the duct, allowing the cable to enter through the opening without reverse bending. Flexible tube guide shall be installed through the opening in a manner that will prevent the cable from rubbing on the edges of any structural member.

C. Pulling force for a cable grip on lead-sheathed cable shall not exceed manufacturer's recommendation. A dynamometer shall be used in the pulling line to ensure that the pulling force is not exceeded. Pulling force for a nonmetallic-sheathed cable shall not exceed the smaller of 4400 Newton (1,000 pounds) or a value computed from the following equation:

TM = 0.008 X N X CM

Where: TM = maximum allowable pulling tension in Newton pounds

N = number of conductors in the cable

CM = cross-sectional area of each conductor in square millimeter circular mils.

D. Cable shall be unreeled from the top of the reel. Payout shall be carefully controlled. Cable to be pulled shall be attached through a swivel to the main pulling wire by means of a pulling eye.

E. Woven-wire cable grips shall be used to grip the cable end when pulling small cables and short straight lengths of heavier cables.

F. Pulling eyes shall be attached to the cable conductors to prevent damage to the cable structure.

G. Pulling eyes and cable grips shall be used together for nonmetallic sheathed cables to prevent damage to the cable structure.

H. Cables shall be liberally coated with a suitable cable-pulling lubricant as it enters the tube guide or duct. Grease and oil lubricants shall be used only on lead-sheathed cables. Nonmetallic sheathed cables shall be covered with wire-pulling compounds when required which have no deleterious effects on the cable. Rollers,

sheaves, or tube guides around which the cable is pulled shall conform to the minimum bending radius of the cable.

I. Cables shall be pulled into ducts at a reasonable speed not in excess of maximum permissible pulling tension specified by the cable manufacturer. Cable pulling using a vehicle shall not be permitted. Pulling operations shall be stopped immediately with any indication of binding or obstruction and shall not be resumed until such difficulty is corrected. Sufficient slack shall be provided for free movement of cable due to expansion or contraction.

J. Cable splices made up in manholes shall be firmly supported on cable racks as indicated. No cable splices shall be pulled in ducts. Cable ends shall overlap at the ends of a section to provide sufficient undamaged cable for splicing. Cables to be spliced in manholes or utility tunnels shall overlap the centerline of the proposed joint by not less than 600 mm (2 feet).

K. Cables cut in the field shall have the cut ends immediately sealed to prevent entrance of moisture. Nonleaded cables shall be sealed with rubber tape wrapped down to 75 mm (3 inches) from the cable end. Rubber tape shall be cover-wrapped with polyvinylchloride tape. Lead-Covered cables shall be sealed with wiping metal making a firm bond with the end of the sheath or with a disk of lead fitted over the end and wiped to the sheath.

3.4 INSTALLATION, SPLICES AND TERMINATIONS

A. Install the materials as recommended by their manufacturer including special precautions pertaining to air temperature during installation.

B. Cross-Linked Polyethylene (XLPE), Ethylene Propylene Rubber and Polyethylene Insulated Cables:

1. Cables rated 5000 volts or less: Install epoxy resin splices and terminations, or pre-molded rubber splices and terminations.

C. Installation shall be accomplished by qualified personnel trained to accomplish high voltage equipment installations. All instructions of the manufacturer shall be followed in detail.

D. Splices shall be made in manholes except where cable terminations are specifically indicated. Splicing and terminating of cables shall be expedited to minimize exposure and cable deterioration.

E. Cables shall be terminated in potheads. Dry terminations with medium voltage pennants, preformed, and hand wrapped stress cones may be used for terminating cables. Potheads shall be provided with adequate means

for making external connections to the cable conductors of single or multiple conductor cables; protecting the cable insulation against moisture, oil, or other contaminant; physically protecting and supporting cables, and maintaining the insulation level of the cable.

F. Pothead terminations shall be field fabricated from termination kits supplied by and in accordance with the pothead manufacturer's recommendations for the type, size, and electrical characteristics of the cable.

G. Installation shall include built-up or prefabricated heat or cold shrink stress-relief cones at the terminals of all shielded cables and at the terminals of single-conductor lead-covered cables rated 15 kV and above, ungrounded.

H. Cable splices shall be field fabricated from splicing kits supplied by and in accordance with cable manufacturer's recommendations for the type, size, and electrical characteristics of the cable specified. Cable splices in manholes shall be located midway between cable racks on walls of manholes and supported with cable arms at approximately the same elevation as the enclosing duct.

I. Cable splices in the tunnel that are not installed in cable trays shall be installed on cable racks or by other approved methods that will minimize physical stress on the splice connections. Splices shall be supported at approximately the same elevation as the installed cable except where space limitations or existing cable length limitations make this method impractical or impossible.

J. Universal demountable splices shall be supported in such manner so as to minimize physical stress on the splice connections. Each cable end termination shall be supported using a pair of saddle type supports under the cable end termination and/or cable with a minimum 300 mm (12 inches) and a maximum 750 mm (30 inches) separation between the supports. Cable end termination and cable shall be secured to the supports in such a manner as to prevent movement of termination or cable at the support. Saddle type supports shall be installed on galvanized steel framing channel anchored to the wall or securely fastened to the cable tray or installed by other approved methods.

3.5 SINGLE-CONDUCTOR POTHEADS

A. Single-conductor potheads shall be the hermetically sealed cap-nut type and shall be suitable for the type, size, and electrical

characteristics of the cable specified. Potheads shall consist of cast bodies, bushings, cable connectors, lugs, and entrance fittings.

B. Pothead bodies shall be metal castings with mounting brackets, when required, pipe plugs for filling and vent holes, and machined flanged surface for cable-entrance fitting. Bodies shall be cast iron for cables up to 130 mm^2 (250 kc mils) 250 amperes, and cast aluminum bronze nonmagnetic metal casting for cable of larger size and higher current ratings.

C. Bushings shall be glazed wet-process electrical porcelain insulators, factory assembled and hermetically sealed to the pothead body.

D. Cable connectors shall be high-conductivity copper accurately machined and threaded for internal and external electrical connections. Cross-sectional and contract areas shall be adequate to carry the full-load current rating of the conductors. Cable connectors shall be solder type with gasket seal between the connector and bushing.

E. Potheads shall be completely filled, leaving no gaps or voids, with an insulating compound suitable for the type of cable, insulation, voltage rating, and ambient operating temperatures in accordance with the pothead manufacturer’s recommendations. Pothead parts that do not carry current shall be grounded.

3.6 INSTALLATION, FIREPROOFING

A. Cover all power cables located in manholes, handholes and junction boxes with arc proof and fireproof tape.

B. Apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.

C. Secure the tape in place by a random wrap of glass cloth tape.

3.7 FEEDER IDENTIFICATION

In each manhole and pullbox install permanent tags on each circuit's cables and wires to clearly designate their circuit identification and voltage. In manholes the tags shall be the embossed brass type and shall also show the cable type and voltage rating. Position the tags so they will be easy to read after the fireproofing is installed.

3.8 INSTALLATION, DIRECT BURIAL CABLE

A. Installation shall be in accordance with the NEC.

B. Tops of the cables shall be:

1. Not less than 750 mm (30 inches) and not less than shown on the drawings below the finished grade.

2. Not less than 60 mm 750 mm (24 inches) and not less than shown on the drawings below road and other pavement surfaces.
3. Do not install them under railroad tracks.

C. Under road and paved surfaces, install the cables within bituminous coated, galvanized steel, rigid conduits, not less than 50 mm (2 inch) trade size, with bushings at each end of each conduit run.

D. Work with extreme care near existing ducts, conduits, cables and other utilities to prevent any damage.

E. Cut the trenches neatly and uniformly:
1. Excavating and backfilling is specified in Section 31 20 00, EARTH MOVING.
2. Place a 75 mm (3 inch) layer of sand in the trenches before installing the cables.
3. Place a 75 mm (3 inch) layer of sand over the installed cables.
4. Install continuous, horizontal, 25 by 200 mm (1 by 8 inch), preservative impregnated wood planking three inches above the installed cables before backfilling.

F. Provide horizontal slack in the cables for contraction during cold weather.

G. Install the cables in continuous lengths. Splices within cable runs will not be accepted.

H. Connections and terminations shall be submersible type designed for the cables being installed.

I. Warning tape shall be continuously placed 300 mm (12 inches) above buried cable.

3.9 FIELD TESTS FOR MEDIUM VOLTAGE CABLE

A. New Cable:
1. Acceptance tests shall be performed on new and service aged PE XLPE, PVC and paper cables in accordance with IEEE 400.2 and as specified herein.
2. Test new cable after installation, splices, and terminations have been made, but before connection to equipment and existing cable.
3. Test equipment, labor and technical personnel shall be provided as necessary to perform the electrical acceptance tests. Arranges shall be made to have tests witnessed by the COTR.

B. Service Age Cable:
1. Maintenance tests shall be performed on service-aged cable interconnected to new cable. See test voltages below.

2. After new cable test and connection to an existing cable, test the interconnected cable. Disconnect cable from all equipment that might be damaged by the test voltages.

C. Dielectric Absorption Test: Both new and service aged power cable shall be completely isolated from extraneous electrical connections at cable terminations and joints. Safety precautions shall be observed. Each cable shall be given a full dielectric – absorption test with a 5000v insulation resistance test set. Test shall be applied for a long enough time to charge the cable. Readings shall be recorded every 15 seconds during the first 3 minutes of test and at 1 minute intervals thereafter. Test shall continue until three equal readings 1 minute apart are obtained. Minimum readings shall be 200 megohms at an ambient temperature 20 degrees C (68 degrees F). Readings taken at other temperatures shall be corrected accordingly.

D. High Potential Test: High potential test shall not be applied to the XLPE new or service aged cables. All other cables shall be subjected to the test but only upon successful dielectric absorption test.

1. Leakage current test shall be by high potential dc step voltage method.
2. High potential test shall measure the leakage current from each conductor to the insulation shield. Use corona shields, guard rings, taping, mason jars, or plastic bags to prevent corona current from influencing the readings. Unprepared cable shield ends shall be trimmed back 25 mm (1 inch) or more for each 10 kV of test voltage. Upon the successful completion of the high potential test on new and service aged PE CCLP, PC PVC cables a second dielectric test will be run on the HV cable system to ensure the cables have not been damaged by the hi-pot test

E. Safety Precautions:

1. Exercise suitable and adequate safety measures prior to, during, and after the high potential tests, including placing warning signs and preventing people and equipment from being exposed to the test voltages.

F. Test Voltages:

1. New shielded EPR and CCLP cable dc test voltages shall be as follows:

Rated Circuit Voltage Phase-to-Phase Volt	Wire Size AWG or MCM	Test Voltage KV

2001-5000	8-1000	25

2. Existing cable of all types interconnected to a new cable shall be tested at 1.7 times the existing cable rated voltage (maintenance test).

G. High Potential Test Method:

1. Apply voltage in approximately 8 to 10 equal steps.
2. Raise the voltage slowly between steps.
3. At the end of each step, allow the charging currents to decay, and time the interval of decay.
4. Read the leakage current and plot a curve of leakage currents versus test voltage on graph paper as the test progresses. Read the leakage current at the same time interval for each voltage step.
5. Stop the test if leakage currents increase excessively or a "knee" appears in the curve before maximum test voltage is reached.
   a. For new cable, repair or replace the cable and repeat the test.
   b. For existing cable interconnected to new cable, notify the COTR for further instructions.
6. Upon reaching maximum test voltage, hold the voltage for five minutes. Read the leakage current at 30 second intervals and plot a curve of leakage current versus time on the same graph paper as the step voltage curve. Stop the test if leakage current starts to rise, or decreases and again starts to rise. Leakage current should decrease and stabilize for good cable.
7. Terminate test and allow sufficient discharge time before testing the next conductor.

H. Test Data: Test data shall be recorded and shall include identification of cable and location, megohm readings versus time, leakage current readings versus time, and cable temperature versus time.

I. Final Acceptance: Final acceptance shall depend upon the satisfactory performance of the cable under test. No cable shall be energized until recorded test data have been approved by the COTR. Final test reports shall be provided to the COTR. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words “Final Test Report” Forward to the COTR for inclusion in the Maintenance Database.

J. Radiographic Tests: Radiographic tests shall be performed on all potheads at the discretion of the COTR to determine if voids exist in

the pothead. Unacceptable terminations shall be reworked at no additional expense to the VA.

K. The contractor shall furnish the instruments, materials and labor for these tests.

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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. Excavation and backfill for cables that are installed in conduit: Section 31 20 00, EARTH MOVING.

B. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.

C. General electrical requirements that are common to more than one section in Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

D. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

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

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certificates: Two weeks prior to final inspection, deliver to the COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

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 reference in the text by the basic designation only.

B. American Society of Testing Material (ASTM):

D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

C. Federal Specifications (Fed. Spec.):

A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed Installation)

D. National Fire Protection Association (NFPA):

70-05.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-02.....Thermoset-Insulated Wires and Cables

83-03.....Thermoplastic-Insulated Wires and Cables

467-01.....Electrical Grounding and Bonding Equipment

486A-01.....Wire Connectors and Soldering Lugs for Use with Copper Conductors

486C-02.....Splicing Wire Connectors

486D-02.....Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations

486E-00.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

493-01.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable

514B-02.....Fittings for Cable and Conduit

1479-03.....Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 CABLE AND WIRE (POWER AND LIGHTING)

A. Cable and Wire shall be in accordance with Fed. Spec. A-A-59544, except as hereinafter specified.

B. Single Conductor:

1. Shall be annealed copper.
2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.

C. Insulation:

1. THW, XHHW, or dual rated THHN-THWN shall be in accordance with UL 44, and 83.
2. Isolated power system wiring: Type XHHW with a dielectric constant of 3.5 or less.

D. Color Code:

1. Secondary service, feeder and branch circuit conductors shall be color coded as follows:

208/120 volt	Phase
Black	A
Red	B
Blue	C
White	Neutral

a. The lighting circuit “switch legs” and 3-way switch “traveling wires” shall have color coding unique and distinct (i.e. pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Field coordinate for a final color coding with the COTR.

2. Use solid color compound or solid color coating for No. 12 AWG and No. 10 AWG branch circuit conductors and neutral sizes.
3. Phase conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
   a. Solid color compound or solid color coating.
   b. Stripes, bands, or hash marks of color specified above.
   c. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (three inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. 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.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES AND JOINTS

A. In accordance with UL 486A, C, D, E and NEC.

B. Branch circuits (No. 10 AWG and smaller):
   1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C 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 manufacturers packaging shall be strictly complied with.

C. Feeder Circuits:

1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material.
2. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less 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. Insulate with not less than that of the conductor level that is being joined.
4. Plastic electrical insulating tape: ASTM D2304 shall apply, flame retardant, cold and weather resistant.

2.3 CONTROL WIRING

A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.

B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

B. Shall not be used on wire for isolated type electrical power systems.

2.5 FIREPROOFING TAPE

A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.

C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.

E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

2.6 WARNING TAPE

A. The tape shall be standard, 76 mm (3 inch) wide, 4-Mil polyethylene detectable type.

B. The tape shall be red with black letters indicating “CAUTION BURIED ELECTRIC LINE BELOW”.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with the NEC, and as specified.

B. Install all wiring in raceway systems, except where direct burial or HCF Type AC cables are used.

C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.

D. Wires of different systems (i.e. 120V, 277V) 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 panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.

G. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.

H. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
2. Use ropes made of nonmetallic material 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. Pull in multiple cables together in a single conduit.

I. No more than (3) single-phase branch circuits shall be installed in any one conduit.

J. The wires shall be derated in accordance with NEC Article 310. Neutral wires, under conditions defined by the NEC, shall be considered current-carrying conductors.

3.2 SPLICE INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure.

B. Where the VA determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the VA.

3.3 CONTROL AND SIGNAL WIRING INSTALLATION

A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.

B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.

C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.

E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.4 CONTROL AND SIGNAL SYSTEM IDENTIFICATION

A. Install a permanent wire marker on each wire at each termination.

B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

C. Wire markers shall retain their markings after cleaning.

D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.5 FEEDER IDENTIFICATION

A. In each interior pulbox and junction box, install metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.

B. In each manhole and handhole, provide tags of the embossed brass type, showing the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

3.6 DIRECT BURIAL CABLE INSTALLATION

A. Tops of the cables:

1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
2. Below road and other pavement surfaces: In conduit as specified, minimum 750 mm (30 inches) unless greater depth is shown.
3. Do not install them under railroad tracks.

B. Under road and paved surfaces: Install cables in concrete encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (two inch) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare.

C. Work with extreme care near existing ducts, conduits, cables and other utilities to prevent any damage.

D. Cut the trenches neatly and uniformly:

1. Excavating and backfilling is specified in Section 31 20 00, EARTH MOVING.
2. Place a 75 mm (3 inch) layer of sand in the trenches before installing the cables.
3. Place a 75 mm (three inch) layer of sand over the installed cables.
4. Install continuous horizontal, 25 mm by 200 mm (1 inch by 8 inch) preservative impregnated wood planking 75 mm (three inches) above the cables before backfilling.

E. Provide horizontal slack in the cables for contraction during cold weather.

F. Install the cables in continuous lengths. Splices within cable runs will not be accepted.

G. Connections and terminations shall be submersible type designed for the cables being installed.

H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried cables.

3.7 EXISITNG WIRING

Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

3.8 FIELD TESTING

A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.

B. Tests shall be performed by megger and conductors shall test free from short-circuits and grounds.

C. Test conductor phase-to-phase and phase-to-ground.

D. The Contractor shall furnish the instruments, materials, and labor for these 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 general grounding and bonding requirements of electrical equipment operations and 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 including made, supplementary, 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 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.

1.3 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 the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:

1. Certification that the materials and installation is in accordance with the drawings and specifications.
2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.4 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 the basic designation only.

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

B1-2001.....Standard Specification for Hard-Drawn Copper Wire

B8-2004.....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

C. National Fire Protection Association (NFPA):

70-2005.....National Electrical Code (NEC)

99-2005.....Health Care Facilities

D. Underwriters Laboratories, Inc. (UL):

44-2005 .....Thermoset-Insulated Wires and Cables

83-2003 .....Thermoplastic-Insulated Wires and Cables

467-2004 .....Grounding and Bonding Equipment

486A-486B-2003 .....Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.

D. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.2 GROUND RODS

A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.

B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3 SPLICES AND TERMINATION COMPONENTS

Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

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. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
3. 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 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

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 SPLICE CASE GROUND ACCESSORIES

Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm^2 (6 AWG) insulated ground wire with shield bonding connectors.

PART 3 - EXECUTION

3.1 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.

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.

D. Special Grounding: For patient care area electrical power system grounding, conform to NFPA 99, and NEC.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS

A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.

B. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium or high voltage conductors, sized per NEC except that minimum size shall be 25 mm^2 (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 or high voltage cable splices and terminations, and equipment enclosures.

C. Pad Mounted Transformers:
1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad metal steel.
2. Ground the secondary neutral.

D. Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.

E. Metallic Conduit: 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.

3.4 SECONDARY 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 and gas pipe systems, building steel, and supplemental or made electrodes. 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. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
D. Switchboards:
   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. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.
E. Transformers:
   1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
F. Conduit Systems:
   1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
   2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
   3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
G. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
H. 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.
3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

I. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

J. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

K. 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.

L. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

M. Panelboard Bonding: The equipment grounding terminal buses of the normal and essential branch circuit panelboards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than 16 mm^2 (10 AWG). These conductors shall be installed in rigid metal conduit.

3.5 CORROSION INHIBITORS

When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.6 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

B. In operating rooms and at intensive care and coronary care type beds, bond the gases and suction piping, at the outlets, directly to the room or patient ground bus.

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 hardware at each electrical room and connect to pigtail extensions of the building grounding ring.

3.9 WIREWAY GROUNDING

A. Ground and Bond Metallic Wireway Systems as follows:

1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm^2 (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated 16 mm^2 (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
3. Use insulated 16 mm^2 (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
4. Use insulated 16 mm^2 (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

3.10 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the VA. Final tests shall assure 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 less 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. Services at power company interface points shall comply with the power company ground resistance requirements.

D. 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.

3.11 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

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. Bedding of conduits: Section 31 20 00, EARTH MOVING.

B. Mounting board for telephone closets: Section 06 10 00, ROUGH CARPENTRY.

C. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.

D. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

E. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.

F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.

G. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

H. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

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

A. Shop Drawings:

1. Size and location of main feeders;
2. Size and location of panels and pull boxes
3. Layout of required conduit penetrations through structural elements.
4. The specific item proposed and its area of application shall be identified on the catalog cuts.

B. Certification: Prior to final inspection, deliver to the COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

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 Fire Protection Association (NFPA):

70-05.....National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL):

1-03.....Flexible Metal Conduit

5-01.....Surface Metal Raceway and Fittings

6-03.....Rigid Metal Conduit

50-03.....Enclosures for Electrical Equipment

360-03.....Liquid-Tight Flexible Steel Conduit

467-01.....Grounding and Bonding Equipment

514A-01.....Metallic Outlet Boxes

514B-02.....Fittings for Cable and Conduit

514C-05.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers

651-02.....Schedule 40 and 80 Rigid PVC Conduit

651A-03.....Type EB and A Rigid PVC Conduit and HDPE Conduit

797-03.....Electrical Metallic Tubing

1242-00.....Intermediate Metal Conduit

D. National Electrical Manufacturers Association (NEMA):

TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing

FB1-03.....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 19 mm (1 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 inch) flexible conduit may be used for tap connections to recessed lighting fixtures.

B. Conduit:

1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
2. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
3. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
4. Flexible galvanized steel conduit: Shall Conform to UL 1.
5. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
6. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).

C. Conduit Fittings:

1. Rigid steel and IMC conduit fittings:
   a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
   b. Standard threaded couplings, locknuts, bushings, 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. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
   f. 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.
2. Electrical metallic tubing fittings:
   a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.

b. Only steel or malleable iron materials are acceptable.
c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
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.

3. Flexible steel conduit fittings:
   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp type, with insulated throat.
4. Liquid-tight flexible metal conduit fittings:
   a. Fittings shall meet the requirements of UL 514B and ANSI/ 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.
5. Direct burial plastic conduit fittings:
   a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
   b. As recommended by the conduit manufacturer.
6. Surface metal raceway fittings: As recommended by the raceway manufacturer.
7. Expansion and deflection couplings:
   a. Conform to UL 467 and UL 514B.
   b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
   c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
   d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

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 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) 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 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.
F. Wireways: Equip with hinged covers, except where removable covers are shown.
G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with “CAUTION BURIED ELECTRIC LINE BELOW”.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:
   1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COTR prior to drilling through structural sections.
   2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the COTR as required by limited working space.
B. Fire Stop: 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, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

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 hereinafter specified.

B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where specifically "accepted" by NEC Article 517.

C. Install conduit as follows:

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically and electrically continuous.
6. Independently support conduit at 8’0” on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
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. Do not use aluminum conduits in wet locations.

13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

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.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COTR.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:
   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 75 mm (3 inches) thick is prohibited.
   a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
   b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
   c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:
   1. Conduit for conductors 600 volts and below:
      a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed 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 1800 mm (six feet) of flexible metal conduit extending from a junction box to the fixture.
   4. Tightening set screws 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 above 600 volts:
   1. Rigid steel.
C. Conduit for Conductors 600 volts and below:
   1. Rigid steel, IMC, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
D. Align and run conduit parallel or perpendicular to the building lines.
E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
F. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
G. Surface metal raceways: Use only where shown.
H. Painting:
   1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
   2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.5 DIRECT BURIAL INSTALLATION

A. Exterior routing of Lighting Systems and Other Branch circuits (600 Volt and Less, and 1500 mm (5 feet) from the buildings):
   1. Conduit: Thick wall PVC or high density PE, unless otherwise shown.
   2. Mark conduit at uniform intervals to show the kind of material, direct burial type, and the UL approval label.

3. Install conduit fittings and terminations as recommended by the conduit manufacturer.
4. Tops of conduits shall be as follows unless otherwise shown:
   a. Not less than 600 mm (24 inches) below finished grade.
   b. Not less than 750 mm (30 inches) below road and other paved surfaces.
5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
6. Excavation for conduit bedding and back-filling of trenches is specified in Section 31 20 00, EARTH MOVING.
   a. Cut the trenches neatly and uniformly.
   b. Do not kink the conduits.
7. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents the entrance of moisture and gases.
8. Where metal conduit is shown, install threaded heavy wall rigid steel galvanized conduit or type A20 rigid steel galvanized conduit coated with .5 mm (20 mil) bonded PVC, or rigid steel or IMC, PVC coated or standard coated with bituminous asphaltic compound.
9. Warning tape shall be continuously placed 300 mm (12 inches) above conduits or electric lines.

B. Exterior routing of lighting systems and other branch circuits (600 volts and less-under buildings slab on grade to 1500 mm (5 feet) from the building):
   1. Pre-coated rigid galvanized steel conduit in accordance with the requirements of Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

3.6 HAZARDOUS LOCATIONS

A. Use rigid steel conduit only, notwithstanding requirements otherwise specified in this or other sections of these specifications.
B. Install UL approved sealing fittings, that prevent passage of explosive vapors, in hazardous areas equipped with explosive proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.7 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 1500 mm (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

3.8 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. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.9 EXPANSION JOINTS

A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

C. Install expansion and deflection couplings where shown.

3.10 CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.

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 90 kg (200 pounds). 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 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
   b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
   c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted.

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.

3.11 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 in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)

E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) 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 black marker.

- - - E N D - - -

SECTION 26 05 41

UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation and connection of manholes, handholes and 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 and have the same meaning.

1.2 RELATED WORK

A. Section 31 20 00, EARTH MOVING: Trenching, backfill and compaction.

B. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings and boxes for raceway systems.

E. 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 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 manholes, handholes, duct materials, and hardware. Proposed deviations from details on the drawings shall be clearly marked on the submittals.

If necessary to locate manholes or handholes at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit four copies to the COTR for approval prior to construction.

3. Reinforcement shop drawings for precast manholes prepared in accordance with ACI-SP-66.

4. Precast manholes and handholes: Submit plans on elevation showing openings, pulling irons cable supports, sump and other details. Also, submit detail drawings and design calculations for approval prior to installation. Submittal shall bear the seal of a registered structural engineer.

C. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:

1. Certification that the materials are in accordance with the drawings and specifications.
2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.4 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 the basic designation only.

A. American Concrete Institute (ACI):

Building Code Requirements for Structural Concrete

318/318M-2005.....Building Code Requirements for Structural Concrete & Commentary

SP-66-04.....ACI Detailing Manual

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

C478/C478M 2006(b).....Standard Specification for Precast Reinforced Concrete Manhole Sections

C990 REV A 2003 .....Standard Specification for joints concrete pipe, Manholes and Precast Box using performed flexible Joint sealants.

C. Institute of Electrical and Electronic Engineers (IEEE):

C2-2002 .....National Electrical Safety Code

D. National Electrical Manufacturers Association (NEMA):

RNI 2005.....Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

TC 2 2003.....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

E. National Fire Protection Association (NFPA):

70 2005.....National Electrical Code (NEC)

F. Underwriters Laboratories, Inc. (UL):

6-2004.....Electrical Rigid Metal Conduit-Steel

467-2004.....Standard for Grounding and Bonding Equipment

651-2005.....Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings

651A-2003.....Type EB and A Rigid PVC Conduit and HDPE Conduit, (RTRC)

651B-2002.....Continuous Length HDPE Conduit

G. U.S. General Services Administration (GSA):

A-A-60005-1998.....Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

SS-S-210A-1981.....Sealing Compound, Preformed Plastic for Expansion joints And Pipe Joints

PART 2 - PRODUCTS

2.1 CONCRETE HANDHOLES AND HARDWARE

A. Reinforced Concrete: ACI 318, 20MPA (3000 psi) minimum 28-day compressive strength.

B. Reinforcing Steel: Number 4 minimum.

C. Handhole Hardware:

1. Frames and covers configuration as shown on the drawings. Cast the words “Electric” and “Telephone” in the top face of the power and telephone manhole covers respectively.
2. Pulling irons, 22 mm (7/8-inch) diameter galvanized steel bar with exposed triangular shaped opening.
3. Cable supports are not required.

D. Ground Rod Sleeve: Provide a 75 mm (3 inches) PVC sleeve in manhole floors so that a driven ground rod may be installed.

E. In lieu of poured-in-place handholes, the Contractor may provide precast units. Units shall comply with ASTM C478, C478M.

1. Size: Plan area and clear height shall be not less than that shown on the drawings for poured-in-place type.

2. Accessories, hardware, and facilities shall be the same as required for poured-in-place type.
3. Assume ground water level 900 mm (3 feet) below ground surface unless a higher water table is shown in the boring logs and adjust design accordingly.
4. Construction:
   a. Units, precast monolithically or of assembled sections. Base and first riser shall be monolithic.
   b. Provide tongue-and-groove joints to firmly interlock adjoining components. Seal joints watertight using preformed plastic or rubber materials conforming to ASTM C990 or GSA SS-S-210A. Install sealing material in strict accordance with the sealant manufacturers' printed instructions.
   c. Provide lifting devices cast into units.
   d. Identify all structures with manufacturer's name embedded in, or otherwise permanently attached to an interior wall face.
   e. Provide a sleeve in manhole floors so that a driven ground rod may be installed.

2.2 DUCTS:

A. Number and sizes shall be as shown on drawings.

B. Ducts (direct burial):
   1. Plastic duct:
      a. NEMA TC2 and TC3
      b. UL 651, 651A and 651B, Schedule 40 PVC or HDPE.
      c. Duct shall be suitable for use with 75 degree C rated conductors.
   2. Rigid metal conduit, PVC-coated: UL6 and NEMA RN1 galvanized rigid steel, threaded type, coated with PVC sheath bonded to the galvanized exterior surface, nominal 1 mm (0.040 inch) thick.

2.3 GROUNDING

A. Rods: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS and UL 467

B. Ground Wire: Stranded bare copper 16 mm^2 (6 AWG) minimum.

2.4 WARNING TAPE:

Standard 4-mil polyethylene 76 mm (3 inch) wide tape, detectable type, red with black letters, imprinted with “CAUTION BURIED ELECTRIC CABLE BELOW”.

2.5 PULL ROPE:

Plastic with 890N (200 pound) minimum tensile strength.

PART 3 - EXECUTION

3.1 HANDHOLE CONSTRUCTION AND INSTALLATION

A. General Requirements:

1. Construct handholes of reinforced concrete.
2. Locate handholes at the approximate locations shown on the drawings with due consideration given to the location of other utilities, grades, and paving.
3. Steel reinforcing concrete cover, not less than 50 mm (2 inches) thick for exterior surfaces, 38 mm (1 1/2 inches) thick for interior surfaces, and 25 mm (1 inch) thick for the bottom surfaces of the top slabs.
4. Walls, floors, and top:
   a. Construct monolithic walls and floors with window openings in walls for ducts.
   b. Provide sump pits in the floor of handholes for drainage.
   c. Provide handhole with a circular opening suitable for the installation of the frame and cover. Provide water stops at framed cold joints.
5. Duct terminations: Provide windows at duct bank terminations and fill with concrete after duct placement. Terminations shall be sealed watertight.
6. Pulling irons:
   a. Provide pulling irons opposite each duct entrance.
   b. Cast pulling irons in the walls opposite duct windows approximately 152mm (6 inches) above the top of the window.

B. Access for Handholes: Make the top of frames and covers flush with finished grade.

C. Precast Units:

1. Precast units shall have the same accessories and facilities as specified above.
2. Assembly and installation of precast components shall follow the printed instructions and recommendations of the manufacturer of the units.
3. Units shall be installed on a 300 mm (12 inch) level bed of 90% compacted granular fill, well-graded from the 25 mm (1 inch) sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.
4. Seal duct terminations watertight.

D. Ladders: Provide securely mounted ladder for every manhole over 1200 mm (4 feet) deep.

3.2 TRENCHING

A. Refer to Section 31 20 00, EARTH MOVING for trenching back-filling, and compaction.

B. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.

C. Cut the trenches neatly and uniformly.

D. For Concrete Encased Ducts:

1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 1200 mm (4 foot) intervals to establish the grade and route of the duct bank.
2. Pitch the trenches uniformly towards manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts towards 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, with appropriate warning tape attached.

E. Conduits to be installed under existing paved areas, roads, and railroad tracks that are not to be disturbed shall be jacked into place. Conduits shall be PVC-coated rigid metal.

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 handholes, and away from building and equipment entrances. Pitch not less than 100 mm (4 inches) in 30 M (100 feet).
3. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be PVC-coated galvanized rigid steel, and shall extend a minimum of 1500 mm (5 feet) outside of building foundation.
4. Stub-ups, sweeps, and risers to equipment mounted on outdoor concrete slabs shall be PVC-coated galvanized rigid steel, and shall extend a minimum of 1500 mm (5 feet) away from edge of slab.

5. Install insulated grounding bushings on the terminations.
6. PVC-coated rigid steel conduits shall be coupled to the ducts with suitable adapters, and the whole encased with 75 mm (3 inches) of concrete.
7. PVC coated rigid steel conduit turns of direction for all duct lines shall have minimum 1200 mm (4 feet) radius in the horizontal and vertical directions. PVC conduit sweeps for all duct lines shall have a minimum 12000 mm (40 feet) radius in the horizontal and 1200 mm (4 feet) in the vertical directions. Where a 12000 mm (40 feet) radius is not possible, horizontal turns of direction shall be rigid steel.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 75 mm (3 inches) above bottom of trench during the concrete pour. Spacer spacing shall not exceed 1500 mm (5 feet).
9. Duct lines shall be installed no less than 300 mm (12 inches) from other utility systems, such as water, sewer, and chilled water.
10. Clearances between individual ducts:
    a. For like services, not less than 75 mm (3 inches).
    b. For power and signal services, not less than 150 mm (6 inches).
    c. Provide plastic spacers to maintain clearances.
    d. Provide nonferrous tie wires to prevent displacement of the ducts during pouring of concrete. Tie wires shall not act as substitute for spacers.
11. Duct lines shall terminate at window openings in manhole 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 insure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel during construction, and seal with tapered plugs upon completion of each portion of the work.

B. Concrete Encased Ducts and Conduits:
1. Install concrete encased ducts for medium and high voltage systems, low voltage systems, and signal systems unless otherwise shown on the drawings.
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 600 mm (24 inches) and not less than shown on the drawings, below finished grade.
b. Not less than 750 mm (30 inches) 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 1200 mm (4 feet) below slab.

4. Extend the concrete envelope encasing the ducts not less than 75 mm (3 inches) beyond the outside walls of the outer ducts and conduits.
5. Within 3000 mm (10 feet) of building, manhole and handhole 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, ducts, conduits, and concrete envelopes, make the joints with the proper fittings and fabricate the concrete envelopes to insure smooth durable transitions.
8. Conduit joints in concrete may be placed side by side horizontally but shall be staggered at least 150 mm (6 inches) vertically.
9. For medium voltage duct bank installations, a grounding conductor shall be extend along all electrical duct banks including stubs through each electrical distribution system manhole and to each transformer and switching-station installation.
10. Duct Bank Markers:
    a. Duct bank markers, where required, shall be located at the ends of duct banks except at manholes or handholes at approximately every 60 meter (200 feet) along the duct run and at each change in direction of the duct run. Markers shall be placed 600 mm (2 feet) 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. 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 75 mm (2-inches) long.

The letter and arrows shall be V-shaped, and shall have a width of stroke at least 6 mm (¼ inch) at the top and a depth of 6 mm (1/4 inch).

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 the same as the angular change of the duct bank.

C. Direct Burial Duct and Conduits:

1. Install direct burial ducts and conduits only where shown on the drawings. Provide direct burial ducts only for low voltage systems.
2. Join and terminate ducts and conduits with fittings recommended by conduit manufacturer.
3. Direct burial ducts and conduits are prohibited under railroad tracks.
4. Tops of ducts and conduits shall be:
   a. Not less than 600 mm (24 inches) and not less than shown on the drawings, below finished grade.
   b. Not less than 750 mm (30 inches) and not less than shown on the drawings, below roads and other paved surfaces.
5. Do not kink the ducts or conduits.

D. Concrete-Encased and Direct Burial Duct and Conduit Identification: Place continuous strip of warning tape approximately 300 mm (12 inches) above ducts or conduits before backfilling trenches. Warning tape shall be preprinted with proper identification.

E. 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.

F. Duct and Conduit Cleaning:

1. Upon completion of the duct bank installation or installation of direct buried ducts, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the line. The mandrel shall be not less than 3600 mm (12 inches) long, and shall have a diameter not less than 13 mm (1/2 inch) 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 COTR.

G. 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.

H. Connections to Manholes: Duct bank envelopes connecting to underground structures shall be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 300 mm (12 inches) in each direction. Perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

I. Connections to Existing Manholes: For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

J. Connections to Existing Ducts: Where connections to existing duct banks are indicated, excavate around the duct banks as necessary. Cut off the duct banks and remove loose concrete from the conduits before installing new concrete-encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks.

K. 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 600 mm (2 feet) back into the envelope and a minimum of 600 mm (2 feet) beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm (3 inches) from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 300 mm (1 foot) 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.

B. A short circuit and coordination study shall be prepared for the electrical over current devices to be installed under this project to assure proper equipment and personnel protection.

C. The study shall present an organized time-current analysis of each protective device in series from the individual device back to the utility and the on-site generator sources. 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 16, PANELBOARDS: Low voltage panelboards.

C. Section 26 24 11, DISTRIBUTION SWITCHBOARDS: Low voltage distribution switchboards.

1.3 SUBMITTALS

A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS , submit the following:

B. Complete short circuit and coordination study as described herein.

C. 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.

D. Certification: Two weeks prior to final inspection, submit four copies of the following to the COTR:

1. Certification by the Contractor that the protective devices have been adjusted and set in accordance with the approved protective device study.

1.4 QUALIFICATIONS

The protective device study shall be prepared by qualified engineers of the switchgear manufacturer or an approved consultant. The Contractor is responsible for providing all pertinent information required by the preparers to complete the study.

1.5 REQUIREMENTS

A. The complete study shall include a system one line diagram, short circuit and ground fault analysis, and protective coordination plots.

B. One Line Diagram:

1. Show, on the one line diagram, all electrical equipment and wiring to be protected by the overcurrent devices installed under this project. Clearly show, on the one line, the schematic wiring of the electrical distribution system.
2. Also show on the one line diagram the following specific information:
   a. Calculated fault impedance, X/R ratios, and short circuit values at each bus and equipment.
   b. Breaker and fuse ratings.
   c. Generator kW and Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
   d. Voltage at each bus.
   e. Identification of each bus.
   f. Conduit material, feeder 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 determined by 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. Coordination Curves:

1. Prepare the coordination curves to determine the required settings of protective devices to assure selective coordination. Graphically illustrate on log-log paper that adequate time separation exists

between series devices, including the VAMC upstream device. Plot the specific time-current characteristics of each protective device in such a manner that all upstream devices will be 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 inrush 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.

1.6 ANALYSIS

A. Analyze the short circuit calculations, and highlight any equipment that is 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 curve characteristics of induction relays, C.T. 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.

1.7 ADJUSTMENTS, SETTINGS AND MODIFICATIONS

A. Necessary final field adjustments, settings and minor modifications shall be made to conform with the protective device study without additional cost to the VA.

B. All final circuit breaker and relay settings and fuse sizes shall be made in accordance with the recommendations of the protective device study.

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SECTION 26 09 13

ELECTRICAL POWER MONITORING AND CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of metering devices, communications channels and equipment, and LAN-based software to form a power monitoring system. Software will be installed on computer(s) as designated by the VA.

B. Meters may be installed in other equipment or in dedicated enclosures. Data may also be reported by other equipment, such as variable speed motor controllers, or circuit breakers that are specified to output data to a power monitoring system. Any devices that reports data to the power monitoring system is referred to in this specification as a 'meter.'

1.2 RELATED WORK

A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements 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 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and outlet boxes.

E. Section 26 24 11, DISTRIBUTION SWITCHBOARDS: Secondary distribution switchboards.

F. Section 26 24 16, PANELBOARDS: Requirements for panelboards.

G. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS: Requirements for motor starters and variable speed motor controllers.

H. Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING: Requirements for data networks to interconnect power monitoring devices.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 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. Catalog data showing features for all equipment.
3. Power monitoring system block diagram and layout plans showing equipment locations and cable routing. Indicate data communication paths, data buses, data gateways, and other devices to be used. Describe characteristics of network and other data communication lines.
4. Device address list and the set point of each device and operator option, as set in applications software
5. Installation drawings including dimensional drawings of any existing enclosures showing equipment cutouts and mounting locations, and indicating adequate clearance from existing wiring and devices in accordance with manufacturer's recommendations.
6. Instrument transformer wiring and installation drawings.

B. Manuals:

1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, user software guides, user software licenses, and information for obtaining software updates and 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 COTR.
   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 COTR:

a. Certification by the Contractor that the assemblies have been properly installed, adjusted 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 basic designation only.

A. Institute of Engineering and Electronic Engineers (IEEE):

C37.13-95.....Standard Requirements for Instrument Transformers

C62.41.1 .....Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits

C62.41.2 .....Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

B. National Electrical Manufacturer's Association (NEMA):

250.....Enclosures for Electrical Equipment(1000 Volts Maximum)

C12.1.....Electric Meters; Code for Electricity Metering

C12.20.....Electricity Meter - 0.2 and 0.5 Accuracy Classes

C. Telecommunications Industry Association (TIA):

TIA-232-F.....Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

TIA-485-A.....Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint System

TIA/EIA-568-B.1.....Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements

D. National Fire Protection Association (NFPA):

70.....National Electrical Code (NEC)

1.6 WARRANTY

A. The manufacturer shall warrant the equipment supplied hereunder. The warranty shall include:

1. One (1) year free telephone technical support.
2. The standard warranty shall be for two (2) years from start-up.
3. During the warranty period, emergency service and routine maintenance calls shall be responded to within a 4-hour period during the hours of 7am-7pm. Between the hours of 7pm-7am, calls shall be responded within an 8-hour period.

PART 2 - PRODUCTS

2.1 GENERAL

A. System accuracy: The system shall maintain the specified end-to-end accuracy from sensor to all workstation displays, with a system accuracy: ± 1.0 percent for current, voltage, power factor, kWh, kW, kVA, kVAR; ± 0.05 Hz for frequency.

B. The system shall include hardware and software that will communicate with meters using any of the following protocols:

1. A published open protocol.
2. Modbus RTU.

C. Communication Channels: The system shall include hardware and software that will communicate with field devices, including but not limited to meters, variable speed motor controllers, circuit breakers with communications capability, and other devices as shown on the plans.

D. Enclosures: Enclosures shall conform to the requirements of NEMA 250 for the types specified. Indoor enclosures shall be NEMA 1. Outdoor enclosures shall be NEMA 3R, unless otherwise shown, and shall contain a thermostatically controlled space heater to maintain the enclosure above the dew point, if required by the equipment installed. Enclosures shall have removable hinged, key-locked front doors.

E. Equipment Power Supply: Field equipment shall be powered from 120 Vac or shall derive power from the monitored circuit.

F. Grounding: Provide grounding in accordance with manufacturer's recommendations and as specified. Provide an adequate ground for all

enclosure circuits and cable shields to prevent ground loops and electrical noise from adversely affecting operation of the system.

G. Communications Devices: Provide communications devices and gateways as necessary for communications between the meter(s) and computer workstation(s).

H. Instrument Transformers: Current and potential transformers shall be compatible with the meters furnished.

I. EMI/RFI Compliance: Equipment shall be designed to minimize the generation of electromagnetic and radio frequency interference.

J. Environmental Conditions: Without mechanical or electrical damage or degradation of operating capability, system components shall be capable of withstanding environmental conditions of 0 to 122 deg F [minus 18 to plus 50 deg C] and 95% RH, noncondensing.

2.2 METERS

A. Meters shall provide multiple measurements for 60 Hz single phase or three phase electric systems, including maximum, minimum, average, and cumulative values (as applicable) for each metered parameter. Metered parameters shall be as follows:

1. Voltage line-to-neutral plus or minus 0.5 percent
2. Voltage line-to-line: plus or minus 1 percent
3. Current: plus or minus 0.5 percent
4. VA: plus or minus 1 percent
5. kVAR: plus or minus 1.5 percent
6. Power factor: plus or minus 1 percent
7. kW: plus or minus 1.5 percent
8. kWh: plus or minus 1.5 percent of reading
9. Frequency: Plus or minus 0.05 Hz
10. THD in percent, for current and voltage, each phase
11. K Factor
12. Sag/Swell Detection
13. Waveform Capture (maintain the ten most recent captured waveforms)

B. Meters shall retain stored data for 72 hours during a power outage.

C. Meters shall be provided with interfaces and ports for communication with other meters, communications devices, and the computer workstation(s).

2.3 WIRING AND TERMINAL BLOCKS

A. Each individual conductor and each individual terminal in individual enclosures shall be uniquely identified. Conductors shall be unspliced.

B. Provide terminal blocks for conductors requiring connection to circuits external to the specified equipment. Provide sufficient space to allow an orderly wiring arrangement. Provide plastic wiring duct to support cables for external circuit wiring.

C. Make terminal blocks, interposing relays, switches, or similar devices readily accessible. Locate the equipment in compartments, enclosures, or junction boxes in such arrangement that maintenance personnel shall have direct access to the equipment without removal of barriers, cover plates, or wiring. Provide grouped terminal blocks for all external connections. All wiring leaving an enclosure shall leave from terminal blocks or prefabricated connectors and not from other devices in the enclosure.

2.4 METER SOFTWARE

Provide software necessary to accomplish the following functions, fully implemented and operational, within the field equipment. Software will include scanning of inputs, averaging or filtering of inputs, display of values, report to workstation of values, and diagnostics.

2.5 SYSTEM SOFTWARE

A. Display Requirements: Displays shall contain any combination of real-time and trended graphic and tabular information, including time and date. A display shall contain any combination of monitored data from all meters.

B. Display Editor: The display editor shall enable an operator with proper password to create, modify, and delete displays. The primary use shall be for adding and modifying one-line diagrams, station status displays, system summaries, and system directories, as field equipment or new data are added.

C. Access Control: The system shall include software security provisions to prevent inadvertent or unauthorized change of the password. The password shall not be displayed or printed.

D. Trending: Any monitored or calculated value shall be trendable. Each data trend file shall retain a minimum of 500 data samples. The time rate of sampling shall be selectable on an individual trend basis.

E. Reports: The system shall generate and format user-definable tabular and graphical reports for displaying, printing, and storing. Reports shall use database dynamic values and parameters, values calculated using the database, and reports stored on disk. Reports shall be

available for any meter or meters by category, such as substation, building, and type of monitored or calculated value.

F. Alarms: The alarm processing software shall recognize excursions of monitored or calculated values beyond operator assigned limits.

2.6 NAMEPLATES

A. Provide nameplates for meters not factory-installed in other equipment.

B. For meters that monitor equipment on the Normal Power system, provide laminated black phenolic resin with white core with 1/2 inch [12mm] engraved lettered nameplates. For Essential Electrical System, provide laminated red phenolic resin with white core with 1/2 inch [12mm] engraved lettered nameplates next to each meter. Nameplates shall indicate equipment monitored. Nameplates shall be mounted with plated screws on front of meter enclosure. Mounting nameplates only with adhesive is not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the metering equipment in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.

B. Install all equipment as specified and required for a fully functional and operational system. Exercise caution when drilling holes in panels housing energized equipment. When mounting field equipment, do not allow metal shavings to fall into energized equipment.

3.2 SOFTWARE AND DATABASE

A. Install all software as specified and required for an operational system including databases, operational parameters, LAN software, system, command, application, and workstation programs. Provide original and backup copies for all software including diagnostics, on each type of media utilized.

B. Develop the entire system database, using the points and system topography shown on the drawings, and supply all other data required for the database.

3.3 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. Perform installation testing of the workstation and field equipment, at the site, including adjustments of the completed system as specified.

B. Provide all personnel, test equipment, instrumentation, and supplies necessary to perform all testing.

C. The procedures shall consist of detailed instructions for test setup, execution, and evaluation of test results. Use the test reports to document results of the tests.

D. Test, adjust, and calibrate all field equipment and verify system communications before the system is placed on line. Verify operation of all systems as specified upon loss of power, and that all systems return to proper operation automatically upon resumption of power.

E. The tests shall be performed as an integrated test with the data transmission system, and with all equipment specified operating and exchanging actual data for an operating electrical distribution system under actual post-occupancy conditions.

F. Install the latest released version of the power monitoring software on the computer or computers as designated by the VA.

G. Verify accuracy of graphic screens and icons.

H. Metering Test: Independently measure current and voltage on each operating feeder conductor, and simultaneously read indicated values on the same phase at the meter and the computer workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.

I. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

3.4 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.

3.5 INSTRUCTIONS

A. Furnish the services of a factory certified instructor for one 8 hour period for instructing personnel in the operation and maintenance of the power monitoring system on the date requested by the COTR.

B. The training shall include physical layout of each piece of hardware, operation of each meter type and each communications device installed, power monitoring system software, troubleshooting and diagnostics procedures, repair instructions, preventive maintenance procedures and schedules, and calibration procedures.

C. The training shall include system architecture, functional operation of the system, display and reports generation, and diagnostics. Upon

completion of training, VA personnel shall be able to start the system, operate the system, and recover the system after a failure.

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SECTION 26 09 23

LIGHTING CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of the lighting controls.

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 24 16, PANELBOARDS: panelboard enclosure and interior bussing used for lighting control panels.

E. 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 accordance with 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 COTR.

D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the COTR:
   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 OUTDOOR PHOTOELECTRIC SWITCHES

A. Solid state, with DPST dry contacts rated for 1800 VA tungsten or 1000 VA inductive, complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc [16.14 to 108 lx], with adjustable turn-on and turn-off levels.
2. Time Delay: 15-second minimum.
3. Surge Protection: Metal-oxide varistor.
4. Mounting: Twist lock, with base-and-stem mounting or stem-and-swivel mounting accessories as required.

2.2 TIMER SWITCHES

A. Digital switches with backlit LCD display, 120/277 volt rated, fitting as a replacement for standard wall switches.

1. Compatibility: Compatible with all ballasts.
2. Warning: Audible warning to sound during the last minute of "on" operation.
3. Time-out: Adjustable from 5 minutes to 12 hours.
4. Faceplate: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

2.3 INDOOR OCCUPANCY SENSORS

A. Wall mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Manual/automatic selector switch.

8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc [21.5 to 2152 lx]; keep lighting off when selected lighting level is present.
9. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.
10. Manual off switches for bi-level lighting control.
11. 900 square feet - 180 degree coverage.

B. Dual-technology Type: Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.
1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch [150mm] minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. [232 sq. cm], and detect a person of average size and weight moving not less than 12 inches [305 mm] in either a horizontal or a vertical manner at an approximate speed of 12 inches/s [305 mm/s].
3. Detection Coverage: wide angle, 1200 square feet.
4. Adjustable 15 seconds to 15 minute time delay.
5. Provide one minimum power pack for every room.

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. Aim outdoor photocell switch according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle photocell turn-on.
C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer’s recommendations.
D. Set occupancy sensor "on" duration to 15 minutes.
E. Label time switches and contactors with a unique designation.

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.

F. Upon completion of the installation, the system shall be commissioned by the manufacturer’s factory-authorized technician who will verify all adjustments and sensor placements.

3.3 FOLLOW-UP VERIFICATION

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 padmounted transformers.

B. Padmounted 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 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of nonstructural components.

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 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY: Short circuit and coordination study.

D. Section 26 05 13, MEDIUM-VOLTAGE CABLES: High voltage cables.

E. Section 26 24 16, PANELBOARDS: Low voltage panelboards.

F. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Manholes, handholes and duct lines for underground raceway systems.

G. 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.

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. Include electrical ratings, nameplate data, impedance, dimensions, 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. 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. Identify terminals on wiring diagrams to facilitate installation, maintenance and operation.
   b. Indicate, on wiring diagrams, the internal wiring for each item of equipment and interconnections between the items 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 COTR.
   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:
1. Two weeks prior to the final inspection, submit four copies of the following certifications to the COTR:
   a. Certification by the manufacturer that the equipment conforms to the requirements of the drawings and specifications.
   b. Certification by the contractor that the padmounted transformers have been properly installed, connected 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. American Concrete Institute (ACI):

318-02.....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

C57.12.25-90.....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

C57.12.28-99.....Pad-Mounted Equipment Enclosure Integrity

C57.12.29-99.....Switchgear and Transformers – Pad-Mounted Equipment – Enclosure Integrity for Coastal Environments

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

D3487-00.....Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus

E. Institute of Electrical and Electronic Engineers (IEEE):

48-03.....Standard Test Procedures and Requirements for Alternating Current Cable Terminations 2.5kV Through 765kV

386-01.....Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V (ANSI/IEEE)

592-96.....Standard for Exposed Semiconducting Shields on High Voltage Cable Joints and Separable Insulated Connectors

F. National Electrical Manufacturers Association (NEMA):

C57.12.26-93.....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 TR1-93 Transformers, Regulators, and Reactors.

G. National Fire Protection Association (NFPA):

70-05.....National Electrical Code (NEC)

H. Underwriters Laboratories Inc. (UL):

467-93.....UL Standard for Safety 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 hereinafter specified.

B. Ratings shall not be less than shown on the drawings.

C. Provide units 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 units 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. The high and low voltage compartments and the transformer compartment shall be fabricated by a single manufacturer. The compartments and the transformer tank shall be assembled as an integral unit by a single manufacturer. Enclosures shall be in accordance with ANSI C57.12.28.
2. The high and low voltage compartments shall be separated with a steel barrier.
3. The compartments shall be constructed of sheet steel (gage to meet ANSI requirements) with bracing, reinforcing gussets and jig-welding to assure rectangular rigidity.
4. Use cadmium or zinc plated bolts, nuts and washers.
5. Sufficient space shall be provided for equipment, cabling and terminations in the compartments.
6. Affix the transformer instruction nameplate permanently to the unit within the low voltage compartment. Voltage ratings, 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 provision for a single padlock to secure the compartment area. The high voltage

compartment door shall be prevented mechanically from opening, unless the low voltage door is opened.

2. The secondary compartment door shall have a one-piece steel handle and incorporate three-point locking mechanisms to assure a secure and tight door closing. Provide each compartment door with open-position doorstops and tamperproof hinges. The hinge assembly shall be made of corrosion-resistant material welded in place.
3. Provide a 50mm (2-inch) size padlock for each assembly as approved by the Chief Engineer. Padlocks shall be keyed to the Engineer's established key set. Firmly attach the padlock to the door assembly by a chain.

2.3 BIL RATING

A. 5 kV class equipment shall have a minimum 60 kV BIL rating, unless otherwise specified.

2.4 TRANSFORMER FUSE ASSEMBLY

A. The transformer primary fuse assembly shall be load break combination fuse and dry-well fuse holder rated for system voltage, for 10 load makes and 10 load breaks with rated 200 amp load current at 75 percent power factor, 10,000 symmetrical amperes 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 ampere symmetrical interrupting, 5 kV class, non-expulsion, current-limiting primary distribution type, size as shown on the drawings. 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 requiring transformer tank cover removal for replacement.
3. For units above 500kVA using fusing above the 50A 15kV and 100A 5kV application, a clip mounted arrangement of the current limiting fuses is, (i.e. Live-front configuration) is required.

2.5 PRIMARY CONNECTIONS

A. Transformer primary connections shall be live front bushings with NEMA spades or eyebolt terminals suitable for cable sizes shown on the drawings.

B. Transformer primary connections shall be 200A deadfront load break wells and inserts for cable sizes shown on the drawings.

2.6 HIGH-VOTAGE SWITCHING

A. The transformer primary disconnect switch for radial feeds shall be an oil-immersed, internal, gang-operated, load-interrupter type, rated 200 amperes, with a close-in on fault duty of 5,000 amperes symmetrical at 5 kV. The switch is to be a two-position, on-off, manual switch located in the high voltage compartment and hot stick operated as described in the following.

   1. Continuous current 200 amperes. A built in switch with momentary current 10,000 amps symmetrical (2 seconds). Make and latch 6,000 amps symmetrical. Load interrupting 200 amps.

2.7 HIGH VOLTAGE PREFORMED TERMINATIONS

A. Terminate the high voltage cables in the high voltage compartment with load break premolded rubber elbow connectors. Elbow connectors shall have a minimum of 3mm (0.125 inch) semi-conductive shield material covering the housing. Each connector shall be tested - prior to shipment from the factory.

B. Ground metallic cable shields with a device designed for the purpose. It shall consist of a solderless connector enclosed in watertight rubber housing covering the entire assembly. The grounding device and elbow connector are to be of the same manufacturer to insure electrical integrity of shielded parts.

C. Premolded parts shall be suitable for submersible applications.

D. Elbow connectors shall be rated as follows:

   1. Voltage: 14.4 kV phase-to-phase.
   2. BIL: 95 kV.
   3. AC withstands: 34 kV, 60 Hz for 1 minute.
   4. DC withstands: 65 kV (field test rating).
   5. Corona voltage: 11 kV minimum.
   6. Continuous current: 200 amperes RMS.
   7. Short time current: 10,000 amperes for 12 cycles.
   8. Fault closure: 10,000 amperes RMS symmetrical for 10 cycles (after 10 loadmake/loadbreak operations at 200 amperes and 14.4 kV contact voltage).
   9. Switching: 10 loadmake/loadbreak operations at 200 amperes, 70-80 percent power factor, and 14.4 kV maximum recovery voltage between contacts.

E. Interchangeability: The separable connector system shall include the loadbreak elbow, the bushing insert, and 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.

F. Allow sufficient slack in high voltage cable, ground, and drain wires to permit elbow connectors to be moved to their respective parking stands.

G. Provide insulated cable supports to relieve any strain imposed by cable weight or movement.

2.8 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.

2.9 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 65 degrees C by resistance, and 80 degrees C hot spot at rated kVA.

D. Transformer insulating material shall be mineral oil and shall be in accordance with ASTM D 3487.

E. Transformer impedance shall be not less than 4.5 percent 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 2-1/2 percent 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.
4. Coil and core losses shall be optimum for the most efficient operation.
5. Primary, secondary and tap connections shall be brazed or pressure type.
6. Provide end fillers or tie downs for coil windings.

J. The transformer tank, cover, and radiator gage 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 gage and filling plug.
   f. A grounding pad in the high 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. Liquid filled 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 equipment manufacturer.

B. Foundation:

1. Provide foundation of reinforced concrete, Type C, 21mPa (3000 psi minimum, 28 day compressive strength), and comply with the ACI 318.
2. Locate the top of foundation pads 150mm (6-inches) 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 the transformers with cadmium or zinc plated bolts, nuts and washers. Bolts shall not be less than 12mm (1/2-inch) diameter.

C. Grounding:

1. Ground each padmounted transformer in accordance with the requirements of the NEC. Install 19mm (3/4-inch) diameter by 3m (10 feet) long copper-clad ground rods, driven 3m (10 feet) below grade to maintain a maximum resistance of five ohms to ground. Thermite weld the cable to the ground rods.
2. Connect the ground rod to the ground pads in the high and low voltage compartments, and to the secondary (and primary) neutral with not less than a 2/0 AWG bare copper conductor.
3. Refer to the section of the specifications describing GROUNDING for testing.
4. 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 will permit circulating currents, or cable fault currents, to pass through them.

3.2 SPARE PARTS

A. Deliver the following spare parts for the project to the COTR two weeks prior to final inspection:

1. Six stand-off insulators.
2. Six insulated protective caps.
3. One spare set of high voltage fuses for each size fuse used in the project.

3.3 INSTRUCTIONS

1. The contractor shall instruct VA maintenance personnel, for not less than one (1) 2-hour period, on the maintenance and operation of the equipment on the date requested by the COTR.

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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 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements 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: Conduit and outlet boxes.

F. Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY: Coordination study of overcurrent protection devices.

G. Section 26 09 13, ELECTRICAL POWER MONITORING AND CONTROL: For metering devices integral to the distribution switchboards.

H. Section 26 27 13, ELECTRIC METERING: For revenue metering devices integral to the distribution switchboards.

I. 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.

C. Furnish four (4) copies of certified manufacturer's factory test reports to the COTR prior to shipment of the switchboards to ensure that the switchboards have been successfully tested as specified.

D. The VA shall have an option to witness the factory tests. All expenses of the VA Representative's trips to witness the testing will be paid by the VA. Notify the COTR not less than 30 days prior to making tests at the factory.

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 COTR.
   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 COTR:
   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 or group mounted with feeder breakers.
   b. Feeder breakers: Group mounted.
2. Section alignment: As shown on the drawings.
3. Accessibility:
   a. Main section line and load terminals: Front and side.
   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: 42,000 amperes rms symmetrical, minimum, or as shown on the drawings, whichever is higher.

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 to be the manufacturers standard gray. Provide a quart of finish paint for touch-up purposes.

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

Refer to Section 26 09 13, ELECTRICAL POWER MONITORING AND CONTROL.

2.7 NAMEPLATES AND MIMIC BUS

A. Nameplates: For Normal Power system, provide laminated black phenolic resin with white core with 1/2 inch [12mm] engraved lettered nameplates next to each circuit breaker. For Essential Electrical System, provide laminated red phenolic resin with white core with 1/2 inch [12mm] 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. 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 BREAKER REMOVAL EQUIPMENT

Where draw out circuit breakers are provided, furnish a portable elevating carriage or switchboard permanent top mounted device for installation and removal of the breakers.

2.10 CONTROL WIRING

Control wiring shall be 600 volt class B stranded SIS. Install all control wiring complete at the factory adequately bundled and protected. Wiring across hinges and between shipping units shall be Class C stranded. Size in accordance with NEC. Provide control circuit fuses.

2.11 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 indicated on the drawings. Final settings shall be as shown on the electrical system protective device study.
   3. Breakers, which have same rating, shall be interchangeable with each other.

2.12 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.

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. In seismic areas, switchboard shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

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 COTR.

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SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of panelboards.

1.2 RELATED WORK

A. Section 09 91 00, PAINTING: Identification and painting of panelboards.

B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of nonstructural components.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.

D. Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY: Requirements for the over current protective devices to be installed to ensure proper equipment and personnel protection.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.

F. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

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.

1.3 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, wiring diagrams accessories and weights of equipment. Complete nameplate data including manufacturer’s name and catalog number.

C. Certification: Two weeks prior to final inspection, submit four copies of the following to the COTR:

1. Certification that the material is in accordance with the drawings and specifications has been properly installed, and that the loads are balanced.

1.4 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 the basic designation only.

A. National Electrical Manufacturers Association (NEMA):

PB-1-2006.....Panelboards

AB-1-2002.....Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures

B. National Fire Protection Association (NFPA):

70-2005 .....National Electrical Code (NEC)

70E-2004.....Standard for Electrical Life Safety in the Workplace

C. Underwriters Laboratories, Inc. (UL):

50-2003.....Enclosures for Electrical Equipment

67-2003.....Panel boards

489-2006.....Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 PANELBOARDS

A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.

B. Panelboards shall be standard manufactured products. All components of the panelboards shall be the product and assembly of the same manufacturer. All similar units of all panelboards to be of the same manufacturer.

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 to circuit breaker operating handles only, not to energized ports.
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. All panelboards shall be completely factory assembled with molded case circuit breakers. Include one-piece removable, inner dead front cover independent of the panelboard cover.

E. Panelboards shall have main breaker or main lugs, 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. Nonreduced size copper or aluminum bus bars, complete with current ratings as shown on the panel schedules connection straps bolted together and rigidly supported on molded insulators.
2. Bus bar connections to the branch circuit breakers shall be the “distributed phase” or “phase sequence” type. Three-phase, four-wire busing shall be such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two-or three-pole breakers can be installed at any location. Current-carrying parts of the bus assembly shall be plated. Mains ratings shall be as shown.
3. Mechanical lugs furnished with panelboards shall be cast, stamped or machined metal alloys of sizes suitable for the conductors indicated to be connected thereto.
4. Neutral bus shall be 100 rated, mounted on insulated supports.
5. Grounding bus bar equipped with screws or lugs for the connection of grounding wires.
6. Buses braced for the available short circuit current, but not less than 22,000 amperes symmetrical for 120/208 volt panelboards.
7. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.
8. Protective devices shall be designed so that they can be easily replaced.
9. Where designated on panel schedule "spaces", include all necessary bussing, device support and connections. Provide blank cover for each space.
10. In two section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panels, and with cable connections to the second section. Panelboard sections with tapped bus or crossover bus are not acceptable.
11. Series rated panelboards are not permitted.

2.2 CABINETS AND TRIMS

A. Cabinets:

1. Provide galvanized steel cabinets to house panelboards.
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. Breakers shall be UL 489 listed and labeled, in accordance with the NEC, as shown on the drawings, and as specified.

B. Circuit breakers in panelboards shall be bolt on type on phase bus bar or branch circuit bar.

1. Molded case circuit breakers for lighting and appliance branch circuit panelboards shall have minimum interrupting rating as indicated but not less than:
   a. 120/208 Volt Panelboard: 22,000 amperes symmetrical.
2. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100-ampere frame or less. Magnetic trip shall be adjustable from 3X to 10X for breakers with 600 ampere frames and higher. Breaker trip setting shall be set in the field based on the approved protective device study as specified in Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY. Factory setting shall be HI, unless otherwise noted.

C. 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.
   a. Line connections shall be bolted.
   b. Interrupting rating shall not be less than the maximum short circuit current available at the line terminals as shown on the

electrical system protective device study as required in Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY.

8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
9. Shunt trips shall be provided where indicated.

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. Coordinate the sizes of cabinets with designated closet space.

C. In accordance with Section 09 91 00, PAINTING, paint the panelboard system voltage, and feeder sizes as shown on the riser diagram in 1 inch block lettering on the inside cover of the cabinet door. Paint the words "LIFE SAFETY BRANCH", "CRITICAL BRANCH", or "EQUIPMENT SYSTEM" as applicable and the panel designation in one inch block letters on the outside of the cabinet doors.

D. Install a typewritten schedule of circuits in each panelboard after being submitted to and approved by the COTR. Schedules, after approval, shall be typed on the panel directory cards and installed in the appropriate panelboards, incorporating all applicable contract changes pertaining to that schedule. Include the room numbers and items served on the cards.

E. Mount the panelboard fully aligned and such that the maximum height of the top circuit breaker above finished floor shall not exceed 1980 mm (78 inches). For panelboards that are too high, mount panelboard so that the bottom of the cabinets will not be less than 150 mm (6 inches) above the finished floor.

F. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.

G. Directory-card information shall be typewritten to indicate outlets, lights, devices, and equipment controlled and final room numbers served by each circuit and shall be mounted in holders behind protective covering.

H. Provide ARC flash identification per NFPA 70E.

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SECTION 26 27 13

ELECTRICITY METERING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, complete installation, and connection of the electric meters for special loads.

1.2 RELATED WORK

Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that is common to more than one section of Division 26.

1.3 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 and clearances required for servicing.

C. Manuals: Two weeks prior to the final inspection, submit four copies of the following to the COTR:

1. Complete maintenance, operating and testing manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:

1. Certification by the manufacturer that the meter conforms to the requirements of the drawings and specifications, and the meter has been properly calibrated.
2. Certification by the contractor that the meter 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. American National Standards Institute (ANSI):

C12.1-01.....Electric Meters Code for Electricity Metering

C12.10-04.....American National Standard for Watt-hour Meters

C. Institute of Electrical and Electronic Engineers (IEEE):
C37-90.1-02.....Standard Surge Withstand Capability (SWC) Tests for Protection Relays and Relay Systems

D. National Fire Protection Association (NFPA):
70-05.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):
414-04.....Standard for Safety Meter Sockets.

PART 2 - PRODUCTS

2.1 SUBMETERING EQUIPMENT FOR SPECIAL LOADS

A. The equipment shall meter all of the single phase and three phase electrical service used by the equipment shown on the drawings

B. Polyphase watthour and recording demand/submetering equipment:

1. Shall be microprocessor-based:
   a. Microprocessor meters shall monitor the energy used on the ac systems 208/120 volts, 3 phase.
   b. The unit shall be able to transmit information by twisted pair cable to a local network, Energy Control Center.
   c. The unit shall be provided with three built-in doughnut type current transformers.
   d. The unit shall display the following:
      1) Watts.
      2) Demand-Present.
      3) Demand-Peak.
      4) Watt-Hours.
   e. The unit shall be provided with an adjustable demand window of 5-, 10-, 15-, 30-, or 60-minute intervals.
   f. Accuracy of the meter shall be ±1 percent. All readings shall be adjustable from a remote location.
   g. Operating temperature range: -40 degrees F to 140 degrees F
2. Integrating demand intervals shall coincide with the power company's meter.
3. Multipliers shall be suitable for the sizes of the connected loads.

PART 3 - EXECUTION

3.1 INSTALLATION & INTEGRATION

A. Installation shall be in accordance with the NEC, and as shown on the drawings.

B. Install circuits and make connections as required for the metering equipment.

C. Meter shall be integrated into Schneider Electric's wireless metering software. Integration through Schneider Electric is part of the scope of this contract. Contact Adrian Bailey, 504-722-4750, or Michael Reed, 615-556-5267, at Schneider Electric.

3.2 DEMONSTRATION

A. At the final inspection in the presence of the VA representative, demonstrate that the electric meter operates properly in all respects.

1. Test and adjust all controls and safeties. Replace or repair all malfunctioning controls, safeties, and equipment as soon as possible to avoid any delay in the use of the equipment.

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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 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. Include electrical ratings, dimensions, mounting details, construction materials, grade and termination information.

C. Manuals: Two weeks prior to final inspection, deliver four copies of the following to the COTR: Technical data sheets and information for ordering replacement units.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR: 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 and Double Duplex Receptacles: Hospital-grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, and conform to the NEMA 5-20R configuration in NEMA WD 6. 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 white in color.
2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The remaining receptacle shall be unswitched.
3. Duplex Receptacles on Emergency Circuit:
   a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.

4. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box.
   a. Ground fault interrupter shall be 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.
5. Safety Type Duplex Receptacles:
   a. Bodies shall be gray in color.
      1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.
      2) Screws exposed while the wall plates are in place shall be the tamperproof type.

C. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete with appropriate cord grip plug. Devices shall meet UL 231.

D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

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 MANUAL DIMMING CONTROL FOR COMPACT FLUORESCENT LAMPS

A. slide dimmer with on/off control, single-pole or three-way as shown on plans. Faceplates shall be ivory in color unless otherwise specified.

B. Manual dimming controls shall be fully compatible with electronic dimming ballasts and approved by the ballast manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.

C. Dimmer shall be solid state.

D. Light output shall be uniform throughout a controlled circuit of lamps, and be free from flicker.

E. the dimming control and fixture/lamp combination shall be totally inaudible at 27dB room ambient.

2.4 WALL PLATES

A. Wall plates for switches and receptacles shall be type smooth nylon. Oversize plates are not acceptable.

B. Color shall be white 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. Wall plates for data, telephone or other communication outlets shall be as specified in the associated specification.

F. Duplex Receptacles on Emergency Circuit:

1. Bodies shall be red in color. Wall plates shall be red with the word "EMERGENCY" engraved in 6 mm, (1/4 inch) white letters.

G. Label all receptacles and light switches with ¼” laminated tape showing the panel and breaker number associated.

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.

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 [1200mm] above floor, OFF position down. Label wall switches with associated panel and breaker on ¼" laminated tape.

H. Install wall dimmers 48 inches [1200mm] above floor; derate ganged dimmers as instructed by manufacturer; do not use common neutral.

I. Install convenience receptacles 18 inches [450mm] above floor, and 6 inches [152mm] 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 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for Seismic Restraint for Nonstructural Components.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.

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 09 13, ELECTRICAL POWER MONITORING AND CONTROL: For metering devices integral to the starters.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 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, weights, mounting details, materials, running over current protection, size of enclosure, over current protection, wiring diagrams, starting characteristics, interlocking and accessories.

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 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 COTR.

C. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certifications to the COTR:

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 COTR 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. Circuit breakers and safety switches within the motor controller enclosures shall have external operating handles with lock-open padlocking provisions and shall indicate the ON and OFF positions.
3. Motor control circuits:
   a. Shall operate at not more than 120 volts.
   b. Shall be grounded except as follows:
      1) Where isolated control circuits are shown.
      2) Where manufacturers of equipment assemblies recommend that the control circuits be isolated.
   c. Incorporate a separate, heavy duty, control transformer within each motor controller enclosure to provide the control voltage for each motor operating over 120 volts.
   d. Incorporate over current protection for both primary and secondary windings of the control power transformers in accordance with the NEC.
4. 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 COTR, which indicates and adequately identifies every motor controller installed. Include the catalog numbers for the correct sizes of protective devices for the motor controllers.

5. Hand-Off-Automatic (H-O-A) switch is required unless specifically stated on the drawings as not required for a particular starter. H-O-A switch is not required for manual motor starters.

6. Incorporate into each control circuit a 120-volt, solid state time delay relay (ON delay), minimum adjustable range from 0.3 to 10 minutes, with transient protection. Time delay relay is not required where H-O-A switch is not required.

7. Unless noted otherwise, equip with not less than two normally open and two normally closed auxiliary contacts. Provide green run pilot lights and H-O-A control devices as indicated, operable at front of enclosure without opening enclosure. Push buttons, selector switches, pilot lights, etc., shall be interchangeable.

8. 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.

b. Doors mechanically interlocked to prevent opening unless the breaker or switch within the enclosure is open. Provision for padlock must be provided.

c. Enclosures shall be primed and finish coated at the factory with the manufacturer’s prime coat and standard finish.

2.2 MANUAL MOTOR STARTERS

A. Shall be in accordance with applicable requirements of 2.1 above.

B. Manual motor starters.

1. Starters shall be general-purpose Class A, manually operated type with full voltage controller for induction motors, rated in horsepower.

2. Units shall include overload protection, red pilot light, and toggle operator.

C. 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.

D. Motor starting switches.
1. Switches shall be general-purpose Class A, manually operated type 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 REDUCED VOLTAGE MOTOR CONTROLLERS

A. Shall be in accordance with applicable portions of 2.1 above.
B. Shall be installed as shown for motors on the contract drawings.
C. Shall have closed circuit transition for the types which can incorporate such transition.
D. Shall limit inrush currents to not more than 70 percent of the locked rotor currents.
E. Provide phase loss protection for each starter, with contacts to de-energize the starter upon loss of any phase.

2.5 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. Operating and Design Conditions:

Elevation:	250 feet AMSL
Temperatures:	Maximum +96°F Minimum +23°F
Relative Humidity:	95%
Drive Location:	Air conditioned Building

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.
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. Include a by-pass starter with circuitry to protect and isolate the variable speed controller. When the variable speed controller is in the by-pass mode, the solid-state components shall be isolated from the power supply on both the line and motor side. Motor overload protection shall be active in by-pass operation.
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. Include Harmonic filter within the enclosure of the VFD.

K. Building automation system interface (BAS): Factory-installed 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. protocols accessible via the communications ports.

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: Contactor-style bypass allows motor operation via the power converter or the bypass controller, 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.

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. In seismic areas, equipment shall be adequately anchored and braced per details on structural contract drawing to withstand the seismic forces at the location where installed.

C. 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.

D. 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.

E. Connect hand-off auto selector switches so that automatic control only is by-passed in "manual" position and any safety controls are not by-passed.

F. Install manual motor starters in flush enclosures in finished areas.

G. Examine control diagrams indicated before ordering motor controllers. Should conflicting data exist in specifications, drawings and diagrams, request corrected data prior to placing orders.

3.2 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust at six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If

tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify COTR before increasing settings.

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. Inspect contactors.
   d. Clean motor starters and variable speed motor controllers.
   e. Verify overload element ratings are correct for their applications.
   f. If motor-running protection is provided by fuses, verify correct fuse rating.
   g. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data.
2. Variable speed motor controllers:
   a. Final programming and connections to variable speed motor controllers shall be by a factory-trained technician. Set all programmable functions of the variable speed motor controllers to meet the requirements and conditions of use.
   b. Test all control and safety features of the variable frequency drive.

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.

3.5 SPARE PARTS

Two weeks prior to the final inspection, provide one complete set of spare fuses (including heater elements) for each starter/controller installed on this project.

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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 1-01.....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 240 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 6 mm (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.

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 13

ENGINE GENERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, complete installation, connection and testing of the engine generator system. This includes: air filtration, starting system, generator controls, instrumentation, lubrication, fuel system, cooling system and exhaust system.

B. The engine generator system shall be fully automatic and shall constitute a unified and coordinated system ready for operation.

C. The engine generator system shall include, but not be limited to the following:

1. Diesel Engine.
2. Lubrication Oil System.
3. Fuel Oil System.
4. Cooling System.
5. Intake and Exhaust Air Systems.
6. Starting System.
7. Generator.
8. Controls, Supervision and Distribution.
9. Outdoor Generator Enclosure.
10. Spare Parts.
11. Integration into BMS Tridium System.

1.2 RELATED WORK

A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural equipment.

B. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Requirements for pipe and equipment support and noise control.

C. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Requirements for hot piping and equipment insulation.

D. Section 23 21 11, Boiler Plant Piping Systems and Section 23 10 00, FACILITY FUEL SYSTEMS for fuel-oil piping.

E. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

F. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW: Cables and Wiring.

G. Section 26 36 23, AUTOMATIC TRANSFER SWITCHES: Requirements for automatic transfer switches.

H. 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.

I. Section 26 24 11, DISTRIBUTION SWITCHBOARDS: Requirements for secondary distribution switchboards.

J. Section 23 09 23, Direct Digital Controls for HVAC Systems (BMS Integration).

1.3 QUALITY ASSURANCE

A. The supplier of the diesel-engine generator set shall be responsible for satisfactory total operation of the system and its certification. This supplier shall have had experience with three or more installations of systems of comparable size and complexity in regards to coordinating, engineering, testing and supervising. Each of these installations shall have been in successful operation for three or more years. Prior to review of submittals, the Department of Veterans Affairs reserves the right to:

   1. Have the manufacturer submit a list of locations of similar installations.
   2. Inspect any of these installations and operations of engine-generator set, and question the user concerning the installations without the presence of the supplier.

B. Factory authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 4 hours maximum of notification.

C. Engine generator and auxiliary components shall be supplied from a single manufacturer.

D. Noise level developed by the generator set shall be as herein specified.

E. Factory Test: The VA shall have the option of witnessing the following tests at the factory. The VA will pay all expenses for the VA representative's trip to witness these tests. Contractor shall notify the COTR 15 days prior to date of testing. Manufacturer shall furnish load banks, testing instruments and all other equipment as necessary to perform these tests.

   1. Load Test: Shall include six hours of continuous operation; four hours while the set is delivering 100 percent of the specified KW

and two hours while delivering 110 percent of the specified KW. During this test record the following data at 20-minute intervals:

Time	Engine RPM	Oil Temperature Out
KW	Water Temperature In	Fuel Pressure
Voltage	Water Temperature Out	Oil Pressure
Amperes	Oil Temperature In	Ambient Temperature

2. Quick Start Test: Record time required for the engine generator set to develop specified voltage, frequency and KW load from a standstill condition.

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. Data shall be submitted in the following form:
   a. Technical data sheets (TDS): These include published performance, rating and derating curves, published ratings, catalog cuts, pictures, manufacturer's specifications, material composition, and gauge thickness.
   b. Description of operation (DO): Manufacturer's literatures and, if suitable, diagrams.
   c. Calculations (CALC): Detailed engineering calculations with all equations, graphs, assumptions, and approximations shown, and data sources referenced.
   d. Certification (CERT): Written confirmation as to the document's accuracy, and genuineness.
   e. Shop Drawings (SD): Scaled drawings showing plan views, side views, elevations and cross sections.
   f. Diagrams (DGM): These include control system diagrams, elementary diagrams, control sequence diagrams or table, wiring diagrams, interconnections diagrams (between local control cubicles, remote annunciator panels, remote derangement panels, remote monitoring panels, remote exercising panel and underground fuel storage tanks), wireless connection diagrams, illustrative diagrams, flow diagrams, and other like items.

3. Prior to fabrication, submit for approval the following data for each engine-generator set, transfer device and control and supervisory equipment:
   a. Engine generator set: TDS, SD including subtransient reactance and short-circuit current capacity.
   b. Engine jacket water heaters: TDS
   c. Muffler assembly: TDS, SD
   d. Motor-operated damper assembly: TDS
   e. Day tank and pumps or integral sub-base fuel tank: TDS, CALC
   f. Batteries, racks and charger: TDS, CALC
   g. Torsional Vibration: CERT
   h. Control and Supervisory Equipment: TDS, DGM, DO, SD
   i. Performance:
      1) Voltage regulating equipment: TDS
      2) Frequency regulating equipment: TDS
      3) Voltage and frequency dips and recovery times due to specified motor loading: CALC
      4) Antifreeze derating: TDS
      5) Ambient derating: TDS
   j. Fuel oil system: DGM
   k. Cooling system: DGM
   l. Vibration isolators: TDS, CALC
   m. Sound power level data for the packaged outdoor generator.
   n. Vibration isolation system performance data from no-load to full-load. This must include seismic qualification of the engine-generator mounting, base and vibration isolation.

C. Manuals:
   1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals of the engine generator set and auxiliaries including technical data sheets, wiring diagrams, and information, such as telephone number, fax number, and web sites, for ordering replacement parts.
   2. Two weeks prior to the final inspection, submit four copies of the updated maintenance and operating manual to the COTR:
      a. Include complete "As installed" diagrams, which indicate all items of equipment and their interconnecting wiring.

b. Include complete diagrams of the internal wiring for each of the items of equipment, including "As installed" revisions of the diagrams.
c. The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation and testing.
d. Complete lists of spare parts and special tools recommended for two years of normal operation of the complete system.

D. Certifications:
1. Prior to fabrication of the engine-generator set, submit the following for approval, to the COTR:
a. A certification in writing that a diesel engine of the same model and configuration, with the same bore, stroke, number of cylinders, and equal or higher BMEP and RPM ratings as the proposed diesel engine has been operating satisfactorily, with connected loads of not less than 75 percent of the specified KW/KVA rating, for not less than 2,000 hours without any failure of a crankshaft, camshaft, piston, valve, injector or governor system.
b. A certification in writing that devices and circuits will be incorporated to protect the voltage regulator and other components of the auxiliary electrical power system during operation of the diesel engine-generator set at speeds other than the rated RPM while performing maintenance. Include thorough descriptions with submittal of any precautions, which will be necessary to protect the voltage regulator and other components of the system during operation of the diesel engine-generator set at speeds other than the rated RPM.
2. Prior to installation of the engine-generator set at the job site, submit four copies of the following to the COTR:
a. Certified test data, alternator temperature rise test and strip chart recordings, and photographs showing test setup and equipment.
3. Two weeks prior to the final inspection, submit four copies of the following, to the COTR:
a. Certified test report by the manufacturer of the engine-generator set that the auxiliary electrical power system conforms to the requirements of the drawings and specifications.

b. Certified report of field tests from the contractor that the engine-generator set and major auxiliaries have been properly installed, adjusted and tested.

c. A certificate by the manufacturer that the engine-generator set, accessories, and components will withstand the seismic forces (Zone=1) and that the set will be fully operational after the seismic event at the project site.

1.5 STORAGE AND HANDLING

A. Equipment shall withstand the mechanical stresses caused by rough handling during shipment in addition to the electrical and mechanical stresses, which occur during operation of the system. Protect radiator core with wood sheet.

B. Store the equipment in a location approved by the COTR.

1.6 JOB CONDITIONS

A. Shall conform to the arrangements and details shown on the drawings. The dimensions, enclosures and arrangements of the engine-generator set shall permit the operating personnel to safely and conveniently operate and maintain the system in the space designated for installation.

B. Unless specified otherwise, each component of the engine-generator system shall be capable of operating as specified herein at 85 meters (250 feet) above sea level in an outdoor space will have average ambient air temperatures ranging from a minimum of -5 degrees C (23 degrees F) in winter to maximum of 36 degrees C (96 degrees F) in summer.

1.7 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):

C37.50-00.....Low-Voltage AC Power Circuit Breakers used In Enclosures-Test Procedures

C. American Society of Testing Materials (ASTM):

A53/A53M-04.....Standard Specification for Pipe, Steel, Black, and Hot-Dipped, Zinc Coated Welded and Seamless.

B88-03.....Specification for Seamless Copper Water Tube

B88M-03.....Specification for Seamless Copper water Tube (Metric)

D. Institute of Electrical and Electronic Engineers (IEEE):

C37.13-95.....Low Voltage AC Power Circuit Breakers Used In Enclosures

C37.90.1-02.....Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

E. National Electrical Manufacturers Association (NEMA):

AB 1-02.....Molded Case Circuit Breakers and Molded Case Switches and Circuit Breaker Enclosures

ICS 6-01.....Industrial Control and Systems: Enclosures

ICS 4-05.....Terminal Blocks,

MG 1-04.....Motor and Generators

MG 2-01.....Safety Standard and Guide for Selection, Installation and use of Electric Motors and Generators

PB 2-01.....Dead-Front Distribution Switchboards

SG 3-95.....Low Voltage Power Circuit Breakers-Power Switching Equipment

SG 5-95.....Power Switchgear Assemblies

250-03.....Enclosures for Electrical Equipment (1000 Volts Maximum)

F. National Electrical Testing Association (NETA):

ATS-95.....Electrical Power Distribution Equipment and Systems

G. National Fire Protection Association (NFPA):

30-03.....Flammable and Combustible Liquids Code.

37-02.....Installations and Use of Stationary Combustion Engine and Gas Turbines

70-05.....National Electrical Code (NEC)

99-05.....Health Care Facilities

110-05.....Standard for Emergency and Standby Power Systems.

H. Underwriters Laboratories, Inc. (UL):

50-03.....Enclosures for Electrical Equipment

142-02.....Steel Aboveground Tanks for Flammable and Combustible liquids

2085-95.....Insulated Aboveground Tanks for Flammable and Combustible Liquids

2200-04.....Stationery Engine Generator Assemblies

1236-02.....Battery Charges for Charging Engine-Starter Batteries

467-04.....Grounding and Bonding Equipment.

489-04.....Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

508-05.....Industrial Control Equipment

891-03.....Dead-Front Switchboards

PART 2 - PRODUCTS

2.1 DIESEL ENGINE-GENERATOR SET

A. The engine generator system shall be in accordance with NFPA, UL, NEMA and ANSI, and as specified and as shown on the drawings.

B. Provide a factory-assembled, wired, (except for the field connections), complete, fully automatic diesel engine-generator system.

   1. For installations with engine driven radiator fan: 440.

C. Published Rating:

   1. Shall be not less than 350/437.5 KW/KVA Standby at 120/208 volts, 3-phase, 4-wire, 60 Hz and 0.80 power factor.
   2. Shall be capable of operating continuously for 7 consecutive days within any 7-day period of operation at 110 percent of its specified rating without damage.

D. Assemble, connect and wire the equipment at the factory so that only the external connections need to be made at the construction site.

E. Unit shall be factory painted with manufacturer's primer and standard finishes.

F. Coordinate the components of the system and their arrangements, electrically and mechanically.

G. Connections between components of the system shall conform to the recommendations of the manufacturer of the diesel engine-generator set.

H. Couplings, shafts, and other moving parts shall be enclosed and guarded. Guards shall be metal, ruggedly constructed, rigidly fastened and readily removable for convenient servicing of the equipment without disassembling any pipes and fittings.

I. Generator set and cooling system shall be furnished with extended life antifreeze solution to protect the system from freezing at all times.

J. Generator set shall have the following features:

1. Factory-mounted on a common, rigid, welded, structural steel base.
2. The maximum engine-generator set vibration in the horizontal, vertical, and axial directions shall be limited to 0.15mm with an overall velocity limit of 24 mm/sec RMS, for all speeds.
3. The isolators shall be constrained with restraints capable of withstanding static forces in any direction equal to twice the weight of the supported equipment.
4. Automatic start, accelerate to the specified RPM and deliver the specified KW/KVA output at 60 Hz within 10 seconds after a single pole contact closes in a remote device.
5. Recover rapidly from instantaneous changes between no load and the specified KW/KVA rating, and the reverse changes of load, without damage.
6. Shall be capable of operating satisfactorily as specified for not less than 10,000 hours between major overhauls.
7. Engine-generator set shall be statically and dynamically balanced at the factory in order to comply with the maximum vibration velocity specified in paragraph 3.1.D.

2.2 DIESEL ENGINE

A. Coupled directly to a generator.

B. Minimum 4-cylinders.

C. Operating speed shall be 1800 RPM.

D. BMEP for the diesel engine, while the engine-generator set is delivering 100 percent of its specified output, shall not exceed the following maximum limits: 313 (psi)

E. The minimum cubic inch displacement of the engine shall not be less than the value calculated from the following equation:

$$\text{Displacement} = \frac{\text{BHP} \times K}{\text{BMEP} \times \text{RPM}}$$

$$\text{Where BHP} = \frac{\text{Specified KW}}{0.746 \times G} + R$$

K = 396,000 for 2-cycle engines

K = 792,000 for 4-cycle engines

BMEP = Values specified above

RPM = 1800

G = generator efficiency expressed as a decimal

R = horsepower of radiator fan

R = O, when electric motor driven radiator fan is herein specified

F. The engine shall be able to start in a 4.5 degrees C (40 degrees F) ambient temperature while using No. 2 diesel fuel oil without the use of starting aids such as glow plugs and ether injections.

G. Fuel oil consumption of the engine rate shall not exceed 0.44 pounds of fuel oil per BHP per hour when it delivers 100 percent of its specified KW/KVA rating.

H. Equipped with electric heaters for maintaining the engine's coolant temperature in the range of 32-38 degrees C (90-100 degrees F) as recommended by the manufacturer.

1. Install thermostatic controls, contactors, and circuit breaker protected circuits for the heaters.
2. The heaters shall operate continuously except while the engine is operating or the water temperature is at the predetermined level.

2.3 GOVERNOR

A. Isochronous; electronic or hydraulic type.

B. Steady-state speed band at 60 Hz shall not exceed plus or minus 1/3 of one percent.

C. At 60 Hz, when load changes equal to 25 percent of the specified KW/KVA rating, frequency change shall not exceed two percent and it shall recover to 60 Hz within three seconds.

D. At 60 Hz, when load changes equal to 100 percent of the specified KW/KVA rating, frequency change shall not exceed eight percent and it shall recover to 60 Hz within five seconds.

E. While the engine is running, manual speed adjustments may be made.

2.4 LUBRICATION OIL SYSTEM

A. Pressurized type.

B. Positive-displacement pump driven by engine crankshaft.

C. Full-flow strainer and full-flow or by-pass filters.

D. Filters shall be cleanable or replaceable type and shall remove particles as small as 3 microns without removing the additives in the oil. For by-pass filters, flow shall be diverted without flow interruption.

E. Extend lube oil sump drain line passing out through the skid base and terminate it with a drain valve and plug.

F. Provide a 120-volt oil heater for exterior generator set.

2.5 FUEL OIL SYSTEM

A. Shall comply with NFPA 37 and NFPA 30, and have the following features:
   1. Injection pump(s) and nozzles.
   2. Plungers shall be carefully lapped for precision fit and shall not require any packing.
   3. Filters or screens, which require cleaning or replacement, will not be permitted in the injection system assemblies.

B. Piping System: Black steel, standard weight, ASTM A-53 pipe and necessary valves and pressure gages between:
   1. The engine and the day tank as shown on the drawings.

2.6 ENGINE COOLING SYSTEM

A. Liquid-cooled, closed loop, with radiator mounted on the engine generator set and integral engine driven circulating pump as shown on the drawings.

B. Cooling capacity shall not be less than the cooling requirements of the engine-generator set and its lubricating oil while operating continuously at 110 percent of its specified rating.

C. Water circulating pumps shall be the centrifugal type driven by engine. Incorporate pressure relief devices, where required, to prevent excessive pressure increase after the engine stops.

D. Coolant shall be extended life antifreeze solution, 50 percent ethylene and 50 percent soft water, with corrosion inhibitor additive as recommended by the manufacturer

E. Radiator core tubes material shall be as recommended by the engine manufacturer.

F. Fan shall be driven by totally enclosed electric motor.

G. Coolant hoses shall be flexible per manufacturer's recommendation.

H. Self-contained thermostatic-control valve shall modulate coolant flow to maintain optimum constant coolant temperature as recommended by the engine manufacturer.

2.7 AIR INTAKE AND EXHAUST SYSTEMS

A. Air Intake:

   Provide an engine-mounted air cleaner with replaceable dry filter and dirty filter indicator.

B. Exhaust System:

   1. Where turbo-charges are required, they shall be engine-mounted, driven by the engine gases, securely braced against vibration and adequately lubricated by the engine's filtered lubrication system.

2. Exhaust Muffler:
   a. Shall be Critical grade type and capable of the following noise attenuation:

Octave Band Hertz (Mid Frequency)	Minimum db Attenuation (.0002 Microbar Reference)
31	5
63	10
125	27
500	37
1000	31
2000	26
4000	25
8000	26

3. Pressure drop in the complete exhaust system shall be small enough for satisfactory operation of the engine-generator set while it is delivering 110 percent of its specified rating.
4. Exhaust pipe size, from the engine to the muffler, shall be as recommended by the engine manufacturer. Pipe size from muffler to air discharge shall be two-pipe sizes larger than engine exhaust pipe.
5. Connections at the engine exhaust outlet shall be made with a flexible exhaust pipe. Provide bolted type pipe flanges welded to each end of the flexible section.

C. Condensate drain at muffler shall be made with schedule 40 black steel pipe through a petcock.

D. Exhaust Piping and Supports: Black steel pipe, ASTM A-53 standard weight with welded fittings. Spring type hangers, as specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, shall support the pipe.

E. Insulation for Exhaust Pipe and Muffler:
   1. Calcium silicate minimum 75 mm (3 inches) thick.
   2. Insulation shall be as specified in Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
   3. The installed insulation shall be covered with aluminum jacket 0.4 mm (0.016 inch) thick. The jacket is to be held in place by bands of (0.38 mm) (0.015 inch) thick by 15 mm (0.5 inch) wide aluminum.

4. Insulation and jacket are not required on flexible exhaust sections.

2.8 ENGINE STARTING SYSTEM

A. Shall start the engine at any position of the flywheel.

B. Electric cranking motor:

1. Shall be engine-mounted.
2. Shall crank the engine via a gear drive.
3. Rating shall be adequate for cranking the cold engine at the voltage provided by the battery system, and at the required RPM during five consecutive starting attempts of 10 seconds cranking each at 10 second intervals, for a total of 50 seconds of actual cranking without damage.

C. Batteries: 24 volt electric with the following features:

1. Batteries shall be nickel-cadmium high discharge rate type.
2. Each battery cell shall have minimum and maximum electrolyte level indicators, and flip top flame arrestor vent cap.
3. Batteries shall have connector covers for protection against external short circuits.
4. With the charger disconnected, the batteries shall have sufficient capacity so that the total system voltage does not fall below 85 percent of the nominal system voltage with the following demands:
   a. Five consecutive starting attempts of 10 seconds cranking at 10 second intervals for a total of 50 seconds of actual cranking (the fifth starting attempt will be manually initiated upon failure of a complete engine cranking cycle).
5. Battery racks shall be metal with an alkali resistant finish and thermal insulation, and secured to the floor.
6. Battery shall operate continuously for 12 hours and be able to provide the cranking power described in 2.8.B.3 without charging.

D. Battery Charger:

1. The charger shall maintain one percent voltage regulation from no load to full load for line voltage variation of 10 percent and frequency variation of ± 3 Hz from 60 Hz.
2. The charger shall maintain a nominal float voltage of 1.4 vdc and a nominal equalizing voltage of 1.6 vdc.
3. The charger shall be capable of continuous operation in an ambient temperature of −20 to 60 degrees C (-30 to 104 degrees F) without derating. The charger shall be convection cooled and housed in a

NEMA 250, Type 1 enclosure. The charger shall have a hinged front door and all components shall be accessible from the front.

4. Provide both AC and DC transient protection. Charger shall be able to recharge a fully discharged battery without tripping AC protective devices. AC circuit breaker shall not trip under any DC load condition including short circuit on output terminals.
5. The charger shall be capable of recharging the fully discharged battery in 12 hours and simultaneously power the Supervisory and Control panel.
6. The charger shall have fused AC input and DC output protection, and shall not discharge the batteries when AC power fails.
7. The charger shall have the following accessories:
   a. On-Off control switch with pilot light.
   b. Hand adjustable 0 to 24 hour equalize charge timer.
   c. AC power failure alarm light.
   d. High DC voltage alarm light.
   e. DC voltmeter – 5 percent accuracy.
   f. DC Ammeter – 5 percent accuracy.

2.9 GENERATOR

A. Synchronous, amortisseur windings, bracket-bearing, self-venting, rotating-field type connected directly to the engine.

B. Lifting lugs designed for convenient connection to and removal from the engine at the construction site.

C. Integral poles and spider, or individual poles dove-tailed to the spider.

D. Insulation shall be as required for the ambient temperature and other requirements designated in the paragraph, DIESEL ENGINE-GENERATOR SET, in this section.

E. Designed for sustained short circuit currents in conformance with NEMA Standards.

F. Designed for sustained operation at 125 percent of the RPM specified for the generator set without damage.

G. Telephone influence factor shall conform to NEMA Standards.

H. Furnished with brushless excitation system or static-exciter-regulator assembly.

I. Nameplates attached to the generator and exciter shall show the manufacturer's name, equipment identification, serial number, voltage ratings, field current ratings, KW/KVA output ratings, power factor

rating, time rating, temperature rise ratings, RPM ratings, full load current rating, number of phases and frequency, and date of manufacture.

J. At full load, the efficiency shall be not less than:
   1. 92 percent for sets specified over 175 KW.

K. The neutral shall be electrically isolated from equipment ground and terminated in same junction box as the phase conductors.

2.10 EQUIPMENT FOR CONTROLS, SUPERVISION AND DISTRIBUTION

A. Shall include Remote Annunciator Panel.
   1. Control Equipment shall be in accordance with UL 508, NEMA ICS-4, ICS-6 and ANSI C37.90.1.
   2. Panels shall be in accordance with UL 50.
   3. Incorporate all of the items required to fulfill the requirements in the specifications and on the drawings.
   4. Components:
      a. Shall be heavy duty, industrial type.
      b. Electrical contacts shall be precious metal surfaced.
      c. Only heavy duty solid-state components will be accepted.
   5. Coordinate controls with the automatic transfer devices shown on the drawings, so that the systems will operate as specified.
   6. Panels:
      a. Code gauge steel; manufacturer's recommended heavy gauge steel with factory primer and light gray finish.
      b. Doors shall be gasketed and be attached with concealed or semi-concealed hinges, and shall have a permanent means of latching in closed position.
      c. Panels shall be wall mounted or incorporated in other equipment as indicated on the drawings or as specified.
      d. Door locks for panels and cubicles shall have identical keying to operate from a single key.
      e. Panel installation shall be suitable for convenient maintenance and operation. Overall heights of the cubicles shall not exceed 2.5 meters (90 inches).
   7. Wiring: Insulated, rated at 600 volts, UL approved.
      a. Install the wiring in vertical and horizontal runs, neatly harnessed.
      b. Terminate all external wiring at heavy duty, pressure type, terminal blocks.

8. Clearly and permanently label the equipment, wiring terminals and wires.
9. Laminate or mount under plexiglas appropriate wiring diagrams and mount them within the frame on the inside of the cubicles and panels.
10. The system shall be designed and manufactured employing the most modern technology to insure maximum reliability and longevity.
11. All indicating lamps and switches shall be accessible and mounted on the cubicle doors.
12. Electronic governor control panel, voltage regulator, control panel, motorized voltage adjusting potentiometer, and associated components shall be shipped to the generator control switchboard manufacturer for assembly, mounting and/or interwiring in the switchboard. Detailed drawings outlining proper interconnection and physical mounting data shall also be furnished to the generator switchboard manufacturer to facilitate proper design and interfacing. The engine generator set supplier shall furnish these items as soon as possible.
13. All meters shall be solid-state switchboard type, 112 mm (4-1/2 inches), 1 percent accuracy transformer rated for 600 volt service. Ammeters and voltmeters shall be furnished with phase selector switches. Metering shall include necessary current and potential transformers and instrument fuses.
14. The repetitive accuracy of the monitors shall be as stated over an environmental temperature range of 0 to 45 degrees C (32 to 113 degrees F) and voltage range of 70 to 110 percent of nominal. The accuracy shall not exceed the following limits:

Voltage Monitors	+ 2 percent of set point
Current Monitors	+ 3 percent of set point
Frequency Monitors	+ 0.2 Hz.
Power Monitors	+ 3 percent of set point

15. The manufacturer shall coordinate the interfacing of the control systems with all related equipment supplied in accordance with other sections of the project specification.

B. Engine Generator Control Cubicle

1. Starting and Stopping Controls:

a. A three-position, maintained-contact type selector switch with positions marked "AUTOMATIC", "OFF" and "MANUAL". Provide flashing amber light for "OFF" and "MANUAL" positions.
b. A momentary contact pushbutton switch with positions marked "MANUAL START" and "MANUAL STOP".
c. Selector switch in "AUTOMATIC" position shall cause the engine to start automatically when a single pole contact in a remote device closes. When the generator's output voltage increases to not less than 90 percent of its rated voltage, and its frequency increases to not less than 58 Hz, the remote devices shall transfer the load to the generator. An adjustable time delay relay, 0 to 15 minute range, shall cause the engine generator set to continue operating without any load after completion of the period of operation with load. Upon completion of the additional 0 to 15 minute (adjustable) period, the engine generator set shall stop.
d. Selector switch in "OFF" position shall prevent the engine from starting either automatically or manually. Selector switch in "MANUAL" position shall cause the engine to start when the manual start pushbutton is also depressed momentarily.
e. With selector switch in "MANUAL" position, depressing the "MANUAL STOP" pushbutton momentarily shall stop the engine after a cool down period.
f. A maintained contact, red mushroom head pushbutton switch marked "EMERGENCY STOP" will cause the engine to stop without a cool down period independent of the position of the selector switch.

2. Engine Cranking Controls:
   a. The cranking cycles shall be controlled by timer that will be independent of the battery voltage fluctuations.
   b. Shall crank the engine through one complete cranking cycle, consisting of four starting attempts of 10 seconds each and 10 seconds between each attempt.
   c. Total actual cranking time for the complete cranking cycle shall be 40 seconds during a 70 second interval.
   d. Cranking shall terminate when the engine starts so the starting system will not be damaged. Termination of the cranking shall be controlled by self-contained, speed-sensitive switch. The switch shall prevent re-cranking of the engine until after the engine stops.

e. After the engine has stopped the cranking control shall reset.

3. Supervisory Controls:

a. Overcrank:

1) When the cranking control system completes one cranking cycle, four starting attempts, without starting the engine, the "OVERCRANK" signal light and the audible alarm shall be energized.

2) The cranking control system shall lock-out, and shall require a manual reset.

b. Coolant Temperature:

1) When the temperature rises to the predetermined first stage level, the "HIGH COOLANT TEMPERATURE - FIRST STAGE" signal light and the audible alarm shall be energized.

2) When the temperature rises to the predetermined second stage level, which shall be low enough to prevent any damage to the engine and high enough to avoid unnecessary engine shutdowns, the "HIGH COOLANT TEMPERATURE - SECOND STAGE" signal light and the audible alarm shall be energized and the engine shall stop.

3) Difference between the first and second stage temperature settings shall be approximately -12 degrees C (10 degrees F).

4) Permanently indicate the temperature settings near the associated signal light.

5) When the coolant temperature drops to below 21 degrees C (70 degrees F), the "LOW COOLANT TEMPERATURE" signal light and the audible alarm shall be energized.

c. Low Coolant Level: When the coolant level falls below the minimum level recommended by the manufacturer, the "LOW COOLANT LEVEL" signal light and audible alarm shall be energized.

d. Lubricating Oil Pressure:

1) When the pressure falls to the predetermined first stage level, the "OIL PRESSURE - FIRST STAGE" signal light and the audible alarm shall be energized.

2) When the pressure falls to the predetermined second stage level, which shall be high enough to prevent damage to the engine and low enough to avoid unnecessary engine shutdowns, the "OIL PRESSURE - SECOND STAGE" signal light and the audible alarm shall be energized and the engine shall stop.

3) Difference between the first and second stage pressure settings shall be approximately 15 percent of the oil pressure.
4) Permanently indicate the pressure settings near the associated signal light.

e. Overspeed:
1) When the engine RPM exceeds the maximum RPM recommended by the manufacturer of the engine, the engine shall stop.
2) Simultaneously, the "OVERSPEED" signal light and the audible alarm shall be energized.

f. Low Fuel - Day Tank:
1) When the fuel oil level in the day tank decreases to less than the level at which the fuel oil transfer pump should start to refill the tank, the "LOW FUEL DAY TANK" light and the audible alarm shall be energized.

g. Reset Alarms and Signals: Overcrank, Coolant Temperature, Coolant Level, Oil Pressure, Overspeed, and Low Fuel signal lights and the associated audible alarms shall require manual reset. A momentary-contact silencing switch and pushbutton shall silence the audible alarm by using relays of solid state devices to seal-in the audible alarm in the de-energized condition Elimination of the alarm condition shall automatically release the sealed-in circuit for the audible so that it will be automatically energized again when the next alarm condition occurs. The signal lights shall require manual reset after elimination of the condition, which caused them to be energized. Install the audible alarm just outside the generator room in a location as directed by the COTR. The audible alarm shall be rated for 85 dB at 3 meter (10 feet).

h. Generator Breaker Signal Light:
1) Molded case circuit breaker and contactor: A flashing green light shall be energized when the generator circuit breaker is in either the "OPEN" or "TRIPPED" position.
2) Power circuit breaker: A flashing green light shall be energized when the generator circuit breaker is in the "OPEN" or "TRIPPED" position.
3) Simultaneously, the audible alarm shall be energized.

4. Monitoring Devices:

a. Electric type gauges for the cooling water temperatures and lubricating oil pressures. These gauges may be engine mounted with proper vibration isolation.
b. A running time indicator, totalizing not less than a 9,999 hour, heavy duty and an electric type tachometer.
c. Voltmeter, ammeter, and their selector switches, frequency meter, kilowatt meter, manual adjusting knob for the output voltage and the other items shown on the drawings shall be mounted on the front of the generator control panels.
d. Install potential and current transformers as required.
e. Individual signal lights:
   1) OVER-CRANK
   2) HIGH COOLANT TEMPERATURE - FIRST STAGE
   3) HIGH COOLANT TEMPERATURE - SECOND STAGE
   4) LOW COOLANT TEMPERATURE
   5) OIL PRESSURE - FIRST STAGE
   6) OIL PRESSURE - SECOND STAGE
   7) LOW COOLANT LEVEL
   8) GENERATOR BREAKER
   9) OVERSPEED
   10) LOW FUEL - DAY TANK
   11) LOW FUEL – MAIN STORAGE TANK
f. Lamp Test: "Lamp Test" momentary contact switch shall momentarily actuate the alarm buzzer and all the indicating lamps.

5. Power switching and overcurrent protection shall be accomplished with molded case circuit breakers.
   a. Molded Case Circuit Breakers shall have the following features:
      1) Solid state adjustable trip type circuit breakers.
      2) Shall be in accordance with UL 489 and NEMA AB-1.
      3) 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 system for circuit breakers rated 480 volt, equal to or greater than 1000 amperes. The system shall alarm but not trip the circuit breaker.

4) Trip setting shall be as indicated on the drawings.

5) Shall be 100 percent rated.

6) Electrically and mechanically trip free.

7) Manual operating handle with lock-open padlocking provisions, and position indicators on the front of the breaker.

8) Rear stud connection for both line and load sides.

9) Shall include type "a" and "b" auxiliary contacts for interfacing with controls.

6. Automatic Voltage Regulator:

a. Shall maintain the generator's output voltage within plus or minus one percent for load variations between no load and full load.

b. Shall correct voltage fluctuations rapidly and restore the output voltage to the predetermined level with a minimum amount of hunting.

c. Shall include voltage level rheostat located inside the control cubicle.

d. Provide a 3-phase automatic voltage regulator immune to waveform distortion.

7. Governor: Specified herein before in Article 2.3 "GOVERNOR".

8. The voltage regulator and other components of the auxiliary electrical power system shall be protected during operation of the diesel engine-generator set at speeds other than the rated RPM while performing maintenance by a power monitoring system which monitors single phase and three phase faults. A time-delay relay shall shut down the engine when the alternator thermal capacity is exceeded.

9. Controller shall include outputs to BMS system.

2.11 REMOTE ANNUNCIATOR PANEL

A. Remote annunciator shall be installed as shown on the bid drawings.

B. The annunciator shall indicate alarm conditions of the emergency or auxiliary power source as follows:

1. Individual visual signals shall indicate:

a. When generator is operating to supply power to load.

b. When battery charger is malfunctioning.

c. When storage tank is low.

2. Individual visual signals plus a common audible alarm shall warn of the following:
   a. "LOW LUBRICATING OIL PRESSURE - FIRST STAGE."
   b. "LOW COOLANT."
   c. "EXCESSIVE COOLANT TEMPERATURE - FIRST STAGE."
   d. LOW FUEL - DAY TANK."
   e. "OVERCRANK" (failure to start).
   f. "OVERSPEED."

C. The annunciator shall also have the following features:
   1. One pushbutton momentary contact switch. Label switch "LAMP - TEST". Initiating this switch shall momentarily actuate the alarm buzzer and all the indicating lamps.
   2. Audible Alarm: There shall be an audible alarm, rated for 85 dB at 10 feet, which shall become actuated whenever an alarm condition occurs. A momentary-contact acknowledge pushbutton shall silence the audible alarm, but not clear the alarm lamp. Elimination of the alarm condition shall automatically release the seal-in circuit for the audible alarm and extinguish the alarm lamp.

2.12 EXERCISING CONTROL PANEL

A. Incorporate exercising controls so as to allow testing of each remotely located transfer switch from the Engine-Generator Control Cubicle.
   1. For each transfer switch, incorporate red and green lamps, indicating the position of the transfer switch.
   2. For each transfer switch, incorporate a two position contact switch. Label switch position: "Test and "Automatic". The "Test" position shall simulate an outage of normal power at the transfer switch. The "Automatic" position shall place the transfer switch in normal operation.

2.13 SOUND ATTENUATED ENCLOSURE

A. The emergency generator set and related equipment shall be housed in an outdoor weatherproof enclosure. The generator will function properly without overheating in the ambient conditions specified. Enclosure shall be weatherproof and sound attenuated (maximum 85 dBA at 1525 mm (five feet) from any side, top and bottom to no more than 75 dBA when measured at 15 meters (50 feet) horizontally from any part of the enclosure). Sound ratings shall be based on full load condition of engine/generator in a single unit operation condition. Airflow configuration of the unit will be intake through rear of unit and

discharge air vertically up. Enclosure shall be suitable for winds up to 193 kmh (120 mph); roof load shall be equal to or greater than 200 kg/sq m (40 lbs per sq. ft). Non-distributed loading as required.

B. The enclosure shall meet the following requirements:
   1. The exterior finish shall be guaranteed for a period of 10 years to be free from any defects when properly maintained.
   2. Enclosure shall be of sufficient size allowing for code clearances and proper servicing isles without removal or opening of enclosure panels.
   3. Radiator exhaust outlet shall be ducted through the end of the enclosure.
   4. All exterior surfaces shall be factory painted with industrial enamel.
   5. Unit shall have sufficient guards to prevent entrance by small animals.
   6. Batteries to fit inside enclosure and along side the engine provide protective shield. (Batteries under the generator are not acceptable.)
   7. Exhaust System: The silencer shall be critical grade, mounted and thermally insulated inside the enclosure. Insulation must be provided for the silencer, flex and all discharge piping. The weight of the silencer shall not be supported by engine. The exhaust pipe size shall be sufficient to insure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer. The exhaust silencer outlet roof penetration shall be sealed to prevent the entrance of rain, snow and sleet. A stainless steel bellowed flex shall be provided.

2.14 SPARE PARTS

A. For each engine-generator set:
   1. Six lubricating oil filters.
   2. Six primary fuel oil filters.
   3. Six secondary fuel oil filters.
   4. Six intake air filters.

B. For each battery charger:
   1. Three complete sets of fuses.
   2. One complete set of indicating lamps.

C. For each control and supervisory panel:
   1. Three complete sets of fuses.

2. One complete set of indicating lamps.

2.15 BMS INTERFACE

A. Campus Tridiuim BMS system shall monitor generator and report all signals to master campus BMS panel in Boiler building. Signals to be monitored all:

1. When generator is operating.
2. When battery charger is malfunctioning.
3. When storage tank is low.
4. When engine fails/common alarm. Provide same alarms as paragraph 2.11.B.2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install concrete bases of dimensions shown on the drawings for packaged engine-generator sets.

B. Installation of the engine generator set shall comply with manufacturer's written instructions and with NFPA 110.

C. Mounting

1. Support the base of engine-generator set on vibration isolators, each isolator bolted to the floor (pad), generator base bolted to isolator.
2. Install sufficient number of isolators so that the floor (pad) bearing pressure under each isolator is within the floor (pad) loading specification.
3. Install equal number of isolators on each side of the engine-generator set's base.
4. Locate isolators for approximately equal load distribution and deflection per isolator. Base of the engine-generator set shall be drilled at the factory for the isolator bolts.
5. Isolators shall be shipped loose with the engine-generator set.
6. All connections between the engine-generator set and exterior systems, such as fuel lines, electrical connections, and engine exhaust system and air exhaust shroud, shall be flexible.

D. Balance:

1. The vibration velocity in the horizontal, vertical, and axial directions shall not exceed 16.25 mm (0.65 inch) per second peak at any specific frequency. These limits apply to main structural components such as the engine block and the generator frame at the bearings.

2. Balance the engine-generator set statically and dynamically at the factory in order to comply with the maximum specified vibration velocity.

E. Connect all components of the essential electrical power system so that they will continue to be energized by the auxiliary electrical power system during failures of the normal electrical power supply system.

F. Install piping between diesel engine and remote components of cooling, fuel and exhaust systems.

G. Flexible connection between radiator and exhaust shroud at the wall damper:

1. Install noncombustible flexible connections made of 20-ounce neoprene-coated fiberglass fabric approximately 150 mm (six inches) wide.
2. Crimp and fasten the fabric to the sheet metal with screws 50 mm (two inch) on center. The fabric shall not be stressed, except by the air pressure.

H. Exhaust System Insulation:

1. Adhesive and insulation materials shall be applied on clean, dry surfaces from which loose scale, and construction debris has been removed by wire brushing.
2. Fill all cracks, voids and joints of applied insulation material with high temperature 1093 degrees C (2000 degrees F) insulating cement before applying the outer covering.
3. The installation shall be neat, thermally and structurally tight without sag, neatly finished at all hangers or other penetrations and shall provide a smooth finish surface.
4. Insulation and jacket shall terminate hard and tight at all anchor points.
5. Insulate completely from engine exhaust flexible connection through roof or wall construction, including muffler.

3.2 START UP AND TESTING

A. Provide the services of a factory-authorized, factory-trained representative of the diesel engine-generator set manufacturer to inspect field-assembled components, and equipment installation and supervise the field tests

B. When the complete auxiliary electrical power system has been installed and prior to the final inspection, tests all components of the system in the presence of the COTR for proper operation of the individual

components and the complete system and to eliminate electrical and mechanical defects.

C. Furnish fuel oil, lubricating oil, anti-freeze liquid, water treatment and rust inhibitor and load bank for testing of the diesel engine-generator set.

D. Field Tests for the Diesel Engine-Generator Set:

1. Test the engine generator set for eight hours of continuous operation as follows:
   a. First six hours while the set is delivering 100 percent of its specified KW rating.
   b. Last two hours while the set is delivering 110 percent of its specified KW rating.
   c. If during the 8-hour continuous test a failure occurs, either the diesel engine shuts down or the full KW rating of the load bank is not achieved, the test is null and void. The test(s) shall be repeated until the satisfactory results are attained at no additional cost to the VA.
2. Record the following test data at 30-minute intervals:
   a. Time of day, also reading of running time indicator.
   b. KW.
   c. Voltage on each phase.
   d. Amperes on each phase.
   e. Engine RPM.
   f. Frequency.
   g. Engine water temperature.
   h. Fuel pressure
   i. Oil pressure.
   j. Outdoor temperature
   k. Average ambient temperature in the vicinity of the diesel engine.
   l. Average ambient temperature in the vicinity of the starting batteries.
3. Demonstrate that the generator set will attain proper voltage, frequency and will accept 100 percent block load within 10 seconds from a cold start after the closing of a single contact.
4. Furnish a resistance type load for the testing of the generator:
   a. When approved in writing by the COTR prior to the testing, the Contractor may use connected loads in the building (resistant plus other types) as part of the test load provided the

Contractor assumes complete responsibility for the use of the connected loads, including personnel injuries and property damage.

b. Test loads shall always include adequate resistance to assure stability of the loads and equipment during all of the testing operations. The test load KW rating:

1) Shall not be less than 110 percent of the specified KW rating of the largest generator set.

2) Shall not be less than 35 percent of the sum of the specified KW ratings of the all generator sets in a paralleling system.

E. Battery and Starting System Test:

1. Demonstrate that the batteries and cranking motor are capable of 5 starting attempts of 10 second cranking each at 10 second intervals with the battery charger turned off.

F. Test local and remote panels: Simulate engine failures while checking for proper operation of each indicating lamp, alarm device and reset button. (It is recommended that one VA inspector be located in the generator room and another at the site of remote panels. By means of telephone or walkie-talkies, the inspectors should be assured of proper operation and coordination of these panels.)

G. At the completion of the field tests, fill the underground storage tank with fuel of grade and quality as recommended by the manufacturer of the engine.

H. When any defects are detected during the tests, correct all the deficiencies and repeat all or part of the 8-hour continuous test as requested by the COTR, at no additional cost to the VA.

I. Provide test and inspection results in writing to the COTR.

3.3 INSTRUCTIONS AND FINAL INSPECTIONS

A. Laminate or mount under Plexiglas a set of operating instructions for the system and install instructions within a frame mounted on the wall near the diesel engine-generator set as requested by the COTR.

B. At the final inspection in the presence of a VA representative, demonstrate that the complete auxiliary electrical power system operates properly in every respect.

C. Furnish the services of a competent, factory-trained engineer or technician for five, 4-hour periods for instructions to VA personnel in operation and maintenance of the equipment, on the dates requested by the COTR.

- - - E N D - - -

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, complete installation, and connection of automatic transfer switches.

1.2 RELATED WORK

A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural equipment.

B. Section 14 24 00, HYDRAULIC ELEVATORS: Requirements for elevator operation.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that is common to more than one section of Division 26.

D. Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY: Requirements for coordinated electrical system.

E. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and Wiring.

F. Section 26 32 13, ENGINE GENERATORS: Requirements for emergency power generation.

G. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personal safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE

A. Factory authorized representative shall maintain a service center capable of providing emergency maintenance and repair services at the project site within 4 hour maximum response time.

B. Automatic transfer switch, bypass/isolation switch and annunciation control panels shall be products of same manufacturer.

C. Comply with OSHA – 29 CFR 1910.7 for the qualifications of the testing agency.

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 (including withstand), dimensions, weights, mounting details, conduit entry provisions front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, and accessories.
3. Complete nameplate data, including manufacturer's name and catalog number.
4. A copy of the markings that are to appear on the transfer switches when installed.

C. Manuals:
1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating and maintenance manuals including technical data sheets, wiring diagrams and information, such as telephone number, fax number and web sites, for ordering replacement parts.
2. Two weeks prior to final inspection, submit four copies of a final updated maintenance and operating manual to the COTR.
   a. Include complete "As installed" diagrams, which indicate all items of equipment and their interconnecting wiring.
   b. Include complete diagrams of the internal wiring for each of the items of equipment, including "As installed" revisions of the diagrams.
   c. The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation and testing.

D. Certifications:
1. Submit, simultaneously with the shop drawings, a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 (Prototype testing).
2. Additionally when transfer switches are used with power air circuit breakers having short-time trip elements without instantaneous trip elements provide a certified test report showing that the sample has passed the additional withstand requirements of this specification. Method of test shall be in accordance with UL 1008. Main contact separation as measured by an oscillograph voltage trace across the contacts will not be allowed during this test. Welding or burning of contacts is unacceptable.
3. Two weeks prior to final inspection, submit four copies of the following to the COTR:

a. Certification that no design changes have been made to the switch or its components since last certified by UL or as tested by an independent laboratory.
b. Certification by the manufacturer that the equipment conforms to the requirements of the drawings and specifications.
c. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.
d. A certified test report from an independent laboratory that a representative sample has passed the ANSI surges withstand test for transfer switches which incorporate solid-state components.
e. Certification from the manufacturer that the automatic transfer switch(s), accessories, and components will withstand the seismic forces and that the unit will be fully operational after the seismic event at the project 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 designation only:

B. Institute of Electrical and Electronic Engineers (IEEE):

446-95.....Recommended Practice for Design and Maintenance of Emergency and Standby Power Systems

C37.90.1-02.....IEEE Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

C. National Electrical Manufacturers Association (NEMA):

250-03.....Enclosure for Electrical Equipment (1000 Volts Maximum).

ICS 6-01.....Industrial Control and Systems Enclosures

IC3 4.....Industrial Control and Systems: Terminal Blocks

MG 1-03.....Motors and Generators, Revision 1

D. National Fire Protection Association (NFPA):

70-05.....National Electrical Code (NEC)

99-05.....Health Care Facilities

110.....Emergency and Standby Power Systems

E. Underwriters Laboratories, Inc. (UL):

50-03.....Enclosures for Electrical Equipment

508-02.....Industrial Control Equipment

891-03.....Dead-Front Switchboards

1008-03.....Transfer Switch Equipment

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

A. General:

1. Comply with UL, NEMA, NEC, ANSI and NFPA.
2. Automatic transfer switches are to be electrically operated, mechanically held open contact type, without integral overcurrent protection. Transfer switches utilizing automatic or non-automatic molded case circuit breakers as switching mechanisms are not acceptable.
3. The unit shall be completely factory-assembled and wired so that only external circuit connections are required in the field. The unit shall include, but not be limited to, operating mechanism, main contacts, auxiliary contacts, timers, pilot lights, switches, and auxiliary sensing devices.
4. Each transfer switch shall be equipped with bypass/ isolation switch. The switch shall be part of the transfer switch.

B. Ratings, Markings and Tests:

1. Ratings:
   a. Phase, voltage, ampere rating, number of poles, withstand rating shall be as shown on the drawings. The ampere rating shall be for 100 percent continuous load current.
   b. Transfer switches are to be rated for total system transfer on emergency systems.
   c. Ratings shall be with non-welding of contacts during the performance of withstand and closing tests.
   d. Maximum automatic transfer switch rating: 800 amperes
2. Markings:
   a. Markings shall be in accordance with UL 1008.
   b. Markings for the additional withstand test hereinafter specified shall be included in the nameplate data.
3. Tests:
   a. Transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device.
   b. Where used with molded case circuit breakers or power air circuit breakers with long-time and instantaneous trip, transfer switch

withstand and closing rating shall equal or exceed the available short circuit current shown on the drawings, but shall not be less than the following:

Switch Rating (Amperes)	Withstanding Amperes (RMS Symmetrical)	Circuit Power Factor
Up to 100	22,000	Per UL
101 to 260	35,000	Per UL
261 to 400	42,000	Per UL
410 to 600	50,000	Per UL
601 to 1200	65,000	Per UL
1201 to 4000	85,000	Per UL

4. Additional Withstand Test:
   a. See paragraph 1.4.D.1 for certification of "Withstand Test."
   b. Where used with power air circuit breakers with long-time and short-time trips without instantaneous trip, transfer switch withstand rating shall be based on the available short circuit current (RMS symmetrical) for a duration of ten cycles.
5. Surge Withstand Test:
   a. Transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with ANSI C37.90.1.

C. Housing:
1. Enclose transfer switches in steel cabinets in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings. NEMA ICS 6 Type or as indicated on the drawings.
2. Doors: Shall have three-point latching mechanism.
3. Padlocking Provisions: Provide chain for attaching a padlock. Attach chain to the cabinet by welding or riveting.
4. Finish: Cabinets shall be given a phosphate treatment, painted with rust inhibiting primer, and finish painted with the manufacturer's standard enamel or lacquer finish.

2.2 FEATURES

A. Transfer switches shall include the following features:

1. Operating Mechanism:
   a. Actuated by an electrical operator.
   b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in both normal and emergency position.
   c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
   d. Shall not include a neutral position.
   e. Contact transfer time shall not exceed six cycles.
   f. Do not use as a current carrying part. Components and mechanical interlocks shall be insulated or grounded.
2. Contacts:
   a. For switches 400 amperes and larger, protect main contacts by separate arcing contacts and magnetic blowouts for each pole. Arc quenching provisions equivalent to magnetic blowouts will be considered acceptable.
   b. Current carrying capacity of arcing contacts shall not be used in the determination of the transfer switch rating, and shall be separate from the main contacts.
   c. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.
3. Manual Operator:
   a. Capable of operation in either direction under no load.
   b. Capable of operation by one person.
   c. Provide a warning sign to caution against operation when energized.
4. Replaceable Parts:
   a. Include the main and arcing contact individually or as units, relays, and control devices.
   b. Switch contacts and accessories are to be replaceable from the front without removing the switch from the cabinet and without removing main conductors.
5. Sensing Relays:

a. Provide voltage-sensing relays in each phase of the normal power supply.
b. Provide adjustable voltage and frequency sensing relays in one phase of the auxiliary power supply.

6. Controls:
   a. Control module shall provide indication of switch status – emergency, normal, and be equipped with alarm diagnostic circuitry.
   b. Control module shall control operation of the transfer switch. The sensing and the logic shall be controlled by a microprocessor equipped with digital communication and battery backup. The control shall comply with IEEE 472.

2.3 ACCESSORIES

A. Transfer switches shall include the following accessories:
   1. Indicating Lights of different colors:
      a. Green Signal light for normal source position.
      b. Red Signal light for emergency source position.
   2. Laminated black phenolic nameplates with white letters to indicate transfer switch position.

B. Manual Test Switch for simulating normal source failure.

C. Engine starting contacts.

D. Time delay relay to accomplish the function as specified.

E. Auxiliary Contacts:
   1. Provide contacts for connection to elevator controllers, one closed when transfer switch is connected to normal, and one closed when transfer switch is connected to emergency.
   2. Provide additional contacts as necessary to accomplish the functions shown on the drawings, specified, and designated in other sections of these specifications and one spare normally open and normally closed contact.
   3. Contacts shall have a minimum rating of ten amperes and be positive acting on pickup and dropout.

F. In-Phase Band Monitor: Monitor shall control the operation of the transfer switch. It shall monitor the voltage and frequency of the normal and emergency voltage.

G. Auxiliary Relay: Provide an auxiliary pre-signal relay on all automatic transfer switches, which will feed elevator loads for use as elevator control.

2.4 TRANSFER SWITCH OPERATION

A. Engine Start: A voltage decrease, at any transfer switch, in one or more phases of the normal power source to less than 70 percent of normal shall start the engine-generator unit after a time delay of two to three seconds. The time delay shall be field adjustable from zero to fifteen seconds.

B. Transfer to Emergency (Emergency System Loads): Transfer switches for emergency system loads shall transfer their loads from normal to emergency source when frequency and voltage of the engine-generator unit have attained 90 percent of rated value. Only those switches with deficient normal source voltage shall transfer.

C. Transfer to Emergency (Equipment System Loads): Transfer switches for equipment system loads shall transfer their loads to the generator on a time delayed staggered basis, after the emergency system switches have transferred. Total delayed transfer time of an equipment system switches shall not exceed two minutes. Time-delay relays shall be field adjustable zero to two minutes.

D. Retransfer to Normal (All Loads): Transfer switch shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to 90 percent or more of normal voltage, and after a time delay. The time delay shall be field adjustable from five to twenty-five minutes (preset for twenty-five minutes). Should the emergency source fail during this time, the transfer switch shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the generator shall continue to run for five minutes unloaded before shut down. Time delay shall be adjustable from zero to fifteen minutes.

E. Exercise Mode: Transfer to emergency power source shall be accomplished by remote manual test switches on a selective basis.

2.5 BYPASS/ISOLATION SWITCHES (BP/IS)

A. Provide two-way bypass/isolation manual type switches. The BP/IS shall permit load by-pass to either normal or emergency power source and complete isolation of the transfer switch, independent of transfer switch position. The switches shall conveniently and electrically bypass and isolate automatic transfer switches, which could not otherwise be safely maintained without disruption of critical loads. Bypass and isolation shall be possible under all conditions including where the automatic transfer switch may be removed from service.

Bypass/Isolation switches shall comply with NFPA 110, and shall be factory tested.

B. Operation: The bypass/isolation switch shall have provisions for operation by one person through the movement of a maximum of two handles at a common dead front panel in no more than 15 seconds or less. Provide a lock, which must energize to unlock the bypass switch, to prevent bypassing to a dead source. Provide means to prevent simultaneous connection between normal and emergency sources.

1. Bypass to normal (or emergency): Operation of bypass handle shall allow direct connection of the load to the normal (or emergency) source, without load interruption or by using a break-before-make design, or provide separate load interrupter contacts to momentarily interrupt the load.
   a. Assure continuity of auxiliary circuits necessary for proper operation of the system.
   b. A red indicating lamp shall light when the automatic transfer switch is bypassed.
   c. Bypassing source to source: If the power source is lost while in the bypass position, bypass to the alternate source shall be achievable without re-energization of the automatic transfer switch service and load connections.
2. Isolation: Operation of the isolating handle shall isolate all live power conductors to the automatic transfer switch without interruption of the load.
   a. Interlocking: Provide interlocking as part of the bypass/ isolation switch to eliminate personnel-controlled sequence of operation, and to prevent operation to the isolation position until the bypass function has been completed.
   b. Padlocking: Include provisions to padlock the isolating handle in the isolated position.
   c. Visual verification: The isolation blades shall be visible in the isolated position.
3. Testing: It shall be possible to test (normal electrical operation) the automatic transfer switch and engine generator with the isolation contacts closed, and the load bypassed without interruption of power to the load.

C. Ratings: The electrical capabilities and ratings of the bypass/isolation switch shall be compatible with those of the

associated automatic transfer switch, including any required additional withstand tests.

D. Enclosure Construction: Enclosure construction shall be in accordance with UL standards. The bypass/isolation switch shall be mounted in a separate enclosure or separate compartment from the automatic transfer switch. NEMA ICS 6 enclosure rating shall match automatic transfer switch.

E. Diagrams: The manufacturer shall provide specific information on the interconnection and installation of the bypass/isolation switch and automatic transfer switch.

F. The bypass/isolation switch shall also meet all the requirements as specified for an automatic transfer switch.

2.6 SPARE PARTS

A. Provide six control fuses for each automatic transfer switch of different rating.

B. Provide six pilot lamps of each type used.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install automatic transfer switch(s) in accordance with the NFPA and as shown on the drawings.

B. Level and anchor the automatic transfer(s) switch to floor or wall.

C. Ground equipment as shown on the drawings and as required by NFPA 70.

3.2 START UP AND TESTING

A. After the complete system has been installed, and before energizing the system, check all components of the system, including insulation resistance, phase to phase and phase to ground, complete electrical circuitry and safety features according to the manufacturer’s written instructions

B. After energizing circuits, test the interlocking sequence and operation of the complete system, including time delays of transfer from normal source to emergency and back to normal source, pick-up and voltage drop, and function of bypass/isolation switch in the presence of the COTR prior to the final inspection.

C. When any defects are detected, correct the defects and repeat the test as requested by the COTR, at no additional cost to the VA.

3.3 DEMONSTRATION

At the final inspection in the presence of a VA representative, demonstrate that the complete auxiliary electrical power system

operates properly in every respect. Coordinate this demonstration with the demonstration of the engine-generator set.

3.4 TRAINING

Furnish the services of a competent, factory-trained engineer or technician for one four-hour period for instructing VA personnel in operation and maintenance of the equipment, including review of the operation and maintenance manual, on a date requested by the COTR. Coordinate this training with that of the generator training.

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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. Facility lightning protection is required as part of the scope of this project.

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 COTR:

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 [9mm] diameter, with sharp nickel-plated points.
3. Ground rods: Copper clad steel, not less than 1/2 inch [13mm] diameter by 8 feet [2400mm] long. Rods made of copper-clad steel shall conform to UL 467 and galvanized ferrous rods shall conform to IEEE C135.30.
4. Ground plates: Solid copper, not less than 1/16 inch [2mm] 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 [300mm] below and seven feet [2100mm] 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 [2mm] 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 COTR. For the conductors located outside of the building or stack, install the conductors not less than two feet [600mm] 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.

K. Connect exterior metal surfaces, located within three feet [900mm] 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 [900mm] 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 [30m].

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 [600mm] deep at a distance not less than 3 feet [900mm] nor more than 8 feet [2.5m] 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 COTR.

W. Metal fences that are electrically continuous with metal posts extending at least 2 feet [600mm] into the ground require no additional grounding. Other fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods every 1000 to 1500 feet [300 to 450m] of length when fences are located in isolated places, and every 500 to 750 feet [150 to 225m] when in proximity (100 feet [30m] or less) to public roads, highways, and buildings.

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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.

C. Section 26 24 16, PANELBOARDS: For factory-installed TVSS.

D. Section 26 26 00, POWER DISTRIBUTION UNITS FOR UNINTERRUPTIBLE POWER SYSTEMS: 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 COTR:

   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.....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.
2. Non-modular design.
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: 160 kA per mode/320 kA 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: 70,000A.
   2. Line to Ground: 70,000A.
   3. Neutral to Ground: 50,000A.
D. Protection modes and UL 1449 SVR for grounded wye circuits shall be as follows:
   1. Line to Neutral: 400 V for 208Y/120 V.
   2. Line to Ground: 400 V for 208Y/120 V.
   3. Neutral to Ground: 400 V for 208Y/120 V.

2.2 PANELBOARD SUPPRESSORS

A. Surge Protection Devices:
   1. Non-modular.
   2. LED indicator lights for power and protection status.
   3. Audible alarm, with silencing switch, to indicate when protection has failed.
B. Peak Single-Impulse Surge Current Rating: 80 kA per mode/160 kA 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: 70,000A.
   2. Line to Ground: 70,000A.
   3. Neutral to Ground: 50,000A.
D. Protection modes and UL 1449 SVR for grounded wye circuits shall be as follows:
   1. Line to Neutral: 400 V for 208Y/120 V.
   2. Line to Ground: 400 V for 208Y/120 V.
   3. Neutral to Ground: 400 V for 208Y/120 V.

2.3 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TVSS devices at switchboard or panelboard on load side, with ground lead bonded to service entrance ground.
B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and 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 switchgear, switchboards, or panelboards 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 VA 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 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 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 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 accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. 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.

1. Material and construction details include information on housing, optics system and lens/diffuser.
2. Physical dimensions and description.
3. Wiring schematic and connection diagram.
4. Installation details.
5. Energy efficiency data.
6. Photometric data based on laboratory tests complying with IESNA Lighting Measurements, testing and calculation guides.

7. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours) and color temperature (degrees Kelvin).
8. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts and total harmonic distortion (THD).

C. Manuals:

3. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
4. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the COTR.

D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the COTR:
   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. 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

C82.4-02.....Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps

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

844-95.....Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

924-95.....Emergency Lighting and Power Equipment

935-01.....Fluorescent-Lamp Ballasts

1029-94.....High-Intensity-Discharge Lamp Ballasts

1029A-06.....Ignitors and Related Auxiliaries for HID Lamp Ballasts

1598-00.....Luminaires

1574-04.....Standard for Track Lighting Systems

2108-04.....Standard for Low-Voltage Lighting Systems

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. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

F. 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.

G. 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.

H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

I. 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 [3.2mm] of average thickness. The average thickness shall be determined by adding the maximum thickness to the minimum unpenetrated 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.

2.2 BALLASTS

A. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 – 277V) electronic programmed-start, 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: 0.87 or higher 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% of rated lamp lumens.

B. Compact Fluorescent Lamp Ballasts: Multi-voltage (120 – 277V), electronic-programmed 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.
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: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.98 or higher.
10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
11. Dimming ballasts shall be as per above, except dimmable from 100% to 5% of rated lamp lumens.

2.3 LAMPS

A. Linear T8 Fluorescent Lamps:

1. All fluorescent T8 lamps shall be super 25 watt T8 type.
2. Rapid start fluorescent lamps shall comply with ANSI C78.1; and instant-start lamps shall comply with ANSI C78.3.
3. Chromacity of fluorescent lamps shall comply with ANSI C78.376.
4. Except as indicated below, lamps shall be low-mercury energy saving type, have a color temperature between 3500° and 4100°K, a Color Rendering Index (CRI) of greater than 70, average rated life of 24,000 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. Compact Fluorescent Lamps:

1. T4, CRI 80 (minimum), color temperature 3500 K, and suitable for use with dimming ballasts, unless otherwise indicated.

C. T5 Fluorescent Lamps:

1. T5, CRI 80 (minimum), color temperature between 3500° and 4100°K, 20,000 hours average rated life.

D. Unless specifically indicated otherwise, all incandescent lamps shall be inside frosted 120 volt.

2.4 FLUORESCENT BEDLIGHT FIXTURES

A. Requirements:

1. Fixed or movable arms are not acceptable.
2. Exposed surfaces shall remain cool to the touch.
3. Fixtures shall be lensed.

B. Bedlight fixtures shall be rated for 120 volt operation.

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 die-cast aluminum.
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 [2.25mm] thick, stenciled with 6 inch [150mm] 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.
5. Fixtures shall not have battery test button, as each fixture is tied into emergency circuits, and not battery powered.

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. Fluorescent bed light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable.

D. 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 lighting fixtures:
   a. All fixture mounting devices connecting fixtures to the ceiling system or building structure shall have a capacity for a horizontal force of 100 percent of the fixture weight and a vertical force of 400 percent of the fixture weight.
   b. Mounting devices shall clamp the fixture to the ceiling system structure (main grid runners or fixture framing cross runners) at four points in such a manner as to resist spreading of these supporting members. Each support point device shall utilize a screw or approved hardware to "lock" the fixture housing to the ceiling system, restraining the fixture from movement in any direction relative to the ceiling. The screw (size No. 10 minimum) or approved hardware shall pass through the ceiling member (T-bar, channel or spline), or it may extend over the inside of the flange of the channel (or spline) that faces away from the fixture, in a manner that prevents any fixture movement.
   c. In addition to the above, the following is required for fixtures exceeding 20 pounds [9kg] in weight.
      1) Where fixtures mounted in ASTM Standard C635-69 "Intermediate" and "Heavy Duty" ceilings and weigh between 20 pounds and 56 pounds [9kg and 25kg] provide two 12 gauge safety hangers

hung slack between diagonal corners of the fixture and the building structure.

2) Where fixtures weigh over 56 pounds [25kg] they shall be independently supported from the building structure by approved hangers. Two-way angular bracing of hangers shall be provided to prevent lateral motion.

d. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.

5. Surface mounted lighting fixtures:

a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 1/4-20 [6mm] bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12 gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 56 pounds [25kg] shall be supported directly from the building structure.

b. Where ceiling cross runners are installed for support of lighting fixtures they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.

c. Fixtures less than 15 pounds [6.8kg] in weight and occupying less than two square feet [600mm x 600mm] of ceiling area may, (when designed for the purpose) be supported directly from the outlet box when all the following conditions are met.

1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.

2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.

3) The outlet box is supported vertically from the building structure.

d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.

6. Single or double pendant-mounted lighting fixtures:

a. Each stem shall be supported by an approved outlet box, mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.

7. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.

E. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.

F. 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.

G. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

H. Exercise electronic dimming ballasts over full range of dimming capability by operating the control devices(s) in the presence of the COTR. Observe for visually detectable flicker over full dimming range.

I. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by VA. 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.

J. 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.

K. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

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SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of exterior luminaries, controls, poles and supports.

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 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.

C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.

D. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.

E. 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 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, wiring and connection diagrams, photometric data, ballasts, poles, luminaries, lamps and controls.

C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the COTR. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement parts.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:

1. Certification that the materials are in accordance with the drawings and specifications.

2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.4 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 the basic designation only.

A. Aluminum Association Inc. (AA):

AAH35.1-2006 .....Alloy and Temper Designation Systems for Aluminum

B. American Association of State Highway and Transportation Officials (AASHTO):

LTS-4-2003 .....Structural Supports for Highway Signs, Luminaries and Traffic Signals

C. American Concrete Institute (ACI):

318-2005 .....Building Code Requirements for Structural Concrete

D. American National Standards Institute (ANSI):

C57.12-2000.....General Requirements For Liquid-Immersed Distribution, Power, and Regulating Transformers

C81.61-2005 .....Electrical Lamp Bases

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

A123/A123M-2002 .....Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153/A153M-2001.....Zinc Coating (Hot-Dip) on Iron and Steel Hardware – AASHTO No.: M232

B108-03a -2003 .....Aluminum-Alloy Permanent Mold Castings

D3487-2000.....Mineral Insulating Oil Used in Electrical Apparatus

F. Federal Aviation Administration (FAA):

AC 70/7460-IK CHG 1-2000.....Obstruction Lighting and Marking

AC 150/5345-43E-1995....Specification for Obstruction Lighting Equipment

G. Illuminating Engineering Society of North America (IESNA)

HB-9-2000.....Lighting Handbook

RP-8-2000 (R-2005).....Roadway Lighting

H. National Electrical Manufacturers Association (NEMA):

C78.41-2001.....Electric Lamps – Guidelines for Low-Pressure Sodium Lamps

C78.42-2004 .....Electric Lamps – Guidelines for High-Pressure Sodium Lamps

C78.43-2005 .....Electric Lamps – Single-Ended Metal-Halide Lamps

C78.1381-1998.....(R 1997) Electric Lamps – 70-Watt M85 Metal-Halide Lamps

C82.4-2002 .....Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

C136.17-2005 .....Roadway Lighting Equipment – Enclosed Side-Mounted Luminaries for Horizontal-Burning High-Intensity-Discharge Lamps

ICS 2-2005 .....Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts

ICS 6-2001 .....Industrial Control and Systems Enclosures

I. National Fire Protection Association (NFPA):

70-2005 .....National Electrical Code (NEC)

J. Underwriters Laboratories, Inc. (UL):

496-2004 .....Edison-Base Lamp holders

773-1995.....Plug-in, Locking Type Photo controls, for Use with Area Lighting

773A-2006 .....Non-industrial Photoelectric Switches for Lighting Control

1029-1994.....High-Intensity-Discharge Lamp Ballasts

1598-2004 .....Luminaries

1.5 DELIVERY, STORAGE, AND HANDLING

Aluminum Poles: Do not store poles on ground. Store poles so they are at least 305 mm (one foot) above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2.2 POLES

A. General:

1. Poles shall be round aluminum, as shown on the drawings, and as specified. Finish shall be as specified on the drawings.
2. The pole and arm assembly shall be designed for wind loading of 161 km/hr (100 miles per hour), with an additional 30 percent gust factor, supporting luminaire(s) having the effective projected areas indicated. The effective projected area of the pole shall be applied at the height of the pole base as shown on the drawings.
3. Poles shall be anchor-bolt type designed for use with underground supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 65 by 125 mm (2.5 by 5 inches). Handhole cover shall be secured by stainless steel captive screws.
4. Provide a steel-grounding stud opposite hand hole openings.
5. Provide a base cover matching the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.
6. Hardware: All necessary hardware shall be 300 series stainless steel.

B. Types:

1. Aluminum: Provide aluminum poles manufactured of corrosion resistant AA AAH35.1 aluminum alloys conforming to AASHTO LTS-4 for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys, and Alloy 356-T4 (3,5) for ASTM B108-03 cast alloys. Poles shall be seamless extruded or spun seamless type. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Base covers for aluminum poles shall be cast from 356-T6 aluminum alloy in accordance with ASTM B108-03.

2.3 FOUNDATIONS FOR POLES

A. Foundations shall be cast-in-place concrete.

B. Foundations shall support the effective projected area of the specified pole, arm(s), and luminaire(s) under wind conditions previously specified in this section.

C. Place concrete in spirally wrapped treated paper forms for round foundations, and construct forms for square foundations.

D. Rub-finish and round all above-grade concrete edges to approximately 6 mm (1/4 inch) radius.

E. Concrete shall have 3000 psi minimum 28 day compressive strength.

F. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings and meet ACI 318. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.

G. Prior to concrete pour, install a copperclad steel ground rod, not less than 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, below each foundation. Drive the rod vertically under the foundation so not less than 1800 mm (6 feet) of rod is in contact with the earth. Remainder of rod may be in the concrete pour. Where rock or layered rock is present, drill a hole not less than 50 mm (2 inches) in diameter and 1800 mm (6 feet) deep, backfill with tamped fine sand and drive the rod into the hole. Bond the rod to the pole with not less than number 6 AWG bare copper wires. The method of bonding shall be approved for the purpose.

2.4 LUMINAIRES

A. UL 1598 and NEMA C136.17. Luminaries shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat and safe cleaning and relamping.

B. IESNA HB-9 and RP-8 light distribution pattern types shall be as shown on the drawings.

C. Incorporate ballasts in the luminaire housing except where otherwise shown on the drawings.

D. Lenses shall be frame-mounted heat-resistant, borosilicate glass, prismatic refractors. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging resistant resilient gaskets to seal and cushion lenses and refractors in luminary doors.

E. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking type porcelain enclosures in conformance to the applicable requirements of ANSI C81.61 and UL 496.

F. Pre-wire internal components to terminal strips at the factory.

G. Bracket mounted luminaries shall have leveling provisions and clamp type adjustable slip-fitters with locking screws.

H. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.

I. IESNA Cutoff Category: As indicated on Lighting Fixture schedule.

2.5 LAMPS

A. Install the proper lamps in every luminaire installed.

B. Lamp types shall be as indicated in Lighting Fixture schedule.

C. Lamps to be general-service, outdoor lighting types.

D. High-Pressure Sodium (HPS) Lamps: NEMA C78.42, wattage as indicated. Lamps shall have average rated life of 16,000 hours minimum for 35 watt lamps and 24,000 hours minimum for all higher wattages.

E. Low-Pressure Sodium (LPS) Lamps: NEMA C78.41.

F. Metal-Halide Lamps: NEMA C78.43 or NEMA C78.1381

G. Mercury vapor lamps shall not be used.

H. Compact fluorescent lamps

I. LED

2.6 COMPACT FLUORESCENT LAMP BALLASTS

A. Compact Fluorescent Lamp Ballasts: Multi-voltage (120 – 277V), electronic-programmed 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.
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: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.98 or higher.
10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
11. Rated ambient operating temperature: 130 degrees F (54 degrees C).
12. Ballasts shall be capable of providing reliable starting of the lamps at minus 30 degrees C.

2.7 LIGHTING CONTACTORS

NEMA ICS 2, electrically held contactors. Rate contactors as indicated. Provide in NEMA 4 enclosure conforming to NEMA ICS 6. Contactors shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor and shall require no arcing contacts. Provide contactors with hand-off-automatic on-off selector switch.

2.8 CONTROLS

A. Each Lighting System:

1. Shall be controlled by one of the following methods as shown for each system on the drawings:

a. A photocell to act as the pilot device. The photocell shall be the type which fails safe to the closed position meeting UL 773 or 773A.
b. The pilot devices shall control the power circuit through the contractor or relay as shown on the drawings.

2. Mount and connect photocells as shown on the drawings.
3. Photocells shall have the following features:
   a. Quick-response, cadmium-sulfide type.
   b. A 15 to 30 second, built-in time delay to prevent response to momentary lightning flashes, car headlights or cloud movements.
   c. Energizes the system when the north sky light decreases to approximately 1.5 footcandles, and maintains the system energized until the north sky light increases to approximately 3 to 5 foot candles.
4. The arrangement and method of control and the control devices shall be as shown on the drawings.

2.9 AUXILIARY EQUIPMENT

A. Series Type Systems:
   1. Provide components specifically for constant-current series type lighting systems.
      a. Shall have capacitors for power factor improvement. The value of power factor under the percent of full load rating shall be as shown on the drawings.
      b. Shall regulate the secondary current within one percent over the entire load rating range while the primary voltage remains within five percent of the rated voltage.
      c. Operation of the transformers shall not be adversely affected while the transformers are mounted five degrees off of perpendicular.
      d. Provide tanks and covers of steel to meet NEMA and ANSI requirements; which are cleaned, phosphatized and painted at the factory with primer and the manufacturer's standard extremely durable finish.
      e. Sound levels shall not exceed 45 db.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer’s recommendations.

B. Aluminum Steel Poles:

1. Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 1.57 rad 90 degrees at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
2. After the poles have been installed, shimmed and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 9 mm (3/8-inch) inside diameter, through the grout tight to the top of the concrete base for moisture weeping.

C. Foundation Excavation: Depth shall be as indicated. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 150 mm (6 inch) maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.

D. Photocell Switch Aiming: Aim switch according to manufacturer’s recommendations. Mount switch on or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm. Set adjustable window slide for proper footcandles photocell turn-on.

3.2 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles, luminaries, mounting arms, brackets, and metallic enclosures as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable and listed for this purpose.

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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 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 VA 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 eight 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 VA 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 VA.

1.5 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 circuits or communication loops and zones, circuit protective devices, conduits, wire, 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 COTR, 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 Section 00 72 00, 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 VA 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 VA.
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 VA'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 VA 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. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.

3. 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.
4. 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 COTR with one sample of each of the following:

1. A 300 mm (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 COTR at least 30 days prior to the planned training.

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SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.

B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, telecommunications system grounding electrodes.

D. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

A. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 27.

B. Section 27 10 00, STRUCTURED CABLING: Low Voltage power and lighting wiring.

C. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.

1.3 SUBMITTALS

A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:

1. Certification that the materials and installation is in accordance with the drawings and specifications.
2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.4 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 the basic designation only.

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

B1-2001.....Standard Specification for Hard-Drawn Copper Wire

B8-2004.....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

C. National Fire Protection Association (NFPA):

70-2005.....National Electrical Code (NEC)

E. Telecommunications Industry Association, (TIA)

J-STO-607-A-2002.....Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

E. Underwriters Laboratories, Inc. (UL):

44-2005 .....Thermoset-Insulated Wires and Cables

83-2003 .....Thermoplastic-Insulated Wires and Cables

467-2004 .....Grounding and Bonding Equipment

486A-486B-2003 .....Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

C. Telecom System Grounding Riser Conductor: Telecommunications Grounding Riser shall be in accordance with J STO-607A. Use a minimum 50mm² (1/0 AWG) insulated stranded copper grounding conductor unless indicated otherwise.

2.2 GROUND RODS

A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.

B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3 SPLICES AND TERMINATION COMPONENTS

Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.4 TELECOMMUNICATION SYSTEM GROUND BUSBARS

A. Provide solid copper busbar, pre-drilled from two-hole lug connections with a minimum thickness of 6 mm (1/4 inch) for wall and backboard mounting using standard insulators sized as follows:

1. Room Signal Grounding: 300 mm x 100 mm (12 inches x 4 inch).
2. Master Signal Ground: 600 mm x 100 mm (24 inches x 4 inch).

2.5 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. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.

C. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.

2.6 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 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

2.7 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.

2.8 SPLICE CASE GROUND ACCESSORIES

Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm^2 (6 AWG) insulated ground wire with shield bonding connectors.

PART 3 - EXECUTION

3.1 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.

B. 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 buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 SECONDARY EQUIPMENT AND CIRCUITS

A. Conduit Systems:

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. Non-metallic conduit systems shall contain an equipment grounding conductor.
3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

B. Boxes, Cabinets and Enclosures:

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.

3.4 CORROSION INHIBITORS

When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.5 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus or patient ground bus.

3.6 TELECOMMUNICATIONS SYSTEM

A. Bond telecommunications system grounding equipment to the electrical grounding electrode system.

B. Furnish and install all wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.

C. Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.

D. Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milli ohms or less.

E. Below-Grade Grounding Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with the manufacturer’s recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly cleaned the joint area. Notify the COTR prior to backfilling any ground connections.

F. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.

G. Bonding Jumpers:

1. Use insulated ground wire of the size and type shown on the Drawings or use a minimum of 16 mm^2 (6 AWG) insulated copper wire.
2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
3. Use compression connectors of proper size for conductors specified. Use connector manufacturer’s compression tool.

H. Bonding Jumper Fasteners:

1. Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.

2. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.
3. Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
4. Unistrut: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.7 COMMUNICATION ROOM GROUNDING

A. Telecommunications Ground Busbars:
1. Provide communications room telecommunications ground busbar hardware at 950 mm (18 inches) at locations indicated on the Drawings.

B. Telephone-Type Cable Rack Systems: aluminum pan installed on telephone-type cable rack serves as the primary ground conductor within the communications room. Make ground connections by installing the following bonding jumpers:
1. Install a 16 mm² (6 AWG) bonding between the telecommunications ground busbar and the nearest access to the aluminum pan installed on the cable rack.
2. Use 16 mm² (6 AWG) bonding jumpers across aluminum pan junctions.

C. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:
1. When ground bars are provided at the rear of lineup of bolted together equipment racks, bond the copper ground bars together using solid copper splice plates supplied by the ground bar manufacturer.
2. Bond together nonadjacent ground bars on equipment racks and cabinets with 16 mm² (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
3. Provide a 16 mm² (6 AWG) bonding jumper between the rack and/or cabinet ground busbar and the aluminum pan of an overhead cable tray or the raised floor stringer as appropriate.

D. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near the top of backboards used for communications cross-connect systems. Connect backboard ground terminals to the aluminum pan in the telephone-type cable tray using an insulated 16 mm² (16 AWG) bonding jumper.

E. Other Communication Room or Areas Ground Systems: Ground all metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to the cable tray pan or the telecommunications ground busbar, whichever is closer, using insulated 16 mm² (6 AWG) ground wire bonding jumpers.

3.8 COMMUNICATIONS CABLE GROUNDING

A. Bond all metallic cable sheaths in multipair communications cables together at each splicing and/or terminating location to provide 100 percent metallic sheath continuity throughout the communications distribution system.

1. At terminal points, install a cable shield bonding connector provide a screw stud connection for ground wire. Use a bonding jumper to connect the cable shield connector to an appropriate ground source like the rack or cabinet ground bar.
2. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or the splice case grounding and bonding accessories provided by the splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to an approved ground source and all other metallic components and equipment at that location.

3.9 COMMUNICATIONS CABLE TRAY SYSTEMS:

A. Bond the metallic structures of one cable tray in each tray run following the same path to provide 100 percent electrical continuity throughout this cable tray systems as follows:

1. Splice plates provided by the cable tray manufacturer can be used for providing a ground bonding connection between cable tray sections when the resistance across a bolted connection is 10 milliohms or less. The Subcontractor shall verify this loss by testing across one slice plate connection in the presence of the Contractor.
2. Install a 16 mm² (6 AWG) bonding jumper across each cable tray splice or junction where splice plates cannot be used.
3. When cable tray terminations to cable rack, install 16 mm² (6 AWG) bonding jumper between cable tray and cable rank pan.

3.10 COMMUNCIATIONS RACEWAY GROUNDING

A. Conduit: Use insulated 16 mm² (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.

B. Wireway: use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.

C. Cable Tray Systems: Use insulated 16 mm² (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 16 meters (50 feet).

3.11 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the VA. Final tests shall assure 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 less 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.

3.12 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

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 27 05 33

RACEWAYS AND BOXES FOR COMMUNICATIONS 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, raceway systems. Raceways are required for all communications cabling 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. Bedding of conduits: Section 31 20 00, EARTH MOVING.

B. Mounting board for communication closets: Section 06 10 00, ROUGH CARPENTRY.

C. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.

D. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

E. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.

F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.

G. General electrical requirements and items that is common to more than one section of Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

H. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

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

A. Shop Drawings:

1. Size and location of panels and pull boxes
2. Layout of required conduit penetrations through structural elements.
3. The specific item proposed and its area of application shall be identified on the catalog cuts.

B. Certification: Prior to final inspection, deliver to the COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

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 Fire Protection Association (NFPA):

70-05.....National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL):

1-03.....Flexible Metal Conduit

5-01.....Surface Metal Raceway and Fittings

6-03.....Rigid Metal Conduit

50-03.....Enclosures for Electrical Equipment

360-03.....Liquid-Tight Flexible Steel Conduit

467-01.....Grounding and Bonding Equipment

514A-01.....Metallic Outlet Boxes

514B-02.....Fittings for Cable and Conduit

514C-05.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers

651-02.....Schedule 40 and 80 Rigid PVC Conduit

651A-03.....Type EB and A Rigid PVC Conduit and HDPE Conduit

797-03.....Electrical Metallic Tubing

1242-00.....Intermediate Metal Conduit

D. National Electrical Manufacturers Association (NEMA):

TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing

FB1-03.....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 13 mm (3/4 inch) for general communication systems, and not less than 25 mm (1 inch) for voice/data unless otherwise shown.

B. Conduit:

1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
2. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
3. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
4. Flexible galvanized steel conduit: Shall Conform to UL 1.
5. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
6. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
7. Surface metal raceway: Shall Conform to UL 5.
8. Innerduct shall be flexible, nonmetallic raceway, manufactured from high density polyethylene.

C. Conduit Fittings:

1. Rigid steel and IMC conduit fittings:
   a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
   a. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
   b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
   c. 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.
   d. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
   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.
2. Electrical metallic tubing fittings:

a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
b. Only steel or malleable iron materials are acceptable.
c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
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.

3. Flexible steel conduit fittings:
   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp type, with insulated throat.
4. Liquid-tight flexible metal conduit fittings:
   a. Fittings shall meet the requirements of UL 514B and ANSI/ 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.
5. Direct burial plastic conduit fittings:
   a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
   b. As recommended by the conduit manufacturer.
6. Surface metal raceway fittings: As recommended by the raceway manufacturer.
7. Expansion and deflection couplings:
   a. Conform to UL 467 and UL 514B.
   b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
   c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.

d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

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 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) 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 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.

G. Wireways: Equip with hinged covers, except where removable covers are shown.

G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with “CAUTION BURIED COMMUNICATIONS CABLE BELOW”.

H. Ladder Rack:

1. Ladder rack shall be ASTM A513 Steel Tube.
2. Stringer shall be high tensile tubular steel, 0.060 wall thickness, 1 1/2 inch tall x 3/8 inch wide.
3. Rungs shall be high tensile tubular steel 1/2 inch x 1 inch x 0.060 wall thickness, welded to stringer and spaced on 9 inch centers.
4. Ladder rack sections shall be a minimum of 12 inch wide and 10 feet long.
5. Layout shall be as shown on the Drawings.

6. All straight sections shall be cut to size in field as required from standard 10 foot sections.
7. All straight sections and fittings shall be assembled with bolted connections.
8. Ladder rack primary supports shall be of the trapeze type with threaded rod. Use ladder rack triangle, L-brackets, or steel 1/4" x 2" x 2" angle for supporting ladder rack from wall as required.
9. Connect ladder racking to top of telecom rack for support and stability.
10. Color for ladder rack and fittings shall be "Flat Black."

I. Wire Basket Cable Tray:

1. Wire Basket Cable Tray shall be steel wire construction. Heights shall be such that the usable loading depth of the cable tray is 2 inches minimum. Wires shall be welded at all intersections. Tray shall utilize a double wire construction for side rails.
2. Wire Basket Cable Tray width shall be as required or shown on the Drawings.
3. All straight sections shall be provided in standard section lengths, generally 10 feet.
4. All straight sections and fittings shall be assembled with bolted connections.
5. Minimum Wire Basket Cable Tray size shall be 2" deep by 6" wide.
6. Wire Basket Cable Tray shall be manufactured from ASTM steel wire, minimum wire diameter shall be 0.191" (4.9mm), and there shall be 2 side rail wires along each side for 2" deep tray and 3 side rail wires for 4" deep tray.
7. Wire Basket Cable Tray and fittings shall have a ZN (zinc plated) finish.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:

1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COTR prior to drilling through structural sections.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not

allowed, except where permitted by the COTR as required by limited working space.

B. Fire Stop: Where conduits, wireways, and other communications 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, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

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. Install conduit as follows:

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 8’0” on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
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. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. 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.

C. Layout and Homeruns:

2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COTR.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
   a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
   b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
   c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
4. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors 600 volts and below:
   a. Rigid steel, IMC, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
2. Align and run conduit parallel or perpendicular to the building lines.
3. Tightening set screws 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 volts and below:

1. Rigid steel, IMC, or EMT. Different type of conduits mixed 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 2400 mm (eight foot) intervals.

F. Surface metal raceways: Use only where shown.

G. Painting:

1. Paint exposed conduit as specified in Section09 91 00, PAINTING.
2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.5 CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.

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 90 kg (200 pounds). 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 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.

b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).

c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted.

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.

3.6 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. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

3.7 COMMUNICATION SYSTEM CONDUIT

A. Install the communication raceway system as shown on drawings.

B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.

C. All conduit ends shall be equipped with insulated bushings.

D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.

E. Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.

F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.

G. Were drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.

H. All empty conduits located in communication closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.

I. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

J. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specified in Section 06 10 00, ROUGH CARPENTRY on the wall of communication closets where shown on drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.

K. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

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SECTION 27 10 00

STRUCTURED CABLING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of the structured cabling system to provide a comprehensive telecommunications infrastructure.

1.2 RELATED WORK

A. Excavation and backfill for cables that are installed in conduit: Section 31 20 00, EARTH MOVING.

B. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.

C. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

D. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

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

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certificates: Two weeks prior to final inspection, deliver to the COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

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 reference in the text by the basic designation only.

B. American Society of Testing Material (ASTM):

D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

C. Federal Specifications (Fed. Spec.):

A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed Installation)

D. National Fire Protection Association (NFPA):

70-05.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-02.....Thermoset-Insulated Wires and Cables

83-03.....Thermoplastic-Insulated Wires and Cables

467-01.....Electrical Grounding and Bonding Equipment

486A-01.....Wire Connectors and Soldering Lugs for Use with Copper Conductors

486C-02.....Splicing Wire Connectors

486D-02.....Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations

486E-00.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

493-01.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable

514B-02.....Fittings for Cable and Conduit

1479-03.....Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 CONTROL WIRING

A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.

B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.2 COMMUNICATION AND SIGNAL WIRING

A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.

B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.

C. Multi-conductor cables shall have the conductors color coded.

2.3 WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

B. Shall not be used on wire for isolated type electrical power systems.

2.4 FIREPROOFING TAPE

A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.

C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.

E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install all wiring in raceway systems.

B. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.

C. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
2. Use ropes made of nonmetallic material 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. Pull in multiple cables together in a single conduit.

3.2 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION

A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.

B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.

C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.

E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.3 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION

A. Install a permanent wire marker on each wire at each termination.

B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

C. Wire markers shall retain their markings after cleaning.

D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.4 EXISITNG WIRING

Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

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SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the furnishing, installing, certification, testing, and guaranty of a complete and operating Voice and Digital Cable Distribution System (here-in-after referred to as "*the System*"), and associated equipment and hardware to be installed in the VA Hospice here-in-after referred to as "the Facility". The System shall include, but not be limited to: equipment cabinets, interface enclosures, and relay racks; necessary combiners, traps, and filters; and necessary passive devices such as: splitters, couplers, cable "patch", "punch down", and cross-connector blocks or devices, voice and data distribution sub-systems, and associated hardware. The System shall additionally include, but not be limited to: telecommunication closets (TC); telecommunications outlets (TCO); copper and fiber optic, and analog radio frequency (RF) systems coaxial distribution cables, connectors, "patch" cables, and/or "break out" devices.

B. The System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.

C. The term "provide", as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.

D. The Voice and Digital and Analog Telecommunication Distribution Cable Equipment and System provides the media which voice and data information travels over and connects to the Telephone System which is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Therefore, since the System connects to or extends the telephone system, the System's installation and operation shall adhere to all appropriate National, VA, and/or Local Life Safety and/or Support Codes, which ever are the more stringent for this Facility. At a minimum , the System shall be installed according to NFPA, Section 70, National Electrical Code (NEC), Article 517 and Chapter 7; NFPA, Section 99, Health Care Facilities, Chapter 3-4; NFPA, Section 101, Life Safety Code, Chapters 7, 12, and/or 13; Joint Commission on Accreditation of Health Care Organization (JCAHCO), Manual for Health Care Facilities, all necessary

Life Safety and/or Support guidelines; this specification; and the original equipment manufacturer's (OEM) suggested installation design, recommendations, and instructions. The OEM and Contractor shall ensure that all management, sales, engineering, and installation personnel have read and understand the requirements of this specification before the System is designed, engineered, delivered, and provided.

E. The VA Project Manager (PM) and/or if delegated, COTR are the approving authorities for all contractual and mechanical changes to the System. The Contractor is cautioned to obtain in writing, all approvals for system changes relating to the published contract specifications and drawings, from the PM and/or the RE before proceeding with the change.

F. System Performance:

1. At a minimum, the System shall be able to support the following voice and data and analog RF operations for Category 6 Certified Telecommunication Service:
   a. Provide the following interchange (or interface) capabilities:
      1) Basic Rate (BRI).
      2) Primary Rate (PRI).
   b. ISDN measured per VA requirements:
      1) Narrow Band BRI:
         a) B Channel: 64 kilo-Bits per second (kBps), minimum.
         b) D Channel: 16 kBps, minimum.
         c) H Channel: 384 kBps, minimum.
      2) Narrow Band PRI:
         a) B Channel: 64 kBps, minimum.
         b) D Channel: 64 kBps, minimum.
         c) H Channel: 1,920 kBps, minimum.
      3) Wide (or Broad) Band: All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at “T” reference.
   c. ATM operation and interface: ATM 155 mBps measured per VA requirements.
   d. Frame Relay: All stated compliance’s measured per VA requirements.
   e. Integrated Data Communications Utility (IDCU) operation and interface: Measured per VA requirements.
   f. VA Open Systems Interconnection Profile (GOSSIP) compliant: Measured per VA requirements.

g. Fiberoptic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed measured per VA requirements (shall be Synchronous Optical Network [SONET] compliant).

h. System Sensitivity: Satisfactory service shall be provided for at least 3,000 feet for all voice and data and analog RF locations.

2. At a minimum the System shall support the following operating parameters:

a. EPBX connection:

1) System speed: 1.0 gBps per second, minimum.

2) Impedance: 600 Ohms.

3) Cross Modulation: -60 deci-Bel (dB).

4) Hum Modulation: -55 dB.

5) System data error: 10 to the -10 Bps, minimum.

6) Loss: Measured at the frame output with reference Zero (0) deciBel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.

a) Trunk to station: 1.5 dB, maximum.

b) Station to station: 3.0 dB, maximum.

c) Internal switch crosstalk: -60 dB when a signal of ± 10 deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.

d) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above reference (terminated) ground noise, whichever is greater.

e) Traffic Grade of Service for Voice and Data:

(1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits will not interfere with, or degrade, the voice service.

(2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.

b. Telecommunications Outlet (TCO):

1) Voice:

a) Isolation (outlet-outlet): 24 dB.

b) Impedance: 600 Ohms, balanced (BAL).

c) Signal Level: 0 deciBel per mili-Volt (dBmV) ± 0.1 dBmV.

d) System speed: 100 mBps, minimum.

e) System data error: 10 to the -6 Bps, minimum.

2) Data:

a) Isolation (outlet-outlet): 24 dB.

b) Impedance: 600 Ohms, BAL.

c) Signal Level: 0 dBmV ± 0.1 dBmV.

d) System speed: 120 mBps, minimum.

e) System data error: 10 to the -8 Bps, minimum.

3) Fiber optic:

a) Isolation (outlet-outlet): 36 dB.

b) Signal Level: 0 dBmV ± 0.1 dBmV.

c) System speed: 540 mBps, minimum.

d) System data error: 10 to the -6 bps, minimum.

4) Analog RF Service:

a) Broadcast or "off air" RF (or television) analog service is considered to be at RF (below 900 mHz in frequency bandwidth). Usually a RF television circuits require a single coaxial cable plant from the headend to each TC location.

b) Isolation (outlet-outlet): 14 dB.

c) Impedance: 75 Ohms, Unbalanced (UNBAL).

d) Signal Level: 10 dBmV ± 5.0 dBmV.

e) Bandwidth: 6.0 mHz per channel, fully loaded.

1.2 RELATED WORK

A. Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Specification Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

C. Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

D. Specification Section 27 10 00, STRUCTURED CABLING.

E. Specification Section 26 27 26, WIRING DEVICES.

F. Specification Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

G. Specification Section 26 41 00, FACILITY LIGHTNING PROTECTION.

H. Specification Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT.

I. Specification Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS.

J. Specification Section 27 41 31, MASTER ANTENNA TV EQUIPMENT AND SYSTEMS.

K. H-088-C3, VA HANDBOOK DESIGN FOR TELEPHONE SYSTEMS

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date the system's submittal is technically approved by VA, shall be enforced.

B. National Fire Protection Association (NFPA):

70	NATIONAL ELECTRICAL CODE (NEC)
75	Protection of Electronic Computer/Data Processing Equipment
77	Recommended Practice on Static Electricity
	Standard for Health Care Facilities
101	Life Safety Code
1221	Emergency Services Communication Systems

C. Underwriters Laboratories, Inc. (UL):

65	Wired Cabinets
96	Lightning Protection Components
96A	INSTALLATION REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEMS
467	Grounding and Bonding Equipment
497/497A/497B	PROTECTORS FOR PAIRED CONDUCTORS/ COMMUNICATIONS CIRCUITS/DATA COMMUNICATIONS AND FIRE ALARM CIRCUITS
884	Underfloor Raceways and Fittings

D. ANSI/EIA/TIA Publications:

568B	Commercial Building Telecommunications Wiring Standard
569B	Commercial Building Standard for

	Telecommunications Pathways and Spaces
606A	ADMINISTRATION STANDARD FOR THE TELECOMMUNICATIONS INFRASTRUCTURE OF COMMERCIAL BUILDINGS
607A	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings
758	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings

E. Lucent Technologies: Document 900-200-318 "Outside Plant Engineering Handbook".

F. International Telecommunication Union – Telecommunication Standardization Sector (ITU-T).

G. Federal Information Processing Standards (FIPS) Publications.

H. Federal Communications Commission (FCC) Publications: Standards for telephone equipment and systems.

I. United States Air Force: Technical Order 33K-l-lOO Test Measurement and Diagnostic Equipment (TMDE) Interval Reference Guide.

J. Joint Commission on Accreditation of Health Care Organization (JCAHO): Comprehensive Accreditation Manual for Hospitals.

K. National and/or VA Life Safety Code(s): The more stringent of each listed code.

1.4 QUALITY ASSURANCE

A. The authorized representative of the OEM, shall be responsible for the design, satisfactory total operation of the System, and its certification.

B. The OEM shall meet the minimum requirements identified in Paragraph 2.1.A. Additionally, the Contractor shall have had experience with three or more installations of systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identification of these installations shall be provided as a part of the submittal as identified in Paragraph 1.5.

C. The System Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The System Contractor shall be authorized by the OEM to certify and warranty the installed equipment. In addition, the OEM and System Contractor shall accept complete

responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certification must be provided in writing as part of the Contractor's Technical Submittal.

D. All equipment, cabling, terminating hardware, TCOs, and patch cords shall be sourced from the certifying OEM or at the OEM's direction, and support the System design, the OEM's quality control and validity of the OEM's warranty.

E. The Contractor's Telecommunications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the RE before being allowed to commence work on the System.

1.5 SUBMITTALS

A. Provide submittals in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The RE shall retain one copy for review and approval.

1. If the submittal is approved the RE shall retain one copy for Official Records and return three (3) copies to the Contractor.
2. If the submittal is disapproved, three (3) copies will be returned to the Contractor with a written explanation attached that indicates the areas the submittal deviated from the System specifications. The RE shall retain one copy for Official Records.

B. Environmental Requirements: Technical submittals shall confirm the environmental specifications for physical TC areas occupied by the System. These environmental specifications shall identify the requirements for initial and expanded system configurations for:

1. Minimum floor space and ceiling heights.
2. Minimum size of doors for equipment passage.
3. Power requirements: The Contractor shall provide the specific voltage, amperage, phases, and quantities of circuits required.
4. Air conditioning, heating, and humidity requirements. The Contractor shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
5. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).

6. Proposed floor plan, based on the expanded system configuration of the bidder's proposed EPBX for this FACILITY.
7. Conduit size requirement (between main TC, computer, and console rooms).
8. Main trunk line and riser pathways, cable duct, and conduit requirements between each MTC, TC, and TCO.

C. Documents: The submittal shall be separated into sections for each subsystem and shall contain the following:

1. Title page to include:
   a. VA Medical Center.
   b. Contractor’s name, address, and telephone (including FAX) numbers.
   c. Date of Submittal.
   d. VA Project No.
2. List containing a minimum of three locations of installations of similar size and complexity as identified herein. These locations shall contain the following:
   a. Installation Location and Name.
   b. VA’s or User’s name, address, and telephone (including FAX) numbers.
   c. Date of Project Start and Date of Final Acceptance by VA.
   d. System Project Number.
   e. Brief (three paragraphs minimum) description of each system’s function, operation, and installation.
3. Narrative Description of the system.
4. A List of the equipment to be furnished. The quantity, make, and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the system and edit between the // - //. Delete equipment items that are not required add additional items required, and renumber section as per system design. The following is the minimum equipment required by the system:

QUANTITY	UNIT
//As required//	Cabinet Assembly(s)
//As required//	Environmental Cabinet
//As required//	Distribution/Interface Cabinet
//As required//	Equipment (Radio Relay) Rack

//As required//	Cross Connection (CCS) Systems
//As required//	Audio Alarm Panel
//As required//	TROUBLE ANNUNCIATOR PANEL
//As required//	Lightning Protection System
//As required//	Wire Management System/Equipment
//As required//	Telecommunications Outlets (TCO)
//As Required//	Distribution Cables
//As required//	TCO Connection Cables
//As required//	System Connectors
//As required//	Terminators
//As required//	Distribution Frames
//As required//	Telecommunications Closets (TC)
//As required//	Environmental Requirements
1 ea.	Installation Kit
//As-required//	Separate List Containing Each Equipment Spare(s)

5. Pictorial layouts of each MTC, IMTC, and RTCs; MCCS, IMCCS, VCCS, and HCCS termination cabinet(s), each distribution cabinet layout drawing, and TCO as each is expected to be installed and configured.
6. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
7. Engineering drawings of the System, showing calculated signal levels at the EPBX output, each input and output distribution point, proposed TCO values, and signal level at each TCO multipin, fiberoptic, and coaxial cable jack.
8. List of test equipment as per paragraph 1.5.D. below.
9. Letter certifying that the Contractor understands the requirements of the SAMPLES Paragraph 1.5.E.
10. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance tests.

D. Test Equipment List:

1. The Contractor is responsible for furnishing all test equipment required to test the system in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the system. The Contractor shall furnish test equipment of accuracy better than the parameters to be tested.

2. The test equipment furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
   a. Spectrum Analyzer.
   b. Signal Level Meter.
   c. Volt-Ohm Meter.
   d. Time Domain Reflectometer (TDR) with strip chart recorder (Data and Optical Measuring).
   e. Bit Error Test Set (BERT).
   f. Camera with a minimum of 60 pictures to that will develop immediately to include appropriate test equipment adapters. A video camera in VHS format is an acceptable alternate.
   g. Video Waveform Monitor.
   h. Video Vector Scope.
   i. Color Video Monitor with audio capability.
   j. 100 mHz Oscilloscope with video adapters

E. Samples: A sample of each of the following items shall be furnished to the COTR for approval prior to installation.
   1. TCO Wall Outlet Box 4" x 4"x 2.5" with:
      a. One each telephone (or voice) rj45 jack installed.
      b. Two each multi pin data rj45 jacks installed.
      c. Cover Plate installed.
      d. Fiber optic ST jack(s) installed.
      e. RF (F)/video (BNC)/audio (XL)jack(s) installed.
   2. Data CCS patch panel, punch block or connection device with RJ45 connectors installed.
   3. Telephone CCS system with IDC and/or RJ45 connectors and cable terminal equipment installed.
   4. Fiber optic CCS patch panel or breakout box with cable management equipment and “ST” connectors installed.
   5. 610 mm (2 ft.) section of each copper cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.
   6. 610 mm (2 ft.) section of each fiber optic cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.

7. 610 mm (2 ft.) section of each analog RF, video coaxial and audio cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.
8. Analog RF patch panel or breakout box with cable management equipment and “F” connectors installed.

F. Certifications:
1. Submit written certification from the OEM indicating that the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or VA Life Safety Guidelines, NFPA, NEC, UL, this specification, and JCAHCO requirements and instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. The VA will not approve any submittal without this certification.
3. Preacceptance Certification: This certification shall be made in accordance with the test procedure outlined in paragraph 3.2.B.

G. Equipment Manuals: Fifteen (15) working days prior to the scheduled acceptance test, the Contractor shall deliver four complete sets of commercial operation and maintenance manuals for each item of equipment furnished as part of the System to the RE. The manuals shall detail the theory of operation and shall include narrative descriptions, pictorial illustrations, block and schematic diagrams, and parts list.

H. Record Wiring Diagrams:
1. Fifteen (15) working days prior to the acceptance test, the Contractor shall deliver four complete sets of the Record Wiring Diagrams of the System to the RE. The diagrams shall show all inputs and outputs of electronic and passive equipment correctly identified according to the markers installed on the interconnecting cables, Equipment and room/area locations.
2. The Record Wiring Diagrams shall be in hard copy and two compact disk (CD) copies properly formatted to match the Facility’s current operating version of Computer Aided Drafting (AutoCAD) system. The RE shall verify and inform the Contractor of the version of AutoCAD being used by the Facility.

I. Surveys Required As A Part Of The Technical Submittal: The Contractor shall provide the following surveys that depict various system features and capacities are required in addition to the on site survey requirements described herein. Each survey shall be in writing and contain the following information (the formats are suggestions and may be used for the initial Technical Submittal survey requirements), as a minimum:

1. Cable Distribution System Design Plan: A design plan for the entire cable distribution systems requirements shall be provided with this document. It is the Contractor's responsibility to provide the Systems entire cable requirements and engineer a distribution system requirement plan using the format of the following paragraph(s), at a minimum:

   a. UTP (and/or STP) Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
BUILDING	Identifies the building by number, title, or location cabling is to be provided in
TO BUILDING IMC	Identifies building main terminal signal closet, by room number or location, to which cabling is provided too, in, and from
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.) cabling and TCOs are to be provided
TC ROOM NUMBER	Identifies the floor signal closet room, by room number, which cabling shall be provided
ROOM NUMBER	Identifies the room, by number, from which cabling and TCOs shall be provided
NUMBER OF CABLE PAIR	Identifies the number of cable pair required to be provided on each floor designated OR the number of cable pair (VA Owned) to be retained
NUMBER OF STRANDS USED/SPARE	Identifies the number of strands provided in each run

   b. Fiber Optic Cabling Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
TO BUILDING IMC	Identifies building, by number, title, or location, to which cabling is provided
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
NUMBER OF STRANDS	Identifies the number of strands in each run of fiber optic cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

c. Analog RF Cabling Requirements/Column Explanation:

Column	Explanation
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
TO FLOOR TC	Identifies building, by number or location, to which cabling is installed
NUMBER OF STRANDS	Identifies the number of strands in each run of RF cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

2. Telecommunication Outlets: The Contractor shall clearly and fully indicate this category for each outlet location and compare the total count to the locations identified above as a part of the

technical submittal. Additionally, the Contractor shall indicate the total number of spares.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. System Requirements:

1. The System shall provide the following minimum services that are designed in accordance with and supported by an Original Equipment Manufacturer (OEM), and as specified herein. The System shall provide continuous inter and/or intra-Facility voice and data, and analog RF service. The System shall be capacity sized so that loss of connectivity to external telephone systems shall not affect the Facilities operation in specific designated locations. The System shall:

   a. Be capable of inter-connecting and functioning fully with the existing Local Telephone Exchange (LEC) Network(s), Federal Telephone System (FTS) Inter-city Network(s), Inter-exchange Carriers, Integrated Services Digital Network (ISDN), Electronic Private Branch Exchange (EPBX) switches, asynchronous/synchronous data terminals and circuits including Automatic Transfer Mode (ATM), Frame Relay, and local area networks (LAN), at a minimum.

   b. Be a voice and data cable distribution system that is based on a physical “Star” Topology. An Analog RF coaxial cable distribution system shall be provided in a “home run” configuration from each associated riser TC to identified locations and as shown on the drawings.

   c. Be compatible with and able to provide direct digital connection to trunk level equipment including, but, not limited to: directly accessing trunk level equipment including the telephone system, audio paging, Industry Standard “T” and/or “DS” carrier services and external protocol converters. Additionally, connections to “T” and/or “DS” access/equipment or Customer Service Units (CSU) that are used in FTS and other trunk applications shall be included in the System design. Provide T-1 access/equipment (or CSU), as required for use, in FTS and other trunk applications by system design if this equipment is not provided by the existing telephone system and/or will be deactivated by the installation of the System. The Contractor shall provide all T-1 equipment necessary to terminate and make operational the quantity of

circuits designated. The CSU's shall be connected to the System's emergency battery power supply. The System shall be fully capable of operating in the Industry Standard "DS" protocol and provide that service when required.

d. Where the System connects to an existing or future telephone system, refer to specification Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT // OR specification Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION // for specific telephone equipment and system operational performance standards.

2. Specific Subsystem Requirements: The System shall consist, as a minimum, of the following independent sub-systems to comprise a complete and functional voice and digital and analog RF telecommunications cabling system: "Main" (MTC), ("vertical" (or "riser") trunk cabling system; vertical cross-connection (VCC) cabling systems, and TCO's with a minimum of four (4) RJ-45 jacks for the appropriate telephone, Data connections, and additional jacks, connectors, drop and patch cords, terminators, and adapters provided.

a. Telecommunication Closet (TC)/IT Room:

1) The maximum DC resistance per cable pair shall be no more than 28.6 Ohms per 305 M (1,000 feet). The TC shall be centrally located to cover the maximum amount of local floor space. The TC's house in cabinets or enclosures, on relay racks, and/or on backboards, various telecommunication data equipment, controllers, multiplexers, bridges, routers, LAN hub(s), telephone cross-connecting, active and passive equipment.

2) Additionally, the TC's may not house fire alarm, nurses call, code one (or blue), video, public address, and intercom equipment. Regardless of the method of installation, mounting, termination, or cross-connecting used, all vertical copper and fiber optic and analog RF coaxial cables shall be terminated on appropriate cross-connection systems (CCS) containing patch panel(s), punch blocks, and/or breakout devices provided in enclosures and tested as described herein. A cable and/or wire management system shall be a part of each CCS.

a) A minimum of three 110-120 VAC active quad outlets shall be provided, each with "U" grounded receptacles at a minimum

of one outlet for each front, side and back wall. These outlets shall be separately protected by an AC circuit breaker provided in the designated VA Emergency Critical Care AC power panel, that is connected to the Facilities Emergency AC Power Distribution System.

b) Climate control shall be provided in each TC 24 hours a day, seven days per week and 52 week per year to prevent failure of electronic components and for mission critical functional applications. The COTR is responsible for informing the Contractor regarding the minimum climate control requirements. In identified hostile TC locations where it has been determined (by COTR) that proper TC climate or external signal radiation cannot be properly maintained or controlled, the Contractor may, at his/her option, provide a minimum of two individual and properly sized self contained climate controlled equipment cabinet enclosures; one designated for voice, and one designated for data, and one additional cabinet designated for analog RF service, in each TC location identified on the drawings, in lieu of providing additional required TC air handling capability.

B. General:

1. All equipment to be supplied under this specification shall be new and the current model of a standard product of an OEM or record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:
   a. Maintains a stock of replacement parts for the item submitted.
   b. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
   c. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid.
2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity, or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a

specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.

3. The Contractor shall provide written verification, in writing to the COTR at time of installation, that the type of wire/cable being provided is recommended and approved by the OEM. The Contractor is responsible for providing the proper size and type of cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.
4. The Telephone Contractor is responsible for providing interfacing cable connections for the telephone, PA, Radio Paging, and Muzak systems with the System.
5. The telephone equipment and PA interface equipment shall be the interface points for connection of the PA interface cabling from the telephone switch via the system telephone interface unit.
6. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone equipment, systems, and service.
7. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
8. All interconnecting twisted pair, fiber-optic or coaxial cables shall be terminated on equipment terminal boards, punch blocks, breakout boxes, splice blocks, and unused equipment ports/taps shall be terminated according to the OEM’s instructions for telephone cable systems without adapters. The Contractor shall not leave unused or spare twisted pair wire, fiber-optic, or coaxial cable unterminated, unconnected, loose or unsecured.
9. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, which ever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance. Reference Specification Section 27 10 00, STRUCTURED CABLING and Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT.
10. Connect the System’s primary input AC power to the Facility’ Critical Branch of the Emergency AC power distribution system as

shown on the plans or if not shown on the plans consult with RE regarding a suitable circuit location prior to bidding.

11. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the System OEM. Base- band cable systems shall utilize barrier terminal screw type connectors, at a minimum. Crimp type connectors installed with a ratchet type installation tool are and acceptable alternate as long as the cable dress, pairs, shielding, grounding, and connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts, or solder type connections are unacceptable and will not be approved.
12. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cycolac plastic for the areas where provided.
13. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.

Underground warning tape shall be standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters imprinted with “CAUTION BURIED ELECTRIC LINE BELOW”, orange with black letters imprinted with “CAUTION BURIED TELEPHONE LINE BELOW” or orange with black letters imprinted with “CAUTION BURIED FIBER OPTIC LINE BELOW”, as applicable.

C. Equipment Functional Characteristics:

FUNCTIONS	**CHARACTERISTICS**
Input Voltage	105 to 130 VAC
POWER LINE FREQUENCY	60 HZ ±2.0 HZ
Operating Temperature	O to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

D. Equipment Standards and Testing:

1. The System has been defined herein as connected to systems identified as Critical Care performing Life Support Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.
2. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory where such standards have been established for the supplies, materials or equipment. See paragraph minimum requirements Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, and the guidelines listed in paragraph 2.J.2.
3. The provided active and passive equipment required by the System design and approved technical submittal must conform with each UL standard in effect for the equipment, as of the date of the technical submittal (or the date when the RE approved system equipment necessary to be replaced) was technically reviewed and approved by VA. Where a UL standard is in existence for equipment to be used in completion of this contract, the equipment must bear the approved UL seal.
4. Each item of electronic equipment to be provided under this contract must bear the approved UL seal or the seal of the testing laboratory that warrants the equipment has been tested in accordance with, and conforms to the specified standards.

2.2 EQUIPMENT ITEMS

A. Stand Alone Equipment Rack:

1. The rack shall be constructed of heavy 16 gauge cold rolled steel and have fully adjustable equipment front mounting rails that allows front panel equipment mounting and access. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the using Facility Service Chief or the RE. It shall be floor or wall mounted or mounted on casters as directed by the RE.
2. Technical Characteristics:

Overall Height	2180 mm (85 7/8in.), maximum
Overall Depth	650 mm (25 1/2in.), maximum
Overall Width	535 mm (21 1/16in.), maximum

Front Panel Opening	480 mm (19in.), EIA horizontal width
Hole Spacing	per EIA and Industry Standards

B. Cross-Connection System (CCS) Equipment Breakout, Termination Connector (or Bulkhead), and Patch Panels:

1. The connector panel(s) shall be made of flat smooth 3.175 mm (1/8 in.) thick solid aluminum, custom designed, fitted and installed in the cabinet. Bulkhead equipment connectors shall be mounted on the panel to enable all cabinet equipment's signal, control, and coaxial cables to be connected through the panel. Each panel shall be color matched to the cabinet installed.

   a. Voice (or Telephone):

      1) The CCS for voice or telephone service shall be Industry Standard type 110 (minimum) punch blocks for voice or telephone, and control wiring in lieu of patch panels, each being certified for category six service. IDC punch blocks (with internal RJ45 jacks) are acceptable for use in all CCS and shall be specifically designed for category 6 telecommunications service and the size and type of UTP cable used as described herein. As a minimum, punch block strips shall be secured to an OEM designed physical anchoring unit on a wall location in the MTC, IMTC, RTC, and TC. However, console, cabinet, rail, panel, etc. mounting is allowed at the OEM recommendation and as approved by the RE. Punch blocks shall not be used for Class II or 120 VAC power wiring.

      2) Technical Characteristics:

Number of horizontal rows	100, MINIMUM
Number of terminals per row	4, minimum
Terminal protector	required for each used or unused terminal
Insulation splicing	required between each row of terminals

   b. Digital or High Speed Data:

      1) The CCS for digital or high-speed data service shall be a patch panel with modular female RJ45 jacks installed in rows. Patch panels and RJ45 jacks shall be specifically designed for category 6 telecommunications service and the size and type of

UTP or STP cable used. Each panel shall be 480 mm (19in.) horizontal EIA rack mountable dimensions with EIA standard spaced vertical mounting holes.

2) Technical Characteristics:

Number of horizontal rows	2, minimum
Number of jacks per row	24, MINIMUM
Type of jacks	RJ45
Terminal protector	required for each used or unused jack
Insulation	required between each row of jacks

c. Fiber optic:

1) Product reference of a VA Approved (US State Department) type is Telewire, PUP-17 with pre-punched chassis mounting holes arranged in two horizontal rows. This panel may be used for fiber optic, audio, control cable, and Class II Low Voltage Wiring installations when provided with the proper connectors. This panel is not allowed to be used for 120 VAC power connections.

2) Technical Characteristics:

Height	Two rack units (RUs), 88 mm (3.5in.) minimum
Width	484 mm (19 1/16in.), EIA minimum
Number of connections	12 pairs, minimum
Connectors	
Audio Service	Use RCA 6.35 mm (1/4in.) Phono, XL or Barrier Strips, surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained and RE approved)
Control Signal Service	Barrier strips surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained and RE approved)
Low voltage power (class II)	Barrier strips with spade lugs and clear full length plastic cover, surfaced mounted

Fiber optic	"ST" Stainless steel, female

d. Mounting Strips and Blocks:

1) Barrier Strips: Barrier strips are approved for AC power, data, voice, and control cable or wires. Barrier strips shall accommodate the size and type of audio spade (or fork type) lugs used with insulating and separating strips between the terminals for securing separate wires in a neat and orderly fashion. Each cable or wire end shall be provided with an audio spade lug, which is connected to an individual screw terminal on the barrier strip. The barrier strips shall be surface secured to a console, cabinet, rail, panel, etc. 120 VAC power wires shall not be connected to signal barrier strips.

2) Technical Characteristics:

Terminal size	6-32, minimum
Terminal Count	ANY COMBINATION
Wire size	20 AWG, minimum
Voltage handling	100 V, minimum
Protective connector cover	Required for Class II and 120 VAC power connections

2. Solderless Connectors: The connectors (or fork connectors) shall be crimp-on insulated lug to fit a 6-32 minimum screw terminal. The fork connector shall be installed using a standard lug-crimping tool.

3. Punch Blocks: As a minimum, Industry Standard 110 type punch blocks are approved for data, voice, and control wiring. Punch blocks shall be specifically designed for the size and type of wire used. Punch block strips shall be secured to a console, cabinet, rail, panel, etc. Punch blocks shall not be used for Class II or 120 VAC power wiring.

120 VAC power wiring.

C. Wire Management System and Equipment:

1. Wire Management System: The system(s) shall be provided as the management center of the respective cable system, CCS, and TC it is incorporated. It shall perform as a platform to house peripheral

equipment in a standard relay rack or equipment cabinet. It shall be arranged in a manner as to provide convenient access to all installed management and other equipment. All cables and connections shall be at the rear of each system interface to IDC and/or patch panels, punch blocks, wire wrap strips, and/or barrier strip.

2. Wire Management Equipment: The wire management equipment shall be the focal point of each wire management system. It shall provide an orderly interface between outside and inside wires and cables (where used), distribution and interface wires and cables, interconnection wires and cables and associated equipment, jumper cables, and provide a uniform connection media for all system fire retardant wires and cables and other subsystems. It shall be fully compatible and interface to each cable tray, duct, wireway, or conduit used in the system. All interconnection or distribution wires and cables shall enter the system at the top (or from a wireway in the floor) via a overhead protection system and be uniformly routed down either side (or both at the same time) of the frames side protection system then laterally via a anchoring or routing shelf for termination on the rear of each respective terminating assembly. Each system shall be custom configured to meet the System design and user needs.

2.3 ENVIRONMENTAL REQUIREMENTS

Technical submittals shall identify the environmental specifications for housing the system. These environmental specifications shall identify the requirements for initial and expanded system configurations for:

A. Floor loading for cabinets.
B. Minimum floor space and ceiling heights.
C. Minimum size of doors for equipment passage.
D. Power requirements: The bidders shall provide the specific voltage, amperage, phases, and quantities of circuits required.
E. Air conditioning, heating, and humidity requirements. The bidder shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
F. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).
G. Proposed floor plan.
H. Conduit size requirement (between equipment room and console room).

2.4 INSTALLATION KIT

The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, or punch block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the RE all unused and partially opened installation kit boxes, coaxial, fiberoptic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware. The following are the minimum required installation sub-kits:

A. System Grounding:
   1. The grounding kit shall include all cable and installation hardware required..
   2. This includes, but is not limited to:
      a. Coaxial Cable Shields.
      b. Control Cable Shields.
      c. Data Cable Shields.
      d. Equipment Racks.
      e. Equipment Cabinets.
      f. Conduits.
      g. Duct.
      h. Cable Trays.
      i. Power Panels.
      j. Connector Panels.
      k. Grounding Blocks.

B. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.

C. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.

D. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat

and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.

E. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.

F. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each subsystem according to the OEM requirements, as-installed drawings, and this document.

G. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this document and explained herein.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Product Delivery, Storage and Handling:

1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment catalog numbers, model and serial identification numbers. The RE may inventory the cable, patch panels, and related equipment.
2. Storage and Handling: Store and protect equipment in a manner, which will preclude damage as directed by the RE.

B. System Installation:

1. After the contract’s been awarded, and within the time period specified in the contract, the Contractor shall deliver the total system in a manner that fully complies with the requirements of this specification. The Contractor shall make no substitutions or changes in the System without written approval from the RE and PM.
2. The Contractor shall install all equipment and systems in a manner that complies with accepted industry standards of good practice, OEM instructions, the requirements of this specification, and in a manner which does not constitute a safety hazard. The Contractor shall insure that all installation personnel understands and complies with all the requirements of this specification.
3. The Contractor shall install suitable filters, traps, directional couplers, splitters, TC’s, and pads for minimizing interference and

for balancing the System. Items used for balancing and minimizing interference shall be able to pass telephone and data, and lightwave, and analog signals in the frequency bands selected, in the direction specified, with low loss, and high isolation, and with minimal delay of specified frequencies and signals. The Contractor shall provide all equipment necessary to meet the requirements of Paragraph 2.1.C and the System performance standards.

4. All passive equipment shall be connected according to the OEM's specifications to insure future correct termination, isolation, impedance match, and signal level balance at each telephone/data outlet.
5. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
6. All lines shall be terminated in a suitable manner to facilitate future expansion of the System.
7. All vertical copper and fiber optic, and coaxial cables shall be terminated so any future changes only requires modifications of the EPBX or signal closet equipment only.
8. Terminating resistors or devices shall be used to terminate all unused branches, outlets, equipment ports of the System, and shall be devices designed for the purpose of terminating fiber optic or twisted pair, and coaxial, and lightwave cables carrying telephone and data, and analog signals in telephone and data, and analog video, and lightwave systems.
9. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with two keys.

C. Conduit and Signal Ducts:

1. Conduit:
   a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weatherheads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed. The minimum conduit size shall be 19 mm (3/4 in.).
   b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow telephone cables to be installed in partitioned cable tray with

data cables may be granted in writing by the RE if requested.) Conduits shall be provided in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NEC Articles 517 for Critical Care and 800 for Communications systems, at a minimum.

c. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.

d. When ”innerduct” flexible cable protective systems is specifically authorized to be provided for use in the System, it’s installation guidelines and standards shall be as the specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.

e. Conduit (including GFE) fill shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from signal conduit.

f. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.

g. Ensure that Critical Care Nurse Call, and PA Systems (as identified by NEC Section 517) are completely separated and protected from all other systems.

2. Signal Duct, Cable Duct, or Cable Tray:

a. The Contractor shall use existing signal duct, cable duct, and/or cable tray, when identified and approved by the RE.

b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 in. X 4 in.) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides or barriers are required on all sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.

c. Approved cable tray shall be fully covered, mechanically and physically partitioned for multiple electronic circuit use, and be UL certified and labeled for use with telecommunication circuits and/or systems. The RE shall approve width and height dimensions.

D. Connectors: Circuits, transmission lines, and signal extensions shall have continuity, correct connection and polarity. A uniform polarity shall be maintained between all points in the system.

1. Wires:
   a. Wire ends shall be neatly formed and where insulation has been cut, heat shrink tubing shall be employed to secure the insulation on each wire. Tape of any type is not acceptable.
   b. Audio spade lugs shall be installed on each wire (including spare or unused) end and connect to screw terminals of appropriate size barrier strips. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current. Punch blocks are approved for signal, not AC wires. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.
2. Cables: Each connector shall be designed for the specific size cable being used and installed with the OEM's approved installation tool. Typical system cable connectors include; but, are not limited to: Audio spade lug, punch block, etc.
3. Line or Microphone Audio: Each connector shall be installed according to the cable or connector OEM's instructions and use the OEM's approved installation tool. Install the connector's to provide and maintain the following audio signal polarity:
   a. XLR type connectors Signal or positive conductor is pin 3; common or neutral conductor is pin 2; ground conductor is pin 1.
   b. Two and 3 conductor 1/4" Signal or positive conductor is tip; neutral or 1/8" phono plugs conductor is ring and ground or shield and jacks conductor is sleeve.
   c. RCA Phono Plugs the Signal or positive conductor is tip; and Jacks neutral or shield conductor is sleeve.
4. Speaker Line Audio:
   a. Each connector shall be installed according to the cable, transformer or speaker OEM instructions and using the OEM's approved installation tool. The Contractor shall ensure each

speaker is properly phased and connected in the same manner throughout the System using two conductor type wires.

b. One of the conductors shall be color coded to aid in establishing speaker signal polarity. Each speaker line shall be permanently soldered or audio spade lug connected to each appropriate speaker or line matching transformer connection terminal. Speaker line connection to each audio amplifier shall use audio spade lugs, as described herein.

E. AC Power: AC power wiring shall be run separately from signal cable.

F. Grounding:

1. General: The Contractor shall ground all Contractor Installed Equipment and identified VA Furnished Equipment to eliminate all shock hazards and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup, crosstalk, etc. The total ground resistance shall be 0.1 Ohm or less.

   a. The Contractor shall install lightning arrestors and grounding in accordance with the NFPA and this specification.

   b. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.

   c. The use of conduit, signal duct or cable trays as system or electrical ground is not acceptable and will not be permitted. These items may be used only for the dissipation of internally generated static charges (not to be confused with externally generated lightning) that may applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.

2. Cabinet Buss: A common ground buss of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.

3. Equipment: Equipment shall be bonded to the cabinet bus with copper braid equivalent to at least #12 AWG. Self grounding equipment enclosures, racks or cabinets, that provide OEM certified functional

ground connections through physical contact with installed equipment, are acceptable alternates.

4. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cable shields shall be insulated from each other, faceplates, equipment racks, consoles, enclosures or cabinets; except, at the system common ground point. Coaxial and audio cables, shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.

G. Equipment Assembly:

1. Cabinets:

a. Each enclosure shall be: floor or wall mounted with standard knockout holes for conduit connections or cable entrance; provide for ventilation of the equipment; have front and rear locking doors (except wall mounted cabinets that require only a front locking door); power outlet strip(s), and connector or patch panel(s).

b. Rack (including freestanding radio relay) mounted equipment shall be installed in the enclosure’s equipment adjustable mounting racks with equipment normally requiring adjustment or observation mounted so operational adjustment(s) can be conveniently made. Heavy equipment shall be mounted with rack slides or rails allowing servicing from the front of the enclosure. Heavy equipment shall not depend only upon front panel mounting screws for support. Equipment shall be provided with sufficient cable slack to permit servicing by removal of the installed equipment from the front of the enclosure. A color matched blank panel (spacer) of 44 mm (1.75 in.) high, shall be installed between each piece of equipment (active or passive) to insure adequate air circulation. The enclosure shall be designed for efficient equipment cooling and air ventilation. Each console or cabinet shall be equipped with a quiet fan and nondisposable air filter.

c. Enclosures and racks shall be installed plumb and square. Each shall be permanently attached to the building structure and held firmly in place. Fifteen inches of front vertical space opening shall be provided for additional equipment.

d. Signal connector, patch, and bulkhead panels (i.e.: audio, data, control, analog video, etc.) shall be connected so that outputs

from each source, device or system component shall enter the panel at the top row of jacks, beginning left to right as viewed from the front, which will be called "inputs". Each connection to a load, device or system component shall exit the panel at the bottom row of jacks, beginning left to right as viewed from the front, which will be called "outputs".

1) Equipment located indoors shall be installed in metal racks or enclosures with hinged doors to allow access for maintenance without causing interference to other nearby equipment.
2) Cables shall enter the equipment racks or enclosures in such a manner that allows all doors or access panels to open and close without disturbing or damaging the cables.
3) All distribution hardware shall be securely mounted in a manner that allows access to the connections for testing and provides sufficient room for the doors or access panels to open and close without disturbing the cables.

H. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for voice and data circuits shall be stenciled using laser printers. Handwritten labels are not acceptable.

1. Cable and Wires (Hereinafter referred to as “Cable”): Cables shall be labeled at both ends in accordance with ANSI/EIA/TIA-606-A. Labels shall be permanent in contrasting colors. Cables shall be identified according to the System “Record Wiring Diagrams”.
2. Equipment: System equipment shall be permanently labeled with contrasting plastic laminate or bakelite material. System equipment shall be labeled on the face of the unit corresponding to its source.
3. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying it as the System. In addition, each enclosure shall be labeled according to this standard.
4. Termination Hardware: The Contractor shall label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with ANSI/EIA/TIA-606-A and the “Record Wiring Diagrams”.

3.2 TESTS

A. Interim Inspection:

1. This inspection shall verify that the equipment provided adheres to the installation requirements of this document. The interim inspection will be conducted by a factory-certified representative and witnessed by a VA Representative. Each item of installed equipment shall be checked to insure appropriate UL certification markings. This inspection shall verify cabling terminations in telecommunications rooms and at workstations adhere to color code for T568B or T568A pin assignments (coordinate with VA) and cabling connections are in compliance with ANSI/EIA/TIA standards. Visually confirm Category 6 marking of outlets, faceplates, outlet/connectors and patch cords.
2. Perform fiber optical field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
3. The Contractor shall notify the RE, in writing, of the estimated date the Contractor expects to be ready for the interim inspection, at least 20 working days before the requested inspection date.
4. Results of the interim inspection shall be provided to the COTR and PM. If major or multiple deficiencies are discovered, a second interim inspection may be required before permitting the Contractor to continue with the system installation.
5. The COTR and/or the PM shall determine if an additional inspection is required, or if the Contractor will be allowed to proceed with the installation. In either case, re-inspection of the deficiencies noted during the interim inspection(s), will be part of the proof of performance test. The interim inspection shall not affect the Systems' completion date. The Contracting Officer shall ensure all test documents will become a part of the Systems record documentation.

B. Pretesting:

1. Upon completing the installation of the System, the Contractor shall align and balance the system. The Contractor shall pretest the entire system.
2. Pretesting Procedure:
   a. During the system pretest, the Contractor shall verify (utilizing the approved spectrum analyzer and test equipment) that the

System is fully operational and meets all the system performance requirements of this standard.

b. The Contractor shall pretest and verify that all System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. The Contractor shall measure and record the aural carrier levels of each system telephone and data channel, at each of the following points in the system:

1) Local Telephone Company Interfaces or Inputs.
2) EPBX interfaces or inputs and outputs.
3) MDF interfaces or inputs and outputs.
4) EPBX output S/NR for each telephone and data channel.
5) Signal Level at each interface point to the distribution system, the last outlet on each trunk line plus all outlets installed as part of this contract.

3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.

C. Acceptance Test:

1. After the System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 days written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of a VA Representative and an OEM certified representative. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance. The test shall verify that the total System meets the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

D. Verification Tests:

1. Test the UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has an overall shield. Test the operation of shorting bars in connection blocks. Test cables after termination and prior to cross-connection.

2. Multimode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-14A using Method A, Optical Power Meter and Light Source. Perform verification acceptance test.

E. Performance Testing:

1. Perform Category 6 tests in accordance with ANSI/EIA/TIA-568-B.1 and ANSI/EIA/TIA-568-B.2. Test shall include the following: wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.
2. Fiber Optic Links: Perform end-to-end fiber optic cable link tests in accordance with ANSI/EIA/TIA-568-B.3.

F. Total System Acceptance Test: The Contractor shall perform verification tests for UTP copper cabling system(s) and the multimode fiber optic cabling system(s) after the complete telecommunication distribution system and workstation outlet are installed.

1. Voice Testing: Connect to the network interface device at the demarcation point. Go off-hook and receive dial tone from the LEC. If a test number is available, place and receive a local, long distance, and FTS telephone call.
2. Data Testing: Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network is achieved.

3.3 TRAINING

A. Furnish the services of a factory-trained engineer or technician for a total of two four hour classes to instruct designated Facility IRM personnel. Instruction shall include cross connection, corrective, and preventive maintenance of the System and equipment.

B. Before the System can be accepted by the VA, this training must be accomplished. Training will be scheduled at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.

3.4 GUARANTEE PERIOD OF SERVICE

A. Contractor’s Responsibilities:

1. The Contractor shall guarantee that all installed material and equipment will be free from defects, workmanship, and will remain so for a period of one year from date of final acceptance of the System by the VA. The Contractor shall provide OEM’s equipment warranty documents, to the RE (or Facility Contracting Officer if the Facility has taken procession of the building(s)), that certifies

each item of equipment installed conforms to OEM published specifications.

2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. The Contractor and OEM shall provide this contact capability at no additional cost to the VA.
3. All Contractor installation, maintenance, and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the one year guarantee period:
   a. Response Time:
      1) The RE (or facility Contracting Officer if the facility has taken possession of the building[s]) are the Contractor’s reporting and contact officials for the System trouble calls, during the guarantee period.
      2) A standard workweek is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal Holidays.
      3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
         a) A routine trouble call within one working days of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord to be inoperable.
         b) An emergency trouble call within 6 hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point to be inoperable at anytime. Additionally, the loss of a minimum of 50 station or system lines shall be deemed as this type of a trouble call.
      4) The Contractor shall respond on-site to a catastrophic trouble call within 4 hours of its report. A catastrophic trouble call is considered total system failure.
         a) If a system failure cannot be corrected within four hours (exclusive of the standard work time limits), the

Contractor shall be responsible for providing alternate system CCS or TCO equipment, or cables. The alternate equipment and/or cables shall be operational within four hours after the four hour trouble shooting time.

b) Routine or emergency trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as a catastrophic trouble call if so determined by the RE or Facility Director. The RE or Facility Contracting Officer shall notify the Contractor of this type of trouble call at the direction of the Facilities Director.

b. Required on-site visits during the one year guarantee period

1) The Contractor shall visit, on-site, for a minimum of eight hours, once every 12 weeks, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this SPEC.

a) The Contractor shall arrange all Facility visits with the RE or Facility Contracting Officer prior to performing the required maintenance visits.

b) The Contractor in accordance with the OEM's recommended practice and service intervals shall perform preventive maintenance during a non-busy time agreed to by the RE or Facility Contracting Officer and the Contractor.

c) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE or Facility Contracting Officer.

2) The Contractor shall provide the RE or Facility Contracting Officer a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the RE with sample copies of these reports for review and approval at the beginning of the Total System Acceptance Test. The following reports are the minimum required:

a) Monthly Report: The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to RE or Facilities Contracting Officer by the fifth working day after the end of each month. The

report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and Systems for preventive and predictive maintenance

b) Contractor Log: The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the System. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

3) The RE or Facility Contracting Officer shall provide the Facility Engineering Officer, two (2) copies of actual reports for evaluation.

a) The RE or Facility Contracting Officer shall ensure copies of these reports are entered into the System's official acquisition documents.

b) The Facilities Chief Engineer shall ensure copies of these reports are entered into the System's official technical as-installed documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use, accidents, other vendor, contractor, VA tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the RE or Facility Contracting Officer in writing upon the discovery of these incidents. The RE or Facility Contracting Officer will investigate all reported incidents and render findings concerning any Contractor's responsibility.

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SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the furnishing, installing, certification, testing, and guaranty of a complete and operating Voice and Digital Cable Distribution System (here-in-after referred to as "*the System*"), and associated equipment and hardware to be installed in the VA Hospice here-in-after referred to as "the Facility". The System shall include, but not be limited to: equipment cabinets, interface enclosures, and relay racks; necessary combiners, traps, and filters; and necessary passive devices such as: splitters, couplers, cable "patch", "punch down", and cross-connector blocks or devices, voice and data distribution sub-systems, and associated hardware. The System shall additionally include, but not be limited to: telecommunication closets (TC); telecommunications outlets (TCO); copper and fiber optic, and analog radio frequency (RF) systems coaxial distribution cables, connectors, "patch" cables, and/or "break out" devices.

B. The System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.

C. The term "provide", as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.

D. The Voice and Digital and Analog Telecommunication Distribution Cable Equipment and System provides the media which voice and data information travels over and connects to the Telephone System which is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Therefore, since the System connects to or extends the telephone system, the System's installation and operation shall adhere to all appropriate National, VA, and/or Local Life Safety and/or Support Codes, which ever are the more stringent for this Facility. At a minimum , the System shall be installed according to NFPA, Section 70, National Electrical Code (NEC), Article 517 and Chapter 7; NFPA, Section 99, Health Care Facilities, Chapter 3-4; NFPA, Section 101, Life Safety Code, Chapters 7, 12, and/or 13; Joint Commission on Accreditation of Health Care Organization (JCAHCO), Manual for Health Care Facilities, all necessary

Life Safety and/or Support guidelines; this specification; and the original equipment manufacturer's (OEM) suggested installation design, recommendations, and instructions. The OEM and Contractor shall ensure that all management, sales, engineering, and installation personnel have read and understand the requirements of this specification before the System is designed, engineered, delivered, and provided.

E. The VA Project Manager (PM) and/or if delegated, COTR are the approving authorities for all contractual and mechanical changes to the System. The Contractor is cautioned to obtain in writing, all approvals for system changes relating to the published contract specifications and drawings, from the PM and/or the RE before proceeding with the change.

F. System Performance:

1. At a minimum, the System shall be able to support the following voice and data and analog RF operations for Category 6 Certified Telecommunication Service:
   a. Provide the following interchange (or interface) capabilities:
      1) Basic Rate (BRI).
      2) Primary Rate (PRI).
   b. ISDN measured per VA requirements:
      1) Narrow Band BRI:
         a) B Channel: 64 kilo-Bits per second (kBps), minimum.
         b) D Channel: 16 kBps, minimum.
         c) H Channel: 384 kBps, minimum.
      2) Narrow Band PRI:
         a) B Channel: 64 kBps, minimum.
         b) D Channel: 64 kBps, minimum.
         c) H Channel: 1,920 kBps, minimum.
      3) Wide (or Broad) Band: All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at “T” reference.
   c. ATM operation and interface: ATM 155 mBps measured per VA requirements.
   d. Frame Relay: All stated compliance’s measured per VA requirements.
   e. Integrated Data Communications Utility (IDCU) operation and interface: Measured per VA requirements.
   f. VA Open Systems Interconnection Profile (GOSSIP) compliant: Measured per VA requirements.

g. Fiberoptic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed measured per VA requirements (shall be Synchronous Optical Network [SONET] compliant).

h. System Sensitivity: Satisfactory service shall be provided for at least 3,000 feet for all voice and data and analog RF locations.

2. At a minimum the System shall support the following operating parameters:

a. EPBX connection:

1) System speed: 1.0 gBps per second, minimum.

2) Impedance: 600 Ohms.

3) Cross Modulation: -60 deci-Bel (dB).

4) Hum Modulation: -55 dB.

5) System data error: 10 to the -10 Bps, minimum.

6) Loss: Measured at the frame output with reference Zero (0) deciBel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.

a) Trunk to station: 1.5 dB, maximum.

b) Station to station: 3.0 dB, maximum.

c) Internal switch crosstalk: -60 dB when a signal of ± 10 deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.

d) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above reference (terminated) ground noise, whichever is greater.

e) Traffic Grade of Service for Voice and Data:

(1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits will not interfere with, or degrade, the voice service.

(2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.

b. Telecommunications Outlet (TCO):

1) Voice:

a) Isolation (outlet-outlet): 24 dB.

b) Impedance: 600 Ohms, balanced (BAL).

c) Signal Level: 0 deciBel per mili-Volt (dBmV) ± 0.1 dBmV.

d) System speed: 100 mBps, minimum.

e) System data error: 10 to the -6 Bps, minimum.

2) Data:

a) Isolation (outlet-outlet): 24 dB.

b) Impedance: 600 Ohms, BAL.

c) Signal Level: 0 dBmV ± 0.1 dBmV.

d) System speed: 120 mBps, minimum.

e) System data error: 10 to the -8 Bps, minimum.

3) Fiber optic:

a) Isolation (outlet-outlet): 36 dB.

b) Signal Level: 0 dBmV ± 0.1 dBmV.

c) System speed: 540 mBps, minimum.

d) System data error: 10 to the -6 bps, minimum.

4) Analog RF Service:

b) Broadcast or "off air" RF (or television) analog service is considered to be at RF (below 900 mHz in frequency bandwidth). Usually a RF television circuits require a single coaxial cable plant from the headend to each TC location.

b) Isolation (outlet-outlet): 14 dB.

c) Impedance: 75 Ohms, Unbalanced (UNBAL).

d) Signal Level: 10 dBmV ± 5.0 dBmV.

e) Bandwidth: 6.0 mHz per channel, fully loaded.

1.2 RELATED WORK

A. Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Specification Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

C. Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

D. Specification Section 27 10 00, STRUCTURED CABLING.

E. Specification Section 26 27 26, WIRING DEVICES.

F. Specification Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

G. Specification Section 26 41 00, FACILITY LIGHTNING PROTECTION.

H. Specification Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT.

I. Specification Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS.

J. Specification Section 27 41 31, MASTER ANTENNA TV EQUIPMENT AND SYSTEMS.

K. H-088-C3 VA HANDBOOK DESIGN FOR TELEPHONE SYSTEMS

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date the system's submittal is technically approved by VA, shall be enforced.

B. National Fire Protection Association (NFPA):

70	NATIONAL ELECTRICAL CODE (NEC)
75	Protection of Electronic Computer/Data Processing Equipment
77	Recommended Practice on Static Electricity
	Standard for Health Care Facilities
101	Life Safety Code
1221	Emergency Services Communication Systems

C. Underwriters Laboratories, Inc. (UL):

65	Wired Cabinets
96	Lightning Protection Components
96A	INSTALLATION REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEMS
467	Grounding and Bonding Equipment
497/497A/497B	PROTECTORS FOR PAIRED CONDUCTORS/ COMMUNICATIONS CIRCUITS/DATA COMMUNICATIONS AND FIRE ALARM CIRCUITS
884	Underfloor Raceways and Fittings

D. ANSI/EIA/TIA Publications:

568B	Commercial Building Telecommunications Wiring Standard
569B	Commercial Building Standard for Telecommunications Pathways and Spaces

606A	ADMINISTRATION STANDARD FOR THE TELECOMMUNICATIONS INFRASTRUCTURE OF COMMERCIAL BUILDINGS
607A	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings
758	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings

E. Lucent Technologies: Document 900-200-318 "Outside Plant Engineering Handbook".

F. International Telecommunication Union – Telecommunication Standardization Sector (ITU-T).

G. Federal Information Processing Standards (FIPS) Publications.

H. Federal Communications Commission (FCC) Publications: Standards for telephone equipment and systems.

I. United States Air Force: Technical Order 33K-l-lOO Test Measurement and Diagnostic Equipment (TMDE) Interval Reference Guide.

J. Joint Commission on Accreditation of Health Care Organization (JCAHO): Comprehensive Accreditation Manual for Hospitals.

K. National and/or VA Life Safety Code(s): The more stringent of each listed code.

1.4 QUALITY ASSURANCE

A. The authorized representative of the OEM, shall be responsible for the design, satisfactory total operation of the System, and its certification.

B. The OEM shall meet the minimum requirements identified in Paragraph 2.1.A. Additionally, the Contractor shall have had experience with three or more installations of systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identification of these installations shall be provided as a part of the submittal as identified in Paragraph 1.5.

C. The System Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The System Contractor shall be authorized by the OEM to certify and warranty the installed equipment. In addition, the OEM and System Contractor shall accept complete responsibility for the design, installation, certification, operation,

and physical support for the System. This documentation, along with the System Contractor and OEM certification must be provided in writing as part of the Contractor's Technical Submittal.

D. All equipment, cabling, terminating hardware, TCOs, and patch cords shall be sourced from the certifying OEM or at the OEM's direction, and support the System design, the OEM's quality control and validity of the OEM's warranty.

E. The Contractor's Telecommunications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the RE before being allowed to commence work on the System.

1.5 SUBMITTALS

A. Provide submittals in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The RE shall retain one copy for review and approval.

1. If the submittal is approved the RE shall retain one copy for Official Records and return three (3) copies to the Contractor.
2. If the submittal is disapproved, three (3) copies will be returned to the Contractor with a written explanation attached that indicates the areas the submittal deviated from the System specifications. The RE shall retain one copy for Official Records.

B. Environmental Requirements: Technical submittals shall confirm the environmental specifications for physical TC areas occupied by the System. These environmental specifications shall identify the requirements for initial and expanded system configurations for:

1. Minimum floor space and ceiling heights.
2. Minimum size of doors for equipment passage.
3. Power requirements: The Contractor shall provide the specific voltage, amperage, phases, and quantities of circuits required.
4. Air conditioning, heating, and humidity requirements. The Contractor shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
5. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).

6. Proposed floor plan, based on the expanded system configuration of the bidder's proposed EPBX for this FACILITY.
7. Conduit size requirement (between main TC, computer, and console rooms).
8. Main backbone, trunk line, riser, and horizontal cable pathways, cable duct, and conduit requirements between each MTC, TC, and TCO.

C. Documents: The submittal shall be separated into sections for each subsystem and shall contain the following:

1. Title page to include:
   a. VA Medical Center.
   b. Contractor’s name, address, and telephone (including FAX) numbers.
   c. Date of Submittal.
   d. VA Project No.
2. List containing a minimum of three locations of installations of similar size and complexity as identified herein. These locations shall contain the following:
   a. Installation Location and Name.
   b. VA’s or User’s name, address, and telephone (including FAX) numbers.
   c. Date of Project Start and Date of Final Acceptance by VA.
   d. System Project Number.
   e. Brief (three paragraphs minimum) description of each system’s function, operation, and installation.
3. Narrative Description of the system.
4. A List of the equipment to be furnished. The quantity, make, and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the system and edit between the // - //. Delete equipment items that are not required add additional items required, and renumber section as per system design. The following is the minimum equipment required by the system:

QUANTITY	UNIT
//As required//	Cabinet Assembly(s)
//As required//	Environmental Cabinet
//As required//	Distribution/Interface Cabinet
//As required//	Equipment (Radio Relay) Rack

//As required//	Cross Connection (CCS) Systems
//As required//	Audio Alarm Panel
//As required//	TROUBLE ANNUNCIATOR PANEL
//As required//	Lightning Protection System
//As required//	Wire Management System/Equipment
//As required//	Telecommunications Outlets (TCO)
//As Required//	Distribution Cables
//As required//	TCO Connection Cables
//As required//	System Connectors
//As required//	Terminators
//As required//	Distribution Frames
//As required//	Telecommunications Closets (TC)
//As required//	Environmental Requirements
1 ea.	Installation Kit
//As-required//	Separate List Containing Each Equipment Spare(s)

5. Pictorial layouts of each MTC, IMTC, and RTCs; MCCS, IMCCS, VCCS, and HCCS termination cabinet(s), each distribution cabinet layout drawing, and TCO as each is expected to be installed and configured.
6. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
7. Engineering drawings of the System, showing calculated signal levels at the EPBX output, each input and output distribution point, proposed TCO values, and signal level at each TCO multipin, fiberoptic, and coaxial cable jack.
8. List of test equipment as per paragraph 1.5.D. below.
9. Letter certifying that the Contractor understands the requirements of the SAMPLES Paragraph 1.5.E.
10. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance tests.

D. Test Equipment List:

1. The Contractor is responsible for furnishing all test equipment required to test the system in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the system. The Contractor shall furnish test equipment of accuracy better than the parameters to be tested.

2. The test equipment furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
   a. Spectrum Analyzer.
   b. Signal Level Meter.
   c. Volt-Ohm Meter.
   d. Time Domain Reflectometer (TDR) with strip chart recorder (Data and Optical Measuring).
   e. Bit Error Test Set (BERT).
   f. Camera with a minimum of 60 pictures to that will develop immediately to include appropriate test equipment adapters. A video camera in VHS format is an acceptable alternate.
   g. Video Waveform Monitor.
   h. Video Vector Scope.
   i. Color Video Monitor with audio capability.
   j. 100 mHz Oscilloscope with video adapters

E. Samples: A sample of each of the following items shall be furnished to the RE for approval prior to installation.
   1. TCO Wall Outlet Box 4" x 4"x 2.5" with:
      a. One each telephone (or voice) rj45 jack installed.
      b. Two each multi pin data rj45 jacks installed.
      c. Cover Plate installed.
      d. Fiber optic ST jack(s) installed.
      e. RF (F)/video (BNC)/audio (XL)jack(s) installed.
   2. Data CCS patch panel, punch block or connection device with RJ45 connectors installed.
   3. Telephone CCS system with IDC and/or RJ45 connectors and cable terminal equipment installed.
   4. Fiber optic CCS patch panel or breakout box with cable management equipment and “ST” connectors installed.
   5. 610 mm (2 ft.) section of each copper cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.
   6. 610 mm (2 ft.) section of each fiber optic cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.

7. 610 mm (2 ft.) section of each analog RF, video coaxial and audio cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.
8. Analog RF patch panel or breakout box with cable management equipment and “F” connectors installed.

F. Certifications:
1. Submit written certification from the OEM indicating that the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or VA Life Safety Guidelines, NFPA, NEC, UL, this specification, and JCAHCO requirements and instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. The VA will not approve any submittal without this certification.
3. Preacceptance Certification: This certification shall be made in accordance with the test procedure outlined in paragraph 3.2.B.

G. Equipment Manuals: Fifteen (15) working days prior to the scheduled acceptance test, the Contractor shall deliver four complete sets of commercial operation and maintenance manuals for each item of equipment furnished as part of the System to the RE. The manuals shall detail the theory of operation and shall include narrative descriptions, pictorial illustrations, block and schematic diagrams, and parts list.

H. Record Wiring Diagrams:
1. Fifteen (15) working days prior to the acceptance test, the Contractor shall deliver four complete sets of the Record Wiring Diagrams of the System to the RE. The diagrams shall show all inputs and outputs of electronic and passive equipment correctly identified according to the markers installed on the interconnecting cables, Equipment and room/area locations.
2. The Record Wiring Diagrams shall be in hard copy and two compact disk (CD) copies properly formatted to match the Facility’s current operating version of Computer Aided Drafting (AutoCAD) system. The RE shall verify and inform the Contractor of the version of AutoCAD being used by the Facility.

I. Surveys Required As A Part Of The Technical Submittal: The Contractor shall provide the following surveys that depict various system features and capacities are required in addition to the on site survey requirements described herein. Each survey shall be in writing and contain the following information (the formats are suggestions and may be used for the initial Technical Submittal survey requirements), as a minimum:

1. Cable Distribution System Design Plan: A design plan for the entire cable distribution systems requirements shall be provided with this document. It is the Contractor's responsibility to provide the Systems entire cable requirements and engineer a distribution system requirement plan using the format of the following paragraph(s), at a minimum:

   a. UTP (and/or STP) Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
BUILDING	Identifies the building by number, title, or location cabling is to be provided in
TO BUILDING IMC	Identifies building main terminal signal closet, by room number or location, to which cabling is provided too, in, and from
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.) cabling and TCOs are to be provided
TC ROOM NUMBER	Identifies the floor signal closet room, by room number, which cabling shall be provided
ROOM NUMBER	Identifies the room, by number, from which cabling and TCOs shall be provided
NUMBER OF CABLE PAIR	Identifies the number of cable pair required to be provided on each floor designated OR the number of cable pair (VA Owned) to be retained
NUMBER OF STRANDS USED/SPARE	Identifies the number of strands provided in each run

   b. Fiber Optic Cabling Requirements/Column Explanation:

Column	Explanation

FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
TO BUILDING IMC	Identifies building, by number, title, or location, to which cabling is provided
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
NUMBER OF STRANDS	Identifies the number of strands in each run of fiber optic cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

c. Analog RF Cabling Requirements/Column Explanation:

Column	Explanation
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
TO FLOOR TC	Identifies building, by number or location, to which cabling is installed
NUMBER OF STRANDS	Identifies the number of strands in each run of RF cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

2. Telecommunication Outlets: The Contractor shall clearly and fully indicate this category for each outlet location and compare the total count to the locations identified above as a part of the

technical submittal. Additionally, the Contractor shall indicate the total number of spares.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. System Requirements:

1. The System shall provide the following minimum services that are designed in accordance with and supported by an Original Equipment Manufacturer (OEM), and as specified herein. The System shall provide continuous inter and/or intra-Facility voice and data, and analog RF service. The System shall be capacity sized so that loss of connectivity to external telephone systems shall not affect the Facilities operation in specific designated locations. The System shall:

   a. Be capable of inter-connecting and functioning fully with the existing Local Telephone Exchange (LEC) Network(s), Federal Telephone System (FTS) Inter-city Network(s), Inter-exchange Carriers, Integrated Services Digital Network (ISDN), Electronic Private Branch Exchange (EPBX) switches, asynchronous/synchronous data terminals and circuits including Automatic Transfer Mode (ATM), Frame Relay, and local area networks (LAN), at a minimum.

   b. Be a voice and data cable distribution system that is based on a physical "Star" Topology. An Analog RF coaxial cable distribution system shall be provided in a "home run" configuration from each associated riser TC to identified locations and as shown on the drawings.

   c. Be compatible with and able to provide direct digital connection to trunk level equipment including, but, not limited to: directly accessing trunk level equipment including the telephone system, audio paging, Industry Standard "T" and/or "DS" carrier services and external protocol converters. Additionally, connections to "T" and/or "DS" access/equipment or Customer Service Units (CSU) that are used in FTS and other trunk applications shall be included in the System design. Provide T-1 access/equipment (or CSU), as required for use, in FTS and other trunk applications by system design if this equipment is not provided by the existing telephone system and/or will be deactivated by the installation of the System. The Contractor shall provide all T-1 equipment

necessary to terminate and make operational the quantity of circuits designated. The CSU's shall be connected to the System's emergency battery power supply. The System shall be fully capable of operating in the Industry Standard "DS" protocol and provide that service when required.

d. Where the System connects to an existing or future telephone system, refer to specification Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT for specific telephone equipment and system operational performance standards.

2. Cable Systems - Twisted Pair and Fiber optic, and Analog RF Coaxial:

a. General:

1) The Contractor shall be responsible for providing a new system conforming to current and accepted telephone and digital, and analog RF industrial/commercial cable distribution standards. The distribution cable installation shall be fully coordinated with the Facility, the PM, the RE and the Contractor prior to the start of installation.

2) The Contractor is responsible for complete knowledge of the space and cable pathways (i.e. equipment rooms, TCs, conduits, wireways, etc.) of the Facility. The Contractor shall at a minimum design and install the System using the Pathway Design Handbook H-088C3, TIA/EIA Telecommunications Building Wiring Standards, and Facility Chief of Information Resource Management's (IRM) instructions, as approved in writing by the PM and/or RE.

3) The System cables shall be fully protected by cable duct, trays, wireways, conduit (rigid, thin wall, or flex), and when specifically approved, flexible innerduct. It is the responsibility of the Contractor to confirm all contract drawings and the Facility's physical layout to determine the necessary cable protective devices to be provided. If flexible innerduct is used, it shall be installed in the same manner as conduit.

4) Cable provided in the system (i.e. backbone, outside plant, inside plant, and station cabling) shall conform to accepted industry and OEM standards with regards to size, color code, and insulation. The pair twists of any pair shall not be exactly the same as any other pair within any unit or sub-unit

of cables that are bundled in twenty-five (25) pairs or less. The absence of specifications regarding details shall imply that best general industry practices shall prevail and that first quality material and workmanship shall be provided. Certification Standards, (i.e., EIA, CCITT, FIPPS, and NFPA) shall prevail.

5) Some areas of this Facility may be considered "plenum". All wire and cable used in support of the installation in those areas (if any) shall be in compliance with national and local codes pertaining to plenum environments. It is the responsibility of the Contractor to review the VA's cable and wire requirements with the RE and the IRM prior to installation to confirm the type of environment present at each location.
6) The Contractor shall provide outside and inside plant cables that furnishes the number of cable pairs required in accordance with the System requirements described herein. The Contractor shall fully coordinate and obtain approval of the design with the OEM, RE and the IRM prior to installation.
7) All metallic cable sheaths, etc. shall be grounded by the Contractor (i.e.: risers, underground, station wiring, etc.) as described herein.
8) If temporary cable and wire pairs are used, they shall be installed so as to not present a pedestrian safety hazard and the Contractor shall be responsible for all work associated with the temporary installation and for their removal when no longer necessary. Temporary cable installations are not required to meet Industry Standards; but, must be reviewed and approved by the RE and the IRM prior to installation.
9) Conductors shall be cabled to provide protection against induction in voice and data, and analog RF circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.
10) Measures shall be employed by the Contractor to minimize the radiation of RF noise generated by the System equipment so as not to interfere with audio, video, data, computer main distribution frame (MDF), telephone customer service unit

(CSU), and electronic private branch exchange (EPBX) equipment the System may service.

11) The System's cables shall be labeled on each end and been fully tested and certified in writing by the Contractor to the RE before proof of performance testing can be conducted. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs. Minimum test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges specified. The tests required for data cable must be made to guarantee the operation of this cable at not less than 10 mega (m) Hertz (Hz) full bandwidth, fully channel loaded and a Bit Error Rate of a minimum of 10-6 at the maximum rate of speed. All cable installation and test records shall be made available at acceptance testing by the RE or Contractor and thereafter maintained in the Facility's Telephone Switch Room. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.

12) The Contractor shall coordinate with the VA to install the telephone entrance cable to the nearest point of entry into the Facility and as shown on the drawings. The Contractor shall coordinate with the RE and the VA to provide all cable pairs/circuits from the Facility point of entry to the IT Room all telephone, FTS, DHCP, ATM, Frame Relay, data, pay stations, patient phones, and any low voltage circuits as described herein.

13) The Contractor shall coordinate with the RE and the IRM to provide all cable pairs/circuits from the Facility IT Room and establish circuits throughout the Facility for all voice, data, computer alarm (except fire alarm), private maintenance line, PA, LAN, DHCP, and any low voltage circuits as described herein.

14) The Contractor shall provide proper test equipment to guarantee that cable pairs and analog RF coaxial cable meet each OEM's standard transmission requirements, and guarantee the cable will carry data transmissions at the required speeds, frequencies, and fully loaded bandwidth.

15) The Contractor shall coordinate with the Facility Chief of Medical Media Production Service (MMPS) to install baseband analog RF, video, and audio interface cables and circuits from each TC to designated TCO locations and as shown on the drawings. The Contractor shall work with the Facility Chief of MMPS to establish circuits throughout the Facility and shall provide proper test equipment to guarantee that analog RF, video, and audio cables meet each OEM's standard transmission requirements, and guarantee the cables will carry analog video and audio transmissions at the required speeds, frequencies, and fully loaded bandwidth.

b. Telecommunications Closets (TC)/IT Room: In TC's that are served with both a UTP backbone cable and a fiber optic backbone cable, the UTP cable shall be terminated on separate RJ-45, 8-pin connectors with 110A or equivalent type punch down blocks located on the back or front of a 48-port modular patch panel dedicated to data applications. Only the UTP backbone cable pairs, identified as being connected to the fiber optic backbone, shall be extended to the fiber optic interface device. All connecting cables required to extend these cables (i.e. patch cords, twenty-five pair connectors, etc.), to the fiber optic interface device, in the TC's shall also be provided by the Contractor to insure a complete and operational fiber optic distribution system:

1) In TC's, which are only served by a UTP backbone cable, the cable shall be terminated on separate modular connecting devices (110A or equivalent) that are dedicated to data applications. In order to provide full service to all data cable pairs as identified in each TC/cabinet including spare capacity noted herein, the size of all vertical (riser) cables and/or outside cables serving these TC's shall be increased as required.

c. Backbone and Trunk Cables:

1) The Contractor shall identify, in the technical submittal, the voice and data (analog RF coaxial cable shall not be provided in main trunk or backbone lines) connecting arrangements required by the LEC for interconnection of the System to the commercial telephone and FTS networks. The Contractor shall provide all required voice and data connecting arrangements.

2) The Contractor shall be responsible for compatibility of the proposed TCs (to be compliant with the EPBX and CSU equipment) numbering scheme with the numbering plan for the FTS, DID, local stations, and the North American Numbering Plan. The Contractor shall consult with the VA and the LEC regarding the FTS and North American Numbering plan to be implemented for the Facility to ensure system compatibility.
3) All submitted equipment shall meet or exceed standards, rules, and regulations of the Federal Communications Commission (FCC) and shall be capable of operating without outboard or "extra" devices. The Contractor shall identify the FCC registration number of the System equipment, EPBX, and proposed CSU (if known) in the technical submittal.
4) This cable shall support the transmission of data information over twisted pair cable. The cable shall be tested and terminated on a Contractor provided cable management frame, RJ-45 modular jacks with eight (8) pin connectors, and 48 port modular patch panels located in the Main Computer Room and Telephone Switch Room. The cable shall be labeled, terminated, and separated from the other cables on the MDF and Telephone Switch Room CCS. This requirement shall be fully coordinated and approved by the Facility Chief, IRM and the RE prior to installation. The cabling requirements of this paragraph are in addition to the requirements specified in the System Design Plan identified herein.

d. Horizontal and Station Cable:
1) A Four (4) UTP 24 AWG station wiring cable shall be installed from the two top TCO jacks to the TC and shall be of a type designed to support Category 6 communications. At the jack location, terminate two (2) pairs on each RJ-45/11 jack. At the signal closet, all four pair shall be terminated on the modular punch down blocks dedicated to telephone applications.
2) Two four (4) UTP 24 AWG (in thermoplastic jacket unless otherwise specified by RE) station wiring cables shall be installed from each of the two (2) bottom TCO RJ-45 jacks (shall conform to EIA/TIA 568 Standard "T568A" and NFPA) to the TC and shall be of a type designed to support Category 6 communications.

e. Telecommunication Outlets (TCO), Jacks: All TCO's shall have a minimum of four (4) RJ-45 type jacks. The top two (2) jacks shall be an eight pin RJ-45/11 compatible jack, labeled, and designated for telephone applications only. The bottom two jacks shall be eight pin RJ-45 type unkeyed (sometimes called center keyed) jacks, labeled, and designated for data.

f. Fiber Optics:

1) A complete fiber optic cable distribution system shall be provided as a part of the System. The Contractor shall provide a fiber optic cable that meets the minimum bandwidth requirements for FDDI, ATM, and Frame Relay services. This fiber optic cable shall be a 62.5/125 micron multi-mode, containing a minimum of 12 strands of fiber, unless otherwise specified, and shall not exceed a distance of 2,000 Meters (M), or 6,560 feet (ft.) in a single run. Loose tube cable, which separates the individual fibers from the environment, shall be installed for all outdoor runs or for any area which includes an outdoor run. Tight buffered fiber cable shall be used for indoor runs. The multimode fibers shall be terminated and secured at both ends in "ST" type female stainless steel connectors installed in an appropriate patch or breakout panel with a cable management system. A 610 mm (50 ft.) cable loop (minimum) shall be provided at each end to allow for future movement.

2) The fiber optic backbone shall use a conventional hierarchical "star" design where each TC is wired to the primary hub (main cross-connect system) or a secondary hub (intermediate cross-connect system) and then to the primary hub. There shall be no more than two hierarchical levels of cross-connects in the backbone wiring. Each primary hub shall be connected and terminated to a CCS in the Telephone Switch Room.

3) In the IT Room and Main Computer Room, all fiber optic cables shall be installed in a CCS and/or MDF rack mounted fiber optic cable distribution component/splice case (Contractor provided and installed rack), patch, or breakout panel in accordance with industry standards. Female "ST" connectors shall be provided and installed on the appropriate panel for termination of each strand.

4) The Contractor shall test each fiber optic strand. Cable transmission performance specifications shall be in accordance with EIA/TIA standards. Attenuation shall be measured in accordance with EIA fiber optic test procedures EIA/TIA-455-46, -61, or -53 and NFPA. Information transmission capacity shall be measured in accordance with EIA/TIA-455-51 or -30 and NFPA. The written results shall be provided to the RE for review and approval.

3. Specific Subsystem Requirements: The System shall consist, as a minimum, of the following independent sub-systems to comprise a complete and functional voice and digital and analog RF telecommunications cabling system: "Main" (MTC), "vertical" (or "riser") trunk cabling system; "horizontal" (or "lateral") sub-trunk cabling system, vertical and horizontal cross-connection (VCC and HCC respectively) cabling systems, and TCO's with a minimum of four (4) RJ-45 jacks for the appropriate telephone, Data connections, and additional jacks, connectors, drop and patch cords, terminators, and adapters provided.

   a. Telecommunication Closet (TC)/IT Room:

      1) The maximum DC resistance per cable pair shall be no more than 28.6 Ohms per 305 M (1,000 feet). Each TC shall be centrally located to cover the maximum amount of local floor space. The TC's house in cabinets or enclosures, on relay racks, and/or on backboards, various telecommunication data equipment, controllers, multiplexers, bridges, routers, LAN hub(s), telephone cross-connecting, active and passive equipment.

      2) Additionally, the TC's may not house fire alarm, nurses call, code one (or blue), video, public address, radio entertainment, and intercom equipment. Regardless of the method of installation, mounting, termination, or cross-connecting used, all backbone, vertical, and horizontal copper and fiber optic and analog RF coaxial cables shall be terminated on appropriate cross-connection systems (CCS) containing patch panel(s), punch blocks, and/or breakout devices provided in enclosures and tested as described herein. A cable and/or wire management system shall be a part of each CCS.

a) A minimum of three 110-120 VAC active quad outlets shall be provided, each with "U" grounded receptacles at a minimum of one outlet for each front, side and back wall. These outlets shall be separately protected by an AC circuit breaker provided in the designated VA Emergency Critical Care AC power panel, that is connected to the Facilities Emergency AC Power Distribution System.

b) Climate control shall be provided in each TC 24 hours a day, seven days per week and 52 week per year to prevent failure of electronic components and for mission critical functional applications. The COTR and/or Facility Chief Engineering Officer are responsible for informing the Contractor regarding the minimum climate control requirements. In identified hostile TC locations where it has been determined (by the RE or Facility Chief Engineer) that proper TC climate or external signal radiation cannot be properly maintained or controlled, the Contractor may, at his/her option, provide a minimum of two individual and properly sized self contained climate controlled equipment cabinet enclosures; one designated for voice, and one designated for data, and one additional cabinet designated for analog RF service, in each TC location identified on the drawings, in lieu of providing additional required TC air handling capability.

b. Cross-connect Systems (CCS):

1) The CCS shall be selected based on the following criteria: requires the use of a single tool, has the fewest amount of parts, and requires the least amount of assembly or projected trouble shooting time during the life of the system.

2) The CCS system used at the IT Room shall force cross-connect cable slack management through adherence to the OEM's installation methods, provided cable management systems, and as described herein, so that moves, adds, and changes can be administered easily and cost effectively.

3) Copper Cables: The IT Room shall contain a copper CCS sized to support the System TCO's as shown on the drawings. The System layout shall allow for a minimum of 50% anticipated growth. Additionally, each CCS must provide maximum flexibility, while

maintaining performance, in order to meet system-changing requirements that are likely to occur throughout its useful life.

4) Fiber Optic Cables:
   a) The IT Room shall contain a fiber CCS sized to support the System TCO's and as shown on the drawings. The System layout shall allow for a minimum of 50% anticipated growth.
   b) Each fiber CCS must provide maximum flexibility and cable management while maintaining performance in order to meet changing requirements that are likely to occur throughout the expected life of the system. All fiber optic cable slack shall be stored in protective enclosures.
5) The Contractor shall not "cross-connect" the copper or fiber optic cabling systems and subsystems even though appropriate "patch" cords are to be provided for each "patch", "punch", or "breakout" panel. In addition, the Contractor shall not provide active electronic distribution or interface equipment as a part of the System.
6) Grounding: Proper grounding and bonding shall be provided for the IT Room and all internal equipment. Reference shall be made to proper codes and standards, such that all grounding systems must comply with all applicable National, Regional, and Local Building and Electrical codes. The most stringent code of these governing bodies shall apply.
   a) If local grounding codes do not exist for the System location, then at a minimum, a #6 American Wire Gauge (AWG) stranded copper wire, or equivalent copper braid, shall be connected to a separate earth grounding system for the IT Room (the looping of IT Room in a general location is allowed as long as the specifications contained herein are met). Under no circumstance shall the AC neutral be used for this ground. See PART 3 – EXECUTION for specific grounding instructions.
   b) Each copper UTP or STP cable that enters the IT Room from the outside of a building (regardless if the cable is installed underground or aerial) shall be provided with a surge protector and grounded an to earth ground at each cable's entry point in and out of the MTC.

c. Main Cross-connection Subsystem (MCCS): The MCCS shall be located in the IT Room and it shall be the common point of appearance for intra-building copper and fiber optic “backbone” system cables, and connections to the telephone and data cable systems. The IT Room usually houses telephone EPBX, public address, radio paging interface, routers, and main hierarchical data LAN concentrating equipment. Additionally, it shall provide a single administration and management point for the entire System.

d. Voice (or Telephone) Cable Cross-Connection Subsystem:

1) Due to the usually high number of copper cable termination’s required at the MCCS, Insulation Displacement Connection (IDC) hardware shall be used. Termination options shall include the following for a Category 6 Cabling System: IDC termination of cross-connection wire(s), IDC patch cord connector to IDC patch cord connector, and hybrid modular cord to IDC patch cord connector shall be the minimum provided.

2) Additionally, due to the large or many MCCS (at initial installation and over the life of the System) copper termination points, the CCS that makes the best use of real estate while still following the OEM design and installation guidelines, and meeting the specifications described herein, shall be provided.

3) For ease of maintenance purposes, all terminations shall be accessible without the need for disassembly of the IDC wafer. IDC wafers shall be removable from their mounts to facilitate testing on either side of the connector. Designation strips or labels shall be removable to allow for inspection of the terminations. The maximum number of terminations on a wall or on a rack frame or panel shall comply with the OEM recommendations and guidelines, and as described herein. A cable management system shall be provided as a part of the IDC.

4) IDC connectors shall be capable of supporting cable re-terminations without damaging the connector and shall support a minimum of 200 (telephone equipment standard compliant) IDC insertions or withdrawals on either side of the connector panel.

5) A non-impact termination method using a full-cycle terminating tool having both a tactile and an audible feedback to indicate proper termination is required. For personnel safety and ease of use in day to day administration, high impact installation tools shall not be used.
6) All system “inputs” from the EPBX, FTS, Local Telephone System, or diverse routed voice distribution systems shall appear on the “left” side of the IDC (110A blocks with RJ45 connections are acceptable alternates to the IDC) of the MCCS.
7) All system “outputs” from the MCCS to the voice backbone cable distribution system shall appear on the “right” side of the same IDC (or 110A blocks) of the MCCS.
8) The splitting of pairs within cables between different jacks or connections shall not be allowed. In the case of ISDN and/or ATM and /or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
9) UTP cross connecting wires shall be provided for each “pair” of connection terminals plus an additional 50% spare.

e. Data Cross-Connection Subsystems:
1) The MCCS shall be a Main Distribution Terminating (MDT) data unit and shall be provided in the IT Room. The MDT shall consist of a “patch” panel(s) provided with modular RJ45 female connectors for cross-connection of all copper data cable terminations. The panels shall provide for system grounding (where no dielectric cables are used) and be provided with a cable management system.
2) Each panel shall conform to EIA dimensions and be suitable for mounting in standard equipment racks, have the RJ45 jacks aligned in two horizontal rows (up to a maximum of 48 jacks per panel), and shall not exceed the OEM’s recommendations. Each RJ45 jack shall be of modular design and capable of accepting and functioning with other modular (i.e. RJ11) plugs without damaging the jack. It is not necessary to provide a jack for unused positions that are not part of the 50% expansion requirement.

a) All data system inputs from the server(s), data LAN, bridge, or interface distribution systems shall appear on the “top” row of jacks of the appropriate patch panel.
b) All System outputs or backbone cable connections shall appear on the “bottom” row of jacks of the same patch panel.
c) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and/or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.

3) A patch cord shall be provided for each system “pair” of connection jacks. Each patch cord shall have modular RJ45 connectors provided on each end to match the panel’s modular RJ45 female jack’s being provided.

f. Fiber optic Cross-Connection Subsystems: The IT Room shall be provided with a separate fiber MCCS. A cable management system shall be provided for each panel.

1) The panel(s) shall contain a minimum of 24 female “ST” connectors, be able to accommodate splices and field mountable connectors and have capacity for additional connectors to be added up to the OEM’s maximum standard panel size for this type of use. All patch panel sides, including the front and back, shall be protected by a cabinet or enclosure.
2) The panel(s) shall conform to EIA dimensions and be suitable for installation in standard racks, cabinets, and enclosures. The panels shall provide for system grounding (where no dielectric cables are used).
3) The patch panel with the highest OEM approved density of fiber “ST” termination’s (maximum of 72 each), while maintaining a high level of manageability, shall be selected. Patch cables, with proper “ST” connectors installed on each end shall be provided for each pair of fiber optic cable “ST” connectors.
a) All System “inputs” from interface equipment or distribution systems shall appear on the “top” row of connectors of the appropriate patch panel.

b) All System “outputs” or backbone cable connections shall appear on the “bottom” row of connectors of the same patch panel.

4) In order to achieve a high level of reliability that approximates that of an OEM connector, field installable connectors shall have an OEM specified physical contact polish. Every fiber cable shall be terminated with the appropriate connector, and tested to ensure compliance to OEM and specifications outlines herein. Where a local fiber optic system connector standard, Industry Standard fiber optic “ST” female connector terminated with a fiber optic cable, shall be used. But, if the fiber optic cable is not used (or “dark”), a “ST” male terminating “cap” shall be provided for each unused “ST” female connector.

g. Distribution Cable Systems / Backbone Cable System (Common to Inter-buildings): The backbone cable system extends from the IT Room to the Main Telecom Room to establish service between buildings on a campus. The media (copper and fiber optic) used in the BC system shall be designed according to the system requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic backbone system shall be provided as a part of the BC distribution system.

1) All outside cable shall be minimum of UTP, 22 AWG solid conductors, solid PVC insulation, and filled core (flexgel - waterproof Rural Electric Association (REA) LISTED PE 39 CODE) between the outer armor or jacket and inner conductors protective lining.

2) The copper cable system shall be configured as a “Star” Topology with separate dedicated cables between the IT Room and the Main Telecom Room.

3) UTP and STP copper cables shall consist of thermoplastic insulated conductors formed into binder groups. The groups are to be identified by distinctly colored binders and assembled to form a single compact core covered by a protective sheath. Each cable shall be rated for Category 6 Telecommunications System Service. A minimum of eight pairs per circuit, plus an additional 50% spare for growth shall be provided.

4) Where the distance limitations of UTP may be exceeded, multimode (or single mode) fiber optic cable(s) shall be used to augment the voice and/or data backbone cable system(s). The total loss of each fiber shall not exceed 12 decibel (dB) at 850 nano-Meter (nM), 11 dB at 1,300 nM, or 10 dB at 1,500 nM.
5) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and /or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
6) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular connectors provided on each end to match the panel's modular female jack.
7) The fiber optic BC system shall be configured as a "Buss" Topology with separate dedicated fibers between IT Room and Main Telecom Room. The System shall be sized to meet the system requirements plus an expansion capability of 50%. Fiber optic cable(s) having a minimum of 12 strands multimode fiber shall be provided.
8) All BC shall be identified with permanent labels at both ends. Labels will indicate system, floor, closet, and zone. The label designations shall match those used for cross-connect terminals and patch panels.

h. Horizontal (or Station) Cabling (HC): The HC distribution cabling systems connects the distribution field of the voice and data HCCS, in a "Star" Topology, to each TCO or connector and as shown on the drawings via the sub-trunk system.
1) Horizontal cables shall consist of insulated, conductors that are rated for Category 6 telecommunications service for voice and data systems.
2) The number of UTP or STP distribution pairs dedicated to each floor from the HC shall be sufficient to accommodate all the horizontal voice and data circuits served by the distribution cable to each TCO.
a) A minimum of four pairs for voice shall be connected to the "right" side of the IDC (or 110A block) that the VCCS "input" connections appear in the RTC.

b) A minimum of two separate sets of four pairs each for data shall be connected to the "bottom" row of RJ45 jacks that the VCCS "input" connections appear in the RTC.

3) The horizontal cable length to the farthest system outlet shall be limited to a maximum of 90M (or 295 ft). These maximum lengths must be derated, adjusted and reduced to include cross-connection and distribution system losses.

4) The splitting of pairs within a cable between different jacks shall not be permitted.

5) The installation of the HC shall conform to appropriate OEM recommendations and standards outlined herein. This requirement will insure adequate protection for Electro-Magnetic Interference (EMI) sources.

6) A system design where "looping" the HC distribution cables from room to room shall not be permitted.

i. System Telecommunication Outlets (TCO): The System shall be capable of receiving the specified telephone (or voice) and data signals acquired from the LEC, FTS contracted carrier and computer system, and one each analog RF cable, and one fiber optic multimode cables and shall process and distribute them to the designated TCO's and as shown on the drawings. At a minimum, one TCO shall be provided on each room wall, associated with an active 120 VAC shall be provided and as shown on the drawings. The only exception to the general rule, of one outlet per wall, shall be those "special" locations (e.g., patient bed rooms, loading docks, storage rooms, etc.) where there is usually only one TCO provided as designated on the drawings.

1) Each TCO shall consist of four (4) multipin modular RJ45 jacks, two designated for telephone and two for data service. Each TCO with appropriate jacks installed shall be provided by the Contractor in each designated location and as shown on the drawings.

2) The modular jack for telephone and data shall meet Category 6 requirements for EIA/TIA-568-B2-1.

3) The Contractor shall connect each telephone multipin modular RJ45 jack to a separate "right side as you look at it" telephone HC distribution system HCCS "punch down" 110A block or approved IDC terminating device in each associated RTC. The

modular RJ45 jack shall be able to accept and operate with smaller modular RJ11 plugs while providing proper connection and not damaging the modular jack. he OEM shall warrant all modular RJ45/11 jacks in such a manner to be usable for modular RJ11 plugs.

4) The Contractor shall connect each TCO data multipin modular RJ45 jack to a separate lower row jack on the HCCS "patch panel" in each associated RTC.
5) A non-impact termination method, using either a stuffer cap with installation tool or full-cycle terminating tool having both tactile and audible feedback to indicate proper termination shall be used. High impact installation tools shall not be used.
6) Each terminated conductor end shall be properly trimmed to assure a minimum clearance of 6.35 mm (0.250 in) clearance between the conductors of adjacent modules.
7) The multipin RJ45 jack shall be modular in construction that will accept and operate with a modular UTP and STP RJ45 connector and its pin assignments.
8) The Contractor shall connect each fiber optic TCO "ST" connector to a separate fiber optic "bottom" row "ST" connector HCCS "patch panel" or "breakout" terminating device in each associated TC.
9) The Contractor shall connect each analog RF cable to a female "F" connector provided on each TCO and as shown on the drawings and to each bottom row of "F" connectors on the HCCS patch panel(s) serving the area.

B. General:

1. All equipment to be supplied under this specification shall be new and the current model of a standard product of an OEM or record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:
   a. Maintains a stock of replacement parts for the item submitted.
   b. Maintains engineering drawings, specifications, and operating manuals for the items submitted.

c. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid.

2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity, or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.
3. The Contractor shall provide written verification, in writing to the RE at time of installation, that the type of wire/cable being provided is recommended and approved by the OEM. The Contractor is responsible for providing the proper size and type of cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.
4. The Telephone Contractor is responsible for providing interfacing cable connections for the telephone, PA and Muzak systems with the System.
5. The telephone equipment and PA interface equipment shall be the interface points for connection of the PA interface cabling from the telephone switch via the system telephone interface unit.
6. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone equipment, systems, and service.
7. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
8. All interconnecting twisted pair, fiber-optic or coaxial cables shall be terminated on equipment terminal boards, punch blocks, breakout boxes, splice blocks, and unused equipment ports/taps shall be terminated according to the OEM’s instructions for telephone cable systems without adapters. The Contractor shall not leave unused or spare twisted pair wire, fiber-optic, or coaxial cable unterminated, unconnected, loose or unsecured.
9. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, which ever is the more stringent. At a minimum, all equipment, cable duct and/or

conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance. Reference Specification Section 27 10 00, STRUCTURED CABLING and Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT.

10. Connect the System's primary input AC power to the Facility' Critical Branch of the Emergency AC power distribution system as shown on the plans or if not shown on the plans consult with RE regarding a suitable circuit location prior to bidding.
11. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the System OEM. Base- band cable systems shall utilize barrier terminal screw type connectors, at a minimum. Crimp type connectors installed with a ratchet type installation tool are and acceptable alternate as long as the cable dress, pairs, shielding, grounding, and connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts, or solder type connections are unacceptable and will not be approved.
12. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cycolac plastic for the areas where provided.
13. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.

    Underground warning tape shall be standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters imprinted with "CAUTION BURIED ELECTRIC LINE BELOW", orange with black letters imprinted with "CAUTION BURIED TELEPHONE LINE BELOW" or orange with black letters imprinted with "CAUTION BURIED FIBER OPTIC LINE BELOW", as applicable.

C. Equipment Functional Characteristics:

FUNCTIONS	**CHARACTERISTICS**
Input Voltage	105 to 130 VAC
POWER LINE FREQUENCY	60 HZ ±2.0 HZ

Operating Temperature	O to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

D. Equipment Standards and Testing:

1. The System has been defined herein as connected to systems identified as Critical Care performing Life Support Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.
2. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory where such standards have been established for the supplies, materials or equipment. See paragraph minimum requirements Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, and the guidelines listed in paragraph 2.J.2.
3. The provided active and passive equipment required by the System design and approved technical submittal must conform with each UL standard in effect for the equipment, as of the date of the technical submittal (or the date when the RE approved system equipment necessary to be replaced) was technically reviewed and approved by VA. Where a UL standard is in existence for equipment to be used in completion of this contract, the equipment must bear the approved UL seal.
4. Each item of electronic equipment to be provided under this contract must bear the approved UL seal or the seal of the testing laboratory that warrants the equipment has been tested in accordance with, and conforms to the specified standards.

2.2 DISTRIBUTION EQUIPMENT AND SYSTEMS

A. Telecommunication Outlet (TCO):

1. The TCO shall consist of two (2) telephone multipin jacks and two (2) data multipin jacks mounted in a steel outlet box. A separate 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled stainless steel faceplate will be used. A second 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled faceplate shall be provided as required adjacent to the

first box to ensure system connections and expandability requirements are met.

2. All telephone multipin connections shall be RJ-45/11 compatible female types. All data multipin connections shall be RJ-45 female types. All fiber optic connections shall be "ST" stainless steel female types. All analog RF connections shall be "F" type.
3. The TCO shall be fed from the appropriate CCS located in the respective RTC in a manner to provide a uniform and balanced distribution system.
4. Interface of the data multipin jacks to appropriate patch panels (or approved "punch down" blocks) in the associated RTC, is the responsibility of the Contractor. The Contractor shall not extend data cables from the RTCs to data terminal equipment or install data terminal equipment.
5. The wall outlet shall be provided with a Thermoplastic or approved alternate cover plate of ivory color to fit the telephone multipin jack, data multi- pin jacks and the outlet box provided (100mm (4in.) x 100mm (4in.) for single and 100mm (4in.) x 200mm (8in.) for dual outlet box applications).
6. Interface of the fiber optic "ST" jacks to appropriate patch panels in the associated RTC, is the responsibility of the Contractor. The Contractor shall not cross-connect fiber optic cables in the to fiber optic equipment or install fiber optic equipment.
7. Interface of the analog RF "F", jacks to appropriate patch panels in the associated RTC, is the responsibility of the Contractor. The Contractor shall not cross-connect analog cables in the RTCs to analog equipment or install active analog equipment.

B. Distribution Cables: Each cable shall meet or exceed the following specifications for the specific type of cable. Each cable reel shall be sweep tested and certified by the OEM by tags affixed to each reel. The Contractor shall turn over all sweep tags to the RE or PM. Additionally, the Contractor shall provide a 610 mm (2 ft.) sample of each provided cable, to the RE and receive approval before installation. Cables installed in any outside location (i.e. above ground, under ground in conduit, ducts, pathways, etc.) shall be filled with a waterproofing compound between outside jacket (not immediately touching any provided armor) and inter conductors to seal punctures in the jacket and protect the conductors from moisture.

1. Remote Control:
   a. The remote control cable shall be multi-conductor with stranded (solid is permissible) conductors. The cable shall be able to handle the power and voltage necessary to control specified system equipment from a remote location. The cable shall be UL listed and pass the FR-1 vertical flame test, at a minimum. Each conductor shall be color-coded. Combined multi-conductor and coaxial cables are acceptable for this installation, as long as all system performance standards are met.
   b. Technical Characteristics:

Length	As required, in 1K (3,000 ft.) reels minimum
Connectors	As required by system design
Size	18 AWG, minimum, Outside 20 AWG, minimum, Inside
Color coding	Required, EIA industry standard
Bend radius	10X the cable outside diameter
Impedance	As required
Shield coverage	As required by OEM specification
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
50.0	52.0

2. Telephone:
   a. The System cable shall be provided by the Contractor to meet the minimum system requirements of Category 6 service. The cable shall interconnect each part of the system. The cable shall be completely survivable in areas where it is installed.

b. Technical Characteristics:

Length	As required, in 1K (3,000 ft.) reels minimum
Cable	Voice grade category six
Connectors	As required by system design
Size	22 AWG, minimum, Outside 24 AWG, minimum, Inside
Color coding	Required, telephone industry standard
Bend radius	10X the cable outside diameter
Impedance	120 Ohms ± 15%, BAL
Shield coverage	As required by OEM specification
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
62.0	52.0
100.0	68.0

3. Data Multi-Conductor:

a. The cable shall be multi-conductor, shielded or unshielded cable with stranded conductors. The cable shall be able to handle the power and voltage used over the distance required. It shall meet Category 6 service at a minimum.

b. Technical Characteristics:

Wire size	22 AWG, minimum
Working shield	350 V
Bend radius	10X the cable outside diameter
Impedance	100 Ohms ± 15%, BAL
Bandwidth	100 mHz, minimum
DC RESISTANCE	10.0 Ohms/100M, maximum

Shield coverage	
Overall Outside (if OEM specified)	100%
Individual Pairs (if OEM specified)	100%
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
62.0	52.0
100.0	68.0

4. Fiber Optic:
   a. Multimode Fiber:
      1) The general purpose multimode fiber optic cable shall be a dual window type installed in conduit for all system locations. A load-bearing support braid shall surround the inner tube for strength during cable installation.
      2) Technical Characteristics:

Bend radius	6.0", minimum Outer jacket, As required
FIBER DIAMETER	62.5 MICRONS
Cladding	125 microns
Attenuation	
850 nM	4.0 dB per kM, maximum
1,300 nM	2.0 dB per kM, maximum
Bandwidth	
850 nM	160 mHz, minimum
1,300 nM	500 mHz, minimum
Connectors	Stainless steel

5. AC Power Cable: AC power cable(s) shall be 3-conductor, no. 12 AWG minimum, and rated for 13A-125V and 1,625W. Master AC power, installation specification and requirements, are given in the NEC and herein.
6. General Purpose Analog RF:
   a. The coaxial cable shall be an RG-6/U type (or equal), minimum and shall be increased in size (i.e. RG-ll/U, .500”, .750”, etc.) as required to meet system design. It may also be used for baseband signals as approved by the OEM.
   b. Technical Characteristics:

Impedance	75 OHM, UNBAL
Center conductor 20 AWG, solid or stranded copper, or copper plated steel or aluminum	
Dielectric	Cellular polyethylene
Shield coverage	95%, copper braid
Connector type	BNC or UHF
Attenuation	
Frequency (k or mHz)	Maximum dB/30.5M (100ft.)
10 kHz	0.20
100 kHz	0.22
1.0 kHz	0.25
4.5 mHz	0.85
10.0 mHz	1.40
100 mHz	5.00

7. Public Address and/or General Purpose Audio:
   a. The audio cable shall be two-conductor, STP cable with stranded conductors. The cable shall be able to handle the power used for the load impedance over the distance required, with not more than 5% power loss. This cable is to be provided in local PA areas only and is not to be used as a part of the telephone system.
   b. Technical Characteristics:

Impedance	70.7VRMS audio signal
Wire size	20 AWG, minimum
Working shield	350 V
Color coding	Required, EIA audio industry standard

Connectors	As required
Bend radius	10X the cable outside diameter
Impedance	100 Ohms ± 15%, BAL
Bandwidth	20 mHz, minimum
DC resistance	10.0 Ohms/100M (330 ft.), maximum
Shield coverage	
Overall Outside (if OEM specified)	100%
Individual Pairs (if OEM specified)	100%
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0

C. Outlet Connection Cables:

1. Telephone:

a. The Contractor shall provide a connection cable for each TCO telephone jack in the System with 10% spares. The telephone connection cable shall connect the telephone instrument to the TCO telephone jack. The Contractor shall not provide telephone instrument(s) or equipment.

b. Technical Characteristics:

Length	1.8M (6ft.), minimum
Cable	Voice Grade
Connector	RJ-11/45 compatible male on each end
Size	24 AWG, minimum
Color coding	Required, telephone industry standard

2. Data:

a. The Contractor shall provide a connection cable for each TCO data jack in the system with 10% spares. The data connection cable shall connect a data instrument to the TCO data jack. The Contractor shall not provide data terminal(s)/equipment.

b. Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Data grade Category Six
Connector	RJ-45 male on each end
Color coding	Required, data industry standard
Size	24 AWG, minimum

3. Analog RF:

a. The Contractor shall provide a connection cable for each TCO analog RF connector in the System with 10% spares. The analog RF connection cable shall connect a analog RF instrument to the TCO analog RF jack. The Contractor shall not provide analog RF equipment.

b. Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Flexible RG-6/U, minimum
Connector	“F” male on each end

D. System Connectors:

1. Solderless (Forked Connector):

a. The connector shall have a crimp-on coupling for quick connect/disconnect of wires or cables. The crimp-on connector shall be designed to fit the wire or cable furnished. The connector barrel shall be insulated and color-coded.

b. Technical Characteristics:

Impedance	As required
Working Voltage	500 V

2. Multipin:

a. The connector shall have a crimp-on coupling for quick connect/disconnect of wires or cables. The crimp-on connector shall be designed to fit the wire or cable furnished. The connector housing shall be fully enclosed and shielded. It shall be secured to the cable group by screw type compression sleeves.

b. Technical Characteristics:

Impedance	As required
Working Voltage	500 V
Number of pins	As requires, usually 25 pairs minimum

3. Modular (RJ-45/11 and RJ-45): The connectors shall be commercial types for voice and high speed data transmission applications. The connector shall be compatible with telephone instruments, computer terminals, and other type devices requiring linking through the modular telecommunications outlet to the System. The connector shall be compatible with UTP and STP cables.

   a. Technical Characteristics:

Type	Number of Pins
RJ-11/45	Compatible with RJ45
RJ-45	Eight
Dielectric	Surge
Voltage	1,000V RMS, 60 Hz @ one minute, minimum
Current	2.2A RMS @ 30 Minutes or 7.0A RMS @ 5.0 seconds
Leakage	100 µA, maximum
Connectability	
Initial contact resistance	20 mili-Ohms, maximum
Insulation displacement	10 mili-Ohms, maximum
Interface	Must interface with modular jacks from a variety of OEMs. RJ-11/45 plugs shall provide connection when used in RJ-45 jacks.
Durability	200 insertions/withdrawals, minimum

4. "F" Type:

   a. The "F" connector shall have a screw type coupling for quick connect/disconnect of coaxial cable/termination's. It shall be a crimp-on connector designed to fit the coaxial cable furnished with integral 12.7 mm (½in.) ferrule.

b. Technical Characteristics:

Impedance	75 Ohms, UNBAL
Working Voltage	500 V

E. Terminators:

1. Coaxial:

a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on type that has low VSWR when installed and the proper impedance to terminate the required system unit or coaxial cable.

b. Technical Characteristics:

Frequency	0-1 GHz
Power blocking	As required
Return loss	25 dB
Connectors	“F”, "BNC", minimum
Impedance	50 or 75 Ohms, UNBAL

2. Audio:

a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on audio spade lug, twin plug, XL types that has low VSWR when installed and the proper impedance to terminate the required system unit or coaxial cable.

b. Technical Characteristics:

Frequency	20-20 kHz, minimum
Power blocking	As required
Return loss	15 dB
Connectors	"Audio spade lug", “1/4”, “1/8”, "XL" or "RCA"
Impedance	
Bal	100 Ohms, minimum
Unbal	75 Ohm, minimum

3. Fiber Optic:

a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on type that

has low VSWR when installed and the proper impedance to terminate the required system unit or fiber optic cable.

b. Technical Characteristics:

Frequency	Lightwave
Power blocking	As required
Return loss	25 dB
Connectors	"ST", minimum
Construction	Stainless steel
Impedance	As required

2.3 TELECOMMUNCATIONS CLOSET/IT ROOM REQUIREMENTS

Refer to VA Handbook H-088C3, Telephone System Requirements, for specific TC guidelines for size, power input, security, and backboard mounting requirements. It is the Contractors responsibility to ensure TC compliance with the System Requirements.

2.4 ENVIRONMENTAL REQUIREMENTS

Technical submittals shall identify the environmental specifications for housing the system. These environmental specifications shall identify the requirements for initial and expanded system configurations for:

A. Floor loading cabinets.

B. Minimum floor space and ceiling heights.

C. Minimum size of doors for equipment passage.

D. Power requirements: The bidders shall provide the specific voltage, amperage, phases, and quantities of circuits required.

E. Air conditioning, heating, and humidity requirements. The bidder shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.

F. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).

G. Proposed floor plan based on the expanded system configuration of the bidder's proposed EPBX for this Facility.

H. Conduit size requirement (between equipment room and console room).

2.5 INSTALLATION KIT

The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties,

solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the RE all unused and partially opened installation kit boxes, coaxial, fiberoptic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware. The following are the minimum required installation sub-kits:

A. System Grounding:
   1. The grounding kit shall include all cable and installation hardware required. All radio equipment shall be connected to earth ground via internal building wiring, according to the NEC.
   2. This includes, but is not limited to:
      a. Coaxial Cable Shields.
      b. Control Cable Shields.
      c. Data Cable Shields.
      d. Equipment Racks.
      e. Equipment Cabinets.
      f. Conduits.
      g. Duct.
      h. Cable Trays.
      i. Power Panels.
      j. Connector Panels.
      k. Grounding Blocks.

B. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.

C. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.

D. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.

E. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.

F. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each subsystem according to the OEM requirements, as-installed drawings, and this document.

G. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this document and explained herein.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Product Delivery, Storage and Handling:

1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment catalog numbers, model and serial identification numbers. The RE may inventory the cable, patch panels, and related equipment.
2. Storage and Handling: Store and protect equipment in a manner, which will preclude damage as directed by the RE.

B. System Installation:

1. After the contract’s been awarded, and within the time period specified in the contract, the Contractor shall deliver the total system in a manner that fully complies with the requirements of this specification. The Contractor shall make no substitutions or changes in the System without written approval from the RE and PM.
2. The Contractor shall install all equipment and systems in a manner that complies with accepted industry standards of good practice, OEM instructions, the requirements of this specification, and in a manner which does not constitute a safety hazard. The Contractor shall insure that all installation personnel understands and complies with all the requirements of this specification.
3. The Contractor shall install suitable filters, traps, directional couplers, splitters, TC’s, and pads for minimizing interference and for balancing the System. Items used for balancing and minimizing

interference shall be able to pass telephone and data, and lightwave, and analog signals in the frequency bands selected, in the direction specified, with low loss, and high isolation, and with minimal delay of specified frequencies and signals. The Contractor shall provide all equipment necessary to meet the requirements of Paragraph 2.1.C and the System performance standards.

4. All passive equipment shall be connected according to the OEM's specifications to insure future correct termination, isolation, impedance match, and signal level balance at each telephone/data outlet.
5. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
6. All lines shall be terminated in a suitable manner to facilitate future expansion of the System. There shall be a minimum of one spare 25 pair cable at each distribution point on each floor.
7. All vertical and horizontal copper and fiber optic, and coaxial cables shall be terminated so any future changes only requires modifications of the signal closet equipment only.
8. Terminating resistors or devices shall be used to terminate all unused branches, outlets, equipment ports of the System, and shall be devices designed for the purpose of terminating fiber optic or twisted pair, and coaxial, and lightwave cables carrying telephone and data, and analog signals in telephone and data, and analog video, and lightwave systems.
9. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two keys.
10. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with two keys.

C. Conduit and Signal Ducts:

1. Conduit:
   a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weatherheads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed. The minimum conduit size shall be 19 mm (3/4 in.).

b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow telephone cables to be installed in partitioned cable tray with data cables may be granted in writing by the RE if requested.) Conduits shall be provided in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NEC Articles 517 for Critical Care and 800 for Communications systems, at a minimum.

c. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.

d. When ”innerduct” flexible cable protective systems is specifically authorized to be provided for use in the System, it’s installation guidelines and standards shall be as the specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.

e. Conduit (including GFE) fill shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from signal conduit.

f. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.

g. Ensure that Critical Care Nurse Call, and PASystems (as identified by NEC Section 517) are completely separated and protected from all other systems.

2. Signal Duct, Cable Duct, or Cable Tray:

a. The Contractor shall use existing signal duct, cable duct, and/or cable tray, when identified and approved by the RE.

b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 in. X 4 in.) inside diameter with removable tops

or sides, as appropriate. Protective sleeves, guides or barriers are required on all sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.

c. Approved cable tray shall be fully covered, mechanically and physically partitioned for multiple electronic circuit use, and be UL certified and labeled for use with telecommunication circuits and/or systems. The RE shall approve width and height dimensions.

D. Distribution System Signal Wires and Cables:

1. Wires and cables shall be provided in the same manner and use like construction practices as Fire Protective and other Emergency Systems that are identified and outlined in NFPA 101, Life Safety Code, Chapters 7, 12, and/or 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions. The wires and cables shall be able to withstand adverse environmental conditions in their respective location without deterioration. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.

   a. Each wire and cable shall terminate on an item of equipment by direct connection. Spare or unused wire and cable shall be provided with appropriate connectors (female types) that are installed in appropriate punch blocks, barrier strips, patch, or bulkhead connector panels.

   b. Fiber optic cables that are spare, unused or dark shall be provided with Industry Standard “ST” type female connectors installed in appropriate break out, patch, or bulkhead connector panels provided in enclosure(s) and shall be protected from the environment.

   c. Coaxial cables that are spare, unused or dark shall be provided with the cable OEM specified type female connectors installed in appropriate break out, patch, or bulkhead connector panels provided in enclosure(s) and shall be protected from the environment.

   d. All cable junctions and taps shall be accessible. Provide an 8” X 8” X 4” (minimum) junction box attached to the cable duct or raceway for installation of distribution system passive equipment. Ensure all equipment and tap junctions are accessible.

2. Routing and Interconnection:
   a. Wires or cables between consoles, cabinets, racks and other equipment shall be in an approved conduit, signal duct, cable duct, or cable tray that is secured to building structure.
   b. Wires and cables shall be insulated to prevent contact with signal or current carrying conductors. Wires or cables used in assembling consoles, panels, equipment cabinets and racks shall be formed into harnesses that are bundled and tied. Harnessed wires or cables shall be combed straight, formed and dressed in either a vertical or horizontal relationship to equipment, controls, components or terminations.
   c. Harnesses with intertwined members are not acceptable. Each wire or cable that breaks out from a harness for connection or termination shall have been tied off at that harness or bundle point, and be provided with a neatly formed service loop.
   d. Wires and cables shall be grouped according to service (i.e.: AC, grounds, signal, DC, control, etc.). DC, control and signal cables may be included with any group. Wires and cables shall be neatly formed and shall not change position in the group throughout the conduit run. Wires and cables in approved signal duct, conduit, cable ducts, or cable trays shall be neatly formed, bundled, tied off in 600 mm to 900 mm (24 in. to 36 in.) lengths and shall not change position in the group throughout the run. Concealed splices are not allowed.
   e. Separate, organize, bundle, and route wires or cables to restrict EMI, channel crosstalk, or feedback oscillation inside any enclosure. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC and speaker wires or cables on the left; coaxial, control, microphone and line level audio and data wires or cables, on the right. This installation shall be accomplished with ties and/or fasteners that will not damage or distort the wires or cables. Limit spacing between tied off points to a maximum of 150 mm (6 inches).
   f. Do not pull wire or cable through any box, fitting or enclosure where change of cable tray or signal or cable duct alignment or direction occurs. Ensure the proper bend radius is maintained for each wire or cable as specified by it's OEM.

g. Employ temporary guides, sheaves, rollers, and other necessary items to protect the wire or cable from excess tension or damage from bending during installation. Abrasion to wire or cable jackets is not acceptable and will not be allowed. Replace all cables whose jacket has been abraded. The discovery of any abraded and/or damaged cables during the proof of performance test shall be grounds for declaring the entire system unacceptable and the termination of the proof of performance test. Completely cover edges of wire or cable passing through holes in chassis, cabinets or racks, enclosures, pull or junction boxes, conduit, etc., with plastic or nylon grommeting.
h. Cable runs shall be splice free between conduit junction and interface boxes and equipment locations.
i. Cables shall be installed and fastened without causing sharp bends or rubbing of the cables against sharp edges. Cables shall be fastened with hardware that will not damage or distort them.
j. Cables shall be labeled with permanent markers at the terminals of the electronic and passive equipment and at each junction point in the System. The lettering on the cables shall correspond with the lettering on the record diagrams.
k. Completely test all of the cables after installation and replace any defective cables.
l. Wires or cables that are installed outside of buildings shall be in conduit, secured to solid building structures. If specifically approved, on a case by case basis, to be run outside of conduit, the wires or cables shall be installed, as described herein. The bundled wires or cables must: Be tied at not less than 460 mm (18 in.) intervals to a solid building structure; have ultra violet protection and be totally waterproof (including all connections). The laying of wires or cables directly on roof tops, ladders, drooping down walls, walkways, floors, etc. is not allowed and will not be approved.
m. Wires or cables installed outside of conduit, cable trays, wireways, cable duct, etc.
   1) Only when specifically authorized as described herein, will wires or cables be identified and approved to be installed outside of conduit. The wire or cable runs shall be UL rated plenum and OEM certified for use in air plenums.

2) Wires and cables shall be hidden, protected, fastened and tied at 600 mm (24 in.) intervals, maximum, as described herein to building structure.
3) Closer wire or cable fastening intervals may be required to prevents sagging, maintain clearance above suspended ceilings, remove unsightly wiring and cabling from view and discourage tampering and vandalism. Wire or cable runs, not provided in conduit, that penetrate outside building walls, supporting walls, and two hour fire barriers shall be sleeved and sealed with an approved fire retardant sealant.
4) Wire or cable runs to system components installed in walls (i.e.: volume attenuators, circuit controllers, signal, or data outlets, etc.) may, when specifically authorized by the RE, be fished through hollow spaces in walls and shall be certified for use in air plenum areas.

n. Wires or cables installed in underground conduit, duct, etc.
1) Wires or cables installed in underground installations shall be waterproofed by the inclusion of a water protective barrier (i.e. gel, magma, etc.) or flooding compound between the outside jacket and first shield. Each underground connection shall be accessible in a manhole, recessed ground level junction box, above ground pedestal, etc., and shall be provided with appropriate waterproof connectors to match the cable being installed. Once the System has been tested and found to meet the System performance standards and accepted by VA, the Contractor shall provide waterproof shrink tubing or approved mastic to fully encompass each wire or cable connection and overlay at least 150 mm (6 inches) above each wire or cable jacket trim point.
2) It is not acceptable to connect waterproofed cable directly to an inside CCS punch block or directly to an equipment connection port. When an under ground cable enters a building, it shall be routed directly to the closest TC that has been designated as the building's IMTC. The Contractor shall provide a "transition" splice in this TC where the "water proofed" cable enters on one side and "dry" cable exits on the other side. The "transition" splice shall be fully waterproof and be capable of reentry for system servicing. Additionally,

the transition splice shall not allow the waterproofing compound to migrate from the water proof cable to the dry cable.

3) Warning tape shall be continuously placed 300 mm (12 inches) above buried conduit, cable, etc.

E. Outlet Boxes, Back Boxes, and Faceplates:

1. Outlet Boxes: Signal, power, interface, connection, distribution, and junction boxes shall be provided as required by the system design, on-site inspection, and review of the contract drawings.
2. Back Boxes: Back boxes shall be provided as directed by the OEM as required by the approved system design, on-site inspection, and review of the contract drawings.
3. Face Plates (or Cover Plates): Faceplates shall be of a standard type, Thermoplastic UL approved cycolac plastic construction of ivory color and provided by the Contractor for each identified system outlet location. Connectors and jacks appearing on the faceplate shall be clearly and permanently marked.

F. Connectors: Circuits, transmission lines, and signal extensions shall have continuity, correct connection and polarity. A uniform polarity shall be maintained between all points in the system.

1. Wires:
   a. Wire ends shall be neatly formed and where insulation has been cut, heat shrink tubing shall be employed to secure the insulation on each wire. Tape of any type is not acceptable.
   b. Audio spade lugs shall be installed on each wire (including spare or unused) end and connect to screw terminals of appropriate size barrier strips. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current. Punch blocks are approved for signal, not AC wires. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.
2. Cables: Each connector shall be designed for the specific size cable being used and installed with the OEM's approved installation tool. Typical system cable connectors include; but, are not limited to: Audio spade lug, punch block, wirewrap, etc.
3. Line or Microphone Audio: Each connector shall be installed according to the cable or connector OEM's instructions and use the

OEM's approved installation tool. Install the connector's to provide and maintain the following audio signal polarity:

a. XLR type connectors Signal or positive conductor is pin 3; common or neutral conductor is pin 2; ground conductor is pin 1.
b. Two and 3 conductor 1/4" Signal or positive conductor is tip; neutral or 1/8" phono plugs conductor is ring and ground or shield and jacks conductor is sleeve.
c. RCA Phono Plugs the Signal or positive conductor is tip; and Jacks neutral or shield conductor is sleeve.

4. Speaker Line Audio:
   a. Each connector shall be installed according to the cable, transformer or speaker OEM instructions and using the OEM's approved installation tool. The Contractor shall ensure each speaker is properly phased and connected in the same manner throughout the System using two conductor type wires.
   b. One of the conductors shall be color coded to aid in establishing speaker signal polarity. Each speaker line shall be permanently soldered or audio spade lug connected to each appropriate speaker or line matching transformer connection terminal. Speaker line connection to each audio amplifier shall use audio spade lugs, as described herein.

G. AC Power: AC power wiring shall be run separately from signal cable.

H. Grounding:
1. General: The Contractor shall ground all Contractor Installed Equipment and identified VA Furnished Equipment to eliminate all shock hazards and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup, crosstalk, etc. The total ground resistance shall be 0.1 Ohm or less.
   a. The Contractor shall install lightning arrestors and grounding in accordance with the NFPA and this specification.
   b. Gas protection devices shall be provided on all circuits and cable pairs serving building distribution frames located in buildings other than the building in which the Hospice is located or in any area served by an unprotected distribution system (manhole, aerial, etc.). The Contractor shall install the gas protection devices at the nearest point of entrance in buildings where protection is required and on the same circuits on the MDF in the telephone switch room.

c. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.

d. The use of conduit, signal duct or cable trays as system or electrical ground is not acceptable and will not be permitted. These items may be used only for the dissipation of internally generated static charges (not to be confused with externally generated lightning) that may applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.

2. Cabinet Buss: A common ground buss of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.

3. Equipment: Equipment shall be bonded to the cabinet bus with copper braid equivalent to at least #12 AWG. Self grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternates.

4. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cable shields shall be insulated from each other, faceplates, equipment racks, consoles, enclosures or cabinets; except, at the system common ground point. Coaxial and audio cables, shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.

I. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for voice and data circuits shall be stenciled using laser printers. Handwritten labels are not acceptable.

1. Cable and Wires (Hereinafter referred to as “Cable”): Cables shall be labeled at both ends in accordance with ANSI/EIA/TIA-606-A. Labels shall be permanent in contrasting colors. Cables shall be identified according to the System “Record Wiring Diagrams”.

2. Equipment: System equipment shall be permanently labeled with contrasting plastic laminate or bakelite material. System equipment

shall be labeled on the face of the unit corresponding to its source.

3. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying it as the System. In addition, each enclosure shall be labeled according to this standard.
4. Termination Hardware: The Contractor shall label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with ANSI/EIA/TIA-606-A and the "Record Wiring Diagrams".

3.2 TESTS

A. Interim Inspection:

1. This inspection shall verify that the equipment provided adheres to the installation requirements of this document. The interim inspection will be conducted by a factory-certified representative and witnessed by a VA Representative. Each item of installed equipment shall be checked to insure appropriate UL certification markings. This inspection shall verify cabling terminations in telecommunications rooms and at workstations adhere to color code for T568B or T568A pin assignments (coordinate with VA) and cabling connections are in compliance with ANSI/EIA/TIA standards. Visually confirm Category 5 marking of outlets, faceplates, outlet/connectors and patch cords.
2. Perform fiber optical field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
3. The Contractor shall notify the RE, in writing, of the estimated date the Contractor expects to be ready for the interim inspection, at least 20 working days before the requested inspection date.
4. Results of the interim inspection shall be provided to the RE and PM. If major or multiple deficiencies are discovered, a second interim inspection may be required before permitting the Contractor to continue with the system installation.
6. The RE and/or the PM shall determine if an additional inspection is required, or if the Contractor will be allowed to proceed with the installation. In either case, re-inspection of the deficiencies

noted during the interim inspection(s), will be part of the proof of performance test. The interim inspection shall not affect the Systems' completion date. The Contracting Officer shall ensure all test documents will become a part of the Systems record documentation.

B. Pretesting:

1. Upon completing the installation of the System, the Contractor shall align and balance the system. The Contractor shall pretest the entire system.
2. Pretesting Procedure:
   a. During the system pretest, the Contractor shall verify (utilizing the approved spectrum analyzer and test equipment) that the System is fully operational and meets all the system performance requirements of this standard.
   b. The Contractor shall pretest and verify that all System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. The Contractor shall measure and record the aural carrier levels of each system telephone and data channel, at each of the following points in the system:
      1) Local Telephone Company Interfaces or Inputs.
      2) EPBX interfaces or inputs and outputs.
      3) MDF interfaces or inputs and outputs.
      4) EPBX output S/NR for each telephone and data channel.
      5) Signal Level at each interface point to the distribution system, the last outlet on each trunk line plus all outlets installed as part of this contract.
3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.

C. Acceptance Test: After the System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 days written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of a VA Representative and an OEM certified representative. The System shall be

tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance. The test shall verify that the total System meets the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

D. Verification Tests:
   1. Test the UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has an overall shield. Test the operation of shorting bars in connection blocks. Test cables after termination and prior to cross-connection.
   2. Multimode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-14A using Method A, Optical Power Meter and Light Source. Perform verification acceptance test.

E. Performance Testing:
   1. Perform Category 6 tests in accordance with ANSI/EIA/TIA-568-B.1 and ANSI/EIA/TIA-568-B.2. Test shall include the following: wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.
   2. Fiber Optic Links: Perform end-to-end fiber optic cable link tests in accordance with ANSI/EIA/TIA-568-B.3.

F. Total System Acceptance Test: The Contractor shall perform verification tests for UTP copper cabling system(s) and the multimode fiber optic cabling system(s) after the complete telecommunication distribution system and workstation outlet are installed.
   1. Voice Testing: Connect to the network interface device at the demarcation point. Go off-hook and receive dial tone from the VA. If a test number is available, place and receive a local, long distance, and FTS telephone call.
   2. Data Testing: Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network is achieved.

3.3 TRAINING

A. Furnish the services of a factory-trained engineer or technician for a total of two four hour classes to instruct designated Facility IRM personnel. Instruction shall include cross connection, corrective, and preventive maintenance of the System and equipment.

B. Before the System can be accepted by the VA, this training must be accomplished. Training will be scheduled at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.

3.4 GUARANTEE PERIOD OF SERVICE

A. Contractor’s Responsibilities:

1. The Contractor shall guarantee that all installed material and equipment will be free from defects, workmanship, and will remain so for a period of one year from date of final acceptance of the System by the VA. The Contractor shall provide OEM’s equipment warranty documents, to the RE (or Facility Contracting Officer if the Facility has taken procession of the building(s)), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. The Contractor and OEM shall provide this contact capability at no additional cost to the VA.
3. All Contractor installation, maintenance, and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the one year guarantee period:
   a. Response Time:
      1) The RE (or facility Contracting Officer if the facility has taken possession of the building[s]) are the Contractor’s reporting and contact officials for the System trouble calls, during the guarantee period.
      2) A standard workweek is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal Holidays.
      3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
         a) A routine trouble call within one working days of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord to be inoperable.

b) An emergency trouble call within 6 hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point to be inoperable at anytime. Additionally, the loss of a minimum of 50 station or system lines shall be deemed as this type of a trouble call.

4) The Contractor shall respond on-site to a catastrophic trouble call within 4 hours of its report. A catastrophic trouble call is considered total system failure.

a) If a system failure cannot be corrected within four hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate system CCS or TCO equipment, or cables. The alternate equipment and/or cables shall be operational within four hours after the four hour trouble shooting time.

b) Routine or emergency trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as a catastrophic trouble call if so determined by the RE or Facility Director. The RE or Facility Contracting Officer shall notify the Contractor of this type of trouble call at the direction of the Facilities Director.

b. Required on-site visits during the one year guarantee period

1) The Contractor shall visit, on-site, for a minimum of eight hours, once every 12 weeks, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this SPEC.

a) The Contractor shall arrange all Facility visits with the RE or Facility Contracting Officer prior to performing the required maintenance visits.

b) The Contractor in accordance with the OEM’s recommended practice and service intervals shall perform preventive maintenance during a non-busy time agreed to by the RE or Facility Contracting Officer and the Contractor.

c) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE or Facility Contracting Officer.

2) The Contractor shall provide the RE or Facility Contracting Officer a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the RE with sample copies of these reports for review and approval at the beginning of the Total System Acceptance Test. The following reports are the minimum required:
   a) Monthly Report: The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to RE or Facilities Contracting Officer by the fifth working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and Systems for preventive and predictive maintenance
   b) Contractor Log: The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the System. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.
3) The COTR or Facility Contracting Officer shall provide the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
   a) The COTR or Facility Contracting Officer shall ensure copies of these reports are entered into the System's official acquisition documents.
   b) The Facilities Chief Engineer shall ensure copies of these reports are entered into the System's official technical as-installed documents.

C. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use, accidents, other vendor, contractor, VA tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the RE or Facility Contracting Officer in writing upon the discovery of these incidents. The RE or Facility Contracting

Officer will investigate all reported incidents and render findings concerning any Contractor’s responsibility.

- - - E N D - - -

SECTION 27 31 00

VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Equipment is being provided by the VA.

- - E N D - -

SECTION 27 41 31

CABLE TELEVISION EQUIPMENT AND SYSTEMS

PART 1 - GENERAL

1.1 SECTION SUMMARY

A. Work covered by this document includes design, engineering, labor, material, products, guarantee, training and services for, and incidental to the complete installation of new and fully operating NFPA listed Cable Television (TV) equipment and systems as detailed herein.

B. Work shall be complete, complete, labeled, VA Central Office (VACO) tested and certified and ready for operation

1.2 RELATED SECTIONS

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below).

C. Section 26 41 00, FACILITY LIGHTNING PROTECTION.

D. Section 27 10 00, STRUCTURED COMMUNICATIONS SYSTEMS CABLING.

E. Section 27 10 00, STRUCTURED CABLING.

F. Section 27 52 23, NURSE CALL/CODE BLUE EQUIPMENT AND SYSTEMS.

1.3 DEFINITIONS

A. Provide: Design, engineer, furnish, install, connect complete, test, certify and guarantee.

B. Work: Materials furnished and completely installed.

C. Review of contract drawings: A service by the engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.

D. Headquarters Technical Review, for National/VA communications and security, codes, frequency licensing, standards, guidelines compliance:

Office of Telecommunications
Special Communications Team (005OP2B)
1335 East West Highway - 3rd Floor
Silver Spring, Maryland 20910
(O) 301-734-0350, (F) 301-734-0360

E. Engineer: //XXXXXXX//
//XXXXXXX//
//XXXXXXX//

//XXXXXXX//

//XXXXXXX//

F. VA: //XXXXXXX//

G. General Contractor (GC): //XXXXXXX//

H. Contractor: Radio Contractor; you; successful bidder

1.4 REFERENCES

A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:

1. United States Federal Law/Codes:

a. Departments of:

1) CFR, Title 15 – Department of Commerce, Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the:

a) Chapter II, National Institute of Standards Technology (NIST – formerly the National Bureau of Standards). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (Public Law 107-347), NIST develops – Federal Information Processing Standards Publication (FIPS) 140-2—Security Requirements for Cryptographic Modules.

b) Chapter XXIII, National Telecommunications and Information Administration (NTIA – aka 'Red Book') Chapter 7.8/9 Federal communications Commission (FCC) Title 47 (CFR), Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions and Locations.

2) CFR, Title 29, Department of Labor, Chapter XVII - Occupational Safety and Health Administration (OSHA), Part 1910 – Occupational Safety and Health Standard:

a) Subpart 7 - Definition and requirements for a National Recognized Testing Laboratory (NRTL – 15 Laboratory's, for complete list, contact http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)

(1) Underwriter's Laboratories (UL):

468	Standard for Grounding and Bonding Equipment.
1449	Standard for Transient Voltage Surge Suppressors.
1069	Hospital Signaling and Nurse Call Equipment.
60950-1/2	Information Technology Equipment – Safety.

(2) Canadian Standards Association (CSA): same tests as for UL.

(3) Communications Certifications Laboratory (CCL): same tests as for UL.

(4) Intertek Testing Services NA, Inc. (ITSNA formerly Edison Testing Laboratory [ETL]): same tests as for UL.

b) Subpart 35, Compliance with NFPA 101 – Life Safety Code.

c) Subpart 36, Design and construction requirements for exit routes.

d) Subpart 268, Telecommunications.

e) Subpart 305, Wiring methods, components, and equipment for general use.

3) Public Law No. 100-527, Department of Veterans Affairs:

a) Office of Telecommunications: Handbook 6100 – Telecommunications.

b) Office of Cyber and Information Security (OCIS):

(1) Handbook 6500 - Information Security Program.

(2) Wireless and Handheld Device Security Guideline Version 3.2, August 15, 2005.

c) Spectrum Management FCC and NTIA Radio Frequency Compliance and Licensing Program.

d) Office of Cyber and Information Security (OCIS):

(1) Handbook 6500 - Information Security Program.

(2) Wireless and Handheld Device Security Guideline Version 3.2, August 15, 2005.

4) Title 42, CFC, Department of Health, Chapter IV Health and Human Services, Subpart 1395(a)(b) Joint Commission on Accreditation of Healthcare Organizations (JCAHO) "a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:"

All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.

5) CFR, Title 47 - Telecommunications, in addition to FCC: Part 15 – Restrictions of use for Part 15 listed Radio Equipment in Safety of Life/Emergency Functions/Equipment/Locations (also see CFR, Title 15 – Department of Commerce, Chapter XXIII – NTIA):

Part 73	Radio Broadcast Service,
Part 90	Rules and Regulations, Appendix C.
Form 854	Antenna Structure Registration.

6) Public Law 89-670, Department of Transportation, CFR-49, Part 1, Subpart C – Federal Aviation Administration (FAA):
   a) Standards AC 110/460-ID and AC 707/460-2E – Advisory Circulars for Constructions of Antenna Towers.
   b) Forms 7450 and 7460-2 – Antenna Construction Registration.

2. National Codes:
   a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.
   b. American National Standards Institute/Electronic Industries Association/Telecommunications Industry Association (ANSI/EIA/TIA):

568-B	Commercial Building Telecommunications Wiring Standards:
569	Commercial Building Standard for Telecommunications Pathways and Spaces.
606	Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
REC 127-49	Power Supplies.
RS 27	Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.

   c. Institute of Electrical and Electronics Engineers (IEEE):

SO/TR 21730:2007	Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices.
0739-5175/08/$25.00©2008IEEE	Medical Grade – Mission Critical – Wireless Networks.
C62.41	Surge Voltages in Low-Voltage AC Power Circuits.

d. American Society of Mechanical Engineers (ASME):
   1) Standard 17.4, Guide for Emergency Personnel.
   2) Standard 17.5, Elevator and Escalator Equipment (prohibition of installing non-elevator equipment in Elevator Equipment Room/Mechanical Penthouse).

e. NFPA:

70	National Electrical Code (current date of issue) – Articles 517, 645 and 800.
75	Standard for Protection of Electronic Computer Data- Processing Equipment.
77	Recommended Practice on Static Electricity.
99	Healthcare Facilities.
101	Life Safety Code.

3. State Hospital Code(s).
4. Local Codes.

1.5 QUALIFICATIONS

A. The OEM shall have had experience with three or more installations of systems of comparable size and complexity about type and design as specified herein. Each of these installations shall have performed satisfactorily for at least 1 year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.

B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of 3 years. The Contractor shall be authorized by the OEM to

pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the system. This documentation, along with the System Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.

C. The Contractor's Communications Technicians assigned to the system shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the system. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the COTR before being allowed to commence work on the system.

D. Applicable national, state and local licenses.

E. Certificate of successful completion of OEM's installation/training school for installing technicians of the equipment being proposed.

1.6 CODES AND PERMITS

A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by the VA.

B. The contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.

1.7 SCHEDULING

A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using "Microsoft Project" software or equivalent. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.

B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The VA will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

1.8 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS

A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance

with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.

B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.

C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (TVE-005OP3B – herein after referred to as [005OP3B]) will not review any submittal that does not have this list.

D. Provide 4 copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C and D, at a minimum for compliance review as described herein where each responsible individual(s) should respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).

E. Head End and each interface distribution cabinet layout drawing, as they are to be installed.

F. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.

H. Engineering drawings of the system, showing calculated signal levels at the Head End input and output, each input and output distribution point, and signal level at each telecommunications outlet.

1.9 PROJECT RECORD DOCUMENTS (AS BUILTS)

A. Throughout progress of the work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.

B. The floor plans shall be marked in pen to include the following:

1. All device locations with labels.
2. Conduit locations.
3. Head-end equipment and specific location.
4. Wiring diagram.
5. Labeling and administration documentation.
6. Warranty certificate.
7. System test results.

1.10 WARRANTIES AND GUARANTEE

A. The Contractor shall warrant the installation be free from defect in material and workmanship for a period of 1 year from the date of acceptance of the project by the VA. The Contractor shall agree to remedy covered defects within eight (8) hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.

B. Refer to Part 4 for applicable System Guarantee requirements.

1.11 USE OF THE SITE

A. Use of the site shall be at the GC's direction.

B. Coordinate with the GC for lay-down areas for product storage and administration areas.

C. Coordinate work with the GC and their sub-contractors.

D. Access to buildings wherein the work is performed shall be directed by the GC.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.

B. Store products in original containers.

C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.

D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the VA.

1.13 PROJECT CLOSEOUT

A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.

B. Before the project closeout date, the Contractor shall submit:

1. Warranty certificate.
2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
3. Project record documents.
4. Instruction manuals and software that is a part of the system.

C. Contractor shall submit written notice that:

1. Contract Documents have been reviewed.
2. Project has been inspected for compliance with contract.

3. Work has been completed in accordance with the contract

PART 2 – PRODUCTS AND FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

A. Furnish and install a complete and fully operational cable TV signal distribution system. Include all amplifiers, power supplies, cables, outlets, attenuators, and all other parts necessary for the reception and distribution of the TV signals.

B. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.

C. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.

D. Distribute cable channels to all TV outlets to permit simple connection of EIA standard high definition television (HDTV) receivers.

E. Deliver at all outlets all HDTV monochrome and color television signals without introducing noticeable effect on picture and color fidelity or sound. System picture fidelity shall be equal to that received from the cable company and other modulated channels.

F. Deliver at all television outlets a minimum +6.0 dBmv (2,000 microvolts across 75 Ohms) and maximum of +20 dBmv (20,000 microvolts) for each channel at each outlet.

G. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

H. Meet all FCC requirements regarding low radiation and/or interference of RF signal(s). The system shall be designed to prevent direct pickup of signals from the building structure.

I. Weather-Resistant Equipment: Listed and labeled by an OSHA certified National Recognized Testing Laboratory (NRTL – i.e. UL) for duty outdoors or in damp locations.

2.2 SYSTEM DESCRIPTION

A. The Contractor is responsible for interfacing the Nurse Call system with the system.

B. The Contractor shall continually employ interfacing methods that are approved by the OEM and VA. At a minimum, an acceptable interfacing method requires not only a physical and mechanical connection, but also a matching of signal, voltage, and processing levels with regard to

signal quality and impedance. The interface point must adhere to all standards described herein for the full separation of Critical Care and Life Safety systems.

C. It is not acceptable to utilize the telephone cable system for the control of TV signals and equipment. The System Contractor shall connect the system ensuring that all NFPA and Underwriters Laboratory, Inc. (UL) Critical Care and Life Safety Circuit and system separation guidelines are satisfied. The System Contractor is not allowed to make any connections to the Telephone System. The VA shall arrange for the interconnection between the TV and Nurses Call System with the appropriate responsible parties.

D. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications and be provided with screw type audio connectors.

E. All trunk, branch, and interconnecting cables and unused equipment ports or taps shall be terminated with proper terminating resistors designed for RF, audio and digital cable systems without adapters.

F. The system shall utilize microprocessor components for all signaling and programming circuits and functions. System program memory shall be non-volatile or protected from erasure from power outages for a minimum of 30 minutes.

G. Provide a backup battery or a UPS for the system (including each distribution cabinet/point) to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of 30 minutes.

H. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and RF transmission line interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the system OEM. Base band cable systems shall utilize barrier terminal screw type connectors, at a minimum. As an alternate, crimp type connectors installed with a ratchet type installation tool are acceptable provided the cable dress, pairs, shielding, grounding, connections and labeling are the same as the barrier terminal strip connectors. Tape of any type, wire nuts or solder type connections are unacceptable and will not be approved.

I. All equipment faceplates utilized in the system shall be stainless steel, anodized aluminum or UL approved cycolac plastic for the areas where provided.

J. Noise filters and surge protectors shall be provided for each equipment interface cabinet, Head End cabinet, control console and local and remote ampler locations to insure protection from input primary AC power surges and to insure noise glitches are not induced into low voltage data circuits.

K. Audio Level Processing: The use of telephone cable to distribute TV signals, carrying system or sub-system AC or DC voltage is not acceptable and will not be approved. Additionally, each control location shall be provided with the equipment required to insure the system can produce its designed audio channel capacity at TV/speaker identified on the contract drawings.

L. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. Unless otherwise noted in this Part, equipment quantities shall be as indicated on the drawings.

2.3 MANUFACTURERS

A. The products specified shall be new, FCC and UL Listed, and produced by OEM manufacturer of record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:

1. Maintains a stock of replacement parts for the item submitted,
2. Maintains engineering drawings, specifications, and operating manuals for the items submitted, and
3. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid.

B. Specifications contained herein as set forth in this document detail the salient operating and performance characteristics of equipment in order for VA to distinguish acceptable items of equipment from unacceptable items of equipment. When an item of equipment is offered or furnished for which there is a specification contained herein, the item of equipment offered or furnished shall meet or exceed the specification for that item of equipment.

C. The equipment items are the salient requirements of VA to provide an acceptable system described herein.

2.4 PRODUCTS

A. The system distribution amplifier shall have a frequency range of 49-1,000 MHz and shall accommodate a minimum of 35 HDTV channels of programming. Gain of the preamplifier shall be 32dB, with an output level of 48dBmV for each HDTV channel processed. The preamplifier shall utilize a hybrid push-pull amplifier module. The preamplifier shall provide gain and slope control ranges of 8dB and 9dB, respectively.

B. Provide one 8-port passive combiner for the combining of all RF signals into one main trunk run for distribution to all building locations. Bandwidth of combiners shall be 0 to 1,000MHz.

C. Provide riser rated coaxial cable with a nominal characteristic impedance of 75 Ohms throughout the entire frequency spectrum utilized in this system. Each reel of cable shall be sweep-tested and return-loss tested over the entire frequency range from 50MHz to 750MHz by the manufacturer. Provide RG-6, RG-11 or appropriate minimum .500” Hardline Coaxial cable as required to achieve the specified signal level. However, all runs over 150’ in length shall be RG-11 or .500”.

D. Line Splitters:

1. Provide low-radiation line splitters with a flat frequency response from 50MHz to 1,000MHhz. Provide units of a hybrid design with a 75-ohm match on input and outputs and a VSWR no greater than 1.4:1.
2. Two way line splitters shall have a signal loss of not more than 3.5dB at each output.
3. Four way line splitters shall have a signal loss of not more than 7.2dB at each output.
4. All unused splitter outputs shall be terminated with 75-Ohm terminations.

E. HDTV Outlets:

1. Provide outlets at each location shown on the plans. Mount in electrical contractor provided 4" square, 2" deep minimum flush electrical boxes as indicated on plans.
2. Provisions shall be incorporated in the network to prevent 60 Hz AC or DC feedback into the distribution lines.
3. Outlets shall be designed to cover a frequency range of 10MHz to 1,000MHz. Insertion loss shall not exceed 1.0 db at any frequency within the designated frequency range for a 17dB isolation network. Outlets shall be back-matched from 10 to 1,000MHz. Outlets shall

have one F-type connector on the front and two F-type connectors on the rear.

4. The minimum isolation value between any two outlets shall be 24 db.
5. Wall plates type shall be smooth nylon and color shall be ivory unless otherwise specified.

F. Television Receivers shall be provided separately by the VA.

G. Distribution Devices:

1. Distribution Amplifier:
   a. Description: Broadband CATV quality HDTV distribution amplifier.
   b. Specifications:

Frequency Range: 49MHz to 1,000MHz.	Channel Loading: 150.
Flatness: +/-.75dB.	Gain: 32dB.
Output Level: +40dBmV.	Gain Control Range: 10dB.
Slope Control Range: 8dB.	Plug in equalizers as needed.
Attenuator options as needed.	

2. Splitters:
   a. Description: RF signal splitter.
   b. Specifications:

Frequency Range: 5MHz to 1,000MHz.	Outputs: 2, 3, 4 and 8.
Splitter Loss: less than 12 dB.	RFI Shielding: 120dB.

3. Taps:
   a. Description: Directional Coupler Type Taps.
   b. For use in Telecomm closets or accessible cable trays.
   c. Specifications:
      1. Frequency Range: 5MHz to 1,000MHz.
      2. Outputs: 2, 4 and 8.
      3. Isolation Tap Value: Varies.
4. Wallplate Bulkhead Connector and Terminators:
   a. Description: Wall plates for termination of CATV signals at television sets.
      1. Impedance: 75 Ohms.
      2. Frequency Band: SUB/VHF/CATV/UHF.

5. “F” Connectors:
   a. Coaxial cable connectors and connector inserts shall be designed to provide maximum performance with the cable to be used. Coaxial cables shall be connectorized with the Head End quality 360 degree F or BNC connectors as applicable, meeting or exceeding standard industry and the cable manufacture's specifications. All drop F-connectors shall be hex type crimp or a “Snap and Seal” type connector. Housing to housing (KS to KS) type or 90-degree type connectors shall be used where specified by the OEM.
6. Terminator:
   a. Description: 75-Ohm terminator.
   b. Specifications:

DC blocking.	Bandwidth: 50MHz-890MHz.
Return Loss: greater than 16dB.	Impedance: 75 Ohm.

7. Trunk Cable:
   a. Description: .500 inch, Semi-Rigid Coax, Riser Rated.
   b. Specifications:
      1. Maximum Attenuation:

2.92 dB/100ft at 700 MHz.	3.78 dB/100ft at 1000 MHz.
Impedance: 75 Ohm	

8. RG6 Cable:
   a. Description: CATV RG6 double shielded cable CM Rated
   b. Specifications:
      1. Attenuation:

1.48 dB/100ft at 50 MHz.	7.45 dB/100ft at 1000 MHz.
Impedance: 75 Ohm	

9. RG11 Cable:
   a. Description: CATV RG11 cable CM Rated
   b. Specifications:
      1. Attenuation:

0.90 dB/100ft at 50 MHz.	5.04 dB/100ft at 1000 MHz.
Impedance: 75 Ohm	

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

A. Assign a single project manager to this project who will serve as the point of contact for the VA, the General Contractor, and the Engineer.

B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with the general contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.

C. Contact the Office of Telecommunications, Special Communications Team (005OP3B) at (301) 734-0350 to have a VA Certified Telecommunications COTR assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and OCIS Teams.

3.2 COORDINATION WITH OTHER TRADES

A. Coordinate with the cabling contractor the location of the faceplate and the faceplate opening for the TV backbox.

B. Coordinate with the cabling contractor the location of TV equipment in the Telecommunications Closets.

C. Before beginning work, verify the location, quantity, size and access for the following:

Isolated ground AC power circuits provided for systems.

Primary, emergency and extra auxiliary AC power generator requirements.

Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.

System components installed by others.

Overhead supports and rigging hardware installed by others.

D. Immediately notify the VA, General Contractor and Consultant in writing of any discrepancies.

3.3 NEEDS ASSESSMENT

Provide a one-on-one meeting with the particular nursing manager of each unit affected by the installation of the new HDTV TV system. Review the floor plan drawing, educate the nursing manager with the functions of the equipment that is being provided and gather details specific to the individual units; coverage and priorities of calls; staffing patterns; and other pertinent details that will affect system programming and training.

3.4 INSTALLATION

A. General:

1. Execute work in accordance with National, State and local codes, regulations and ordinances.
2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the VA.
3. Install equipment according to OEM’s recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc:
   a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
   b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
   c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
   d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
5. Finishes for any exposed work such as plates, racks, panels, etc. shall be approved by the Architect, VA and 005OP3B.
6. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommeted holes in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.

B. Equipment Racks:
1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
2. Provide security covers for all devices not requiring routine operator control.
3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow

manufacturer’s recommendations regarding ventilation space between amplifiers.

4. Provide insulated connections of the electrical raceway to equipment racks.
5. Provide continuous raceway and conduit with no more than 40 percent fill between wire troughs and equipment racks for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.

C. Wiring Practice - in addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED COMMUNICATIONS CABLING SYSTEM, the following additional practices shall be adhered to:

1. Comply with requirements for raceways and boxes specified in Division 26, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications, which share the same enclosure, shall be mechanically partitioned and separated by at least 4 inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
4. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
5. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
6. Replace the entire length of the run of any wire or cable that is damaged or abraided during installation. There are no acceptable methods of repairing damaged or abraided wiring.
7. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
8. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.

9. Do not use tape-based or glue-based cable anchors.
10. Ground shields and drain wires as indicated by the drawings.
11. Field wiring entering equipment racks shall be terminated as follows:
    a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
    b. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see "Products"). Provide 15 percent spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
    c. If specified terminal blocks are not designed for rack mounting, utilize 3/4 inch plywood or 1/8 inch thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
    d. Employ permanent strain relief for any cable with an outside diameter of 1 inch or greater.
12. Use only balanced audio circuits unless noted otherwise
13. Make all connections as follows:
    a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
    b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
    c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
    d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.

D. Cable Installation - In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING the following additional practices shall be adhered to:
1. Support cable on maximum 4'-0" centers. Acceptable means of cable support are cable tray, j-hooks, and bridal rings. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
2. Run cables parallel to walls.

3. Install maximum of 10 cables in a single row of J-hooks. Provide necessary rows of J-hooks as required by the number of cables.
4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2’-0” clearance from all shielded electrical apparatus.
5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the VA.
6. Ends of cables shall be properly terminated on both ends per industry and OEM’s recommendations.
7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until you are ready to terminate.
8. Cover the end of the overall jacket with a 1 inch (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2 inches (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2 inches (minimum) past the Heatshrink and serve as indicated below.
9. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing 1/4 inch past the end of unused wires, fold back over jacket and secure with cable tie.
10. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
11. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
12. 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.
13. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
14. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

15. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

E. Labeling:

1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
2. Engrave and paint fill all receptacle panels using 1/8 inch (minimum) high lettering and contrasting paint.
3. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8 inch (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
4. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
5. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
6. Contractor’s name shall appear no more than once on each continuous set of racks. The Contractor’s name shall not appear on wall plates or portable equipment.
7. Ensure each OEM supplied equipment has permanently attached/marked the appropriate UL Labels/Marks for the service the equipment is performed. Equipment installed not bearing these UL marks will not be allowed to be part of the system. The Contractor shall bear all costs required to provide replacement equipment with approved UL marks.

3.5 PROTECTION OF NETWORK DEVICES

Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved electrostatic discharge (ESD) wrist straps tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician encounter high voltage.

3.6 CUTTING AND PATCHING

A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.

B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.

C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the Work or to make its parts fit together properly.

D. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the VA or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the VA or a separate contractor except with written consent of the VA and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the VA or a separate Contractor, the Contractor's consent to cutting or otherwise altering the work.

E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

3.7 FIREPROOFING

A. Where TV cables penetrate fire rated walls, floors and ceilings, fireproof the opening.

B. Provide conduit sleeves (if not already provided by electrical contractor) for cables that penetrate fire rated walls. After the cabling installation is complete, install fire proofing material in and around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.

C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.

3.8 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, commonmode 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 26, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

D. Do not use “3rd or 4th” wire internal electrical system conductors for ground.

E. Do not connect system ground to the building’s external lightning protection system.

F. Do not “mix grounds” of different systems.

PART 4 - TESTING/GUARANTEE/TRAINING

4.1 SYSTEM CLASSIFICATION

The HDTV TV System is FCC and NFPA listed. Therefore, the following testing and guaranty provisions are the minimum to be performed and provided by the contractor and Warranted by the OEM.

4.2 PROOF OF PERFORMANCE TESTING

A. Intermediate Testing:

1. After completion of 25 – 30 percent of the installation of a head end cabinet(s) and equipment, one wing of HDTV TV outlets and interconnection to the corresponding Nurse Call (Code Blue) System Patient Head Wall Units and prior to any further work, this portion of the system must be pretested, inspected, and certified.
   Each item of installed equipment shall be checked to ensure appropriate FCC listing and UL certification labels are affixed, NFPA, Emergency, Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.
2. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a VA Representative. The results of the inspection will be officially recorded by a local VA Representative and maintained on file by the COTR, until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75percent of the system construction phase, at the direction of the COTR.

B. Pretesting:

1. Upon completing installation of the system, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
2. Pretesting Procedure:
   a. During the system pretest the Contractor shall verify (utilizing approved test equipment) that the system is fully operational and meets all the system performance requirements of this standard.

b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, each of the following locations shall be fully pretested:
   1) Lightning Grounds.
   2) Head End.
   3) All Networked locations.
   4) System trouble reporting.
   5) UPS operation.
   6) Primary and Emergency AC Power Requirements

3. The Contractor shall provide 4 copies of the recorded system pretest measurements and the written certification that the system is ready for the formal acceptance test shall be submitted to the COTR.

C. Acceptance Test:

1. After the system has been pre-tested and the Contractor has submitted the pretest results and certification to the COTR, then the Contractor shall schedule an acceptance test date and give the COTR 30 days written notice prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a VA Representative and an OEM certified representative. The system shall be tested utilizing the approved test equipment to certify proof of performance and FCC compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed system does comply with all requirements of this specification under operating conditions. The system shall be rated as either acceptable or unacceptable at the conclusion of the test. Failure of any part of the system that precludes completion of system testing, and which cannot be repaired in 4 hours, shall be cause for terminating the acceptance test of the system. Repeated failures that result in a cumulative time of 8 hours to affect repairs shall cause the entire system to be declared unacceptable.

Retesting of the entire system shall be rescheduled at the convenience of the VA.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:

   a. The VACO VA Representative will tour all major areas where the system is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.

   b. The system diagrams, record drawings, equipment manuals, Telecommunications Infrastructure Plant (TIP) Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.

   c. Failure of the system to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

   a. After the Physical and Mechanical Inspection, head end terminating and control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter shall be utilized to accomplish this requirement.

   b. Following the Head End equipment test, the local and remote control unit be connected to the Head End equipment’s output test tap to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.

   c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last leg to verify that the HDTV TV video, audio and control signals meets all system performance standards.

   d. Each HDTV TV outlet shall be functionally tested at the same time utilizing the Contractor’s approved hospital grade TV receiver and Spectrum Analyzer.

   e. The red system and volume stepper switches shall be checked to insure proper operation of the pillow speaker, the volume stepper and the red system (if installed).

f. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system.

g. Individual Item Test: The VACO VA Representative will select individual items of equipment for detailed proof of performance testing until 100percent of the system has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.

3. Test Conclusion:

a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the COTR. Any retesting to comply with these specifications will be done at the Contractor's expense.

b. If the system is declared unacceptable without conditions, all rescheduled testing expenses will be borne by the Contractor.

E. Acceptable Test Equipment:

1. The test equipment shall furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the equipment.

4.3 SYSTEM GUARANTEE PERIOD OF SERVICE

A. Contractor’s Responsibility:

1. The Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the system by the VA. The Contractor shall provide OEM’s equipment warranty documents, to the COTR (or Facility Contracting Officer if the Facility has taken procession of the building), that certifies each item of equipment installed conforms to OEM published specifications.

2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability

shall be provided by the Contractor and OEM at no additional cost to the VA.

3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide 2 copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the Two Year Guarantee Period:
   a. Response Time during the Two Year Guarantee Period:
      1) The COTR (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor's only official reporting and contact official for TV system trouble calls, during the guarantee period.
      2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the COTR (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
      3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
         a) A routine trouble call within 1 working day of its report. A routine trouble is considered a trouble that causes a pillow speaker or cordset, 1 master IC control station, room station or emergency station to be inoperable.
         b) Routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as an emergency trouble call. The COTR (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.
         c) An emergency trouble call within 4 hours of its report. An emergency trouble is considered a trouble that causes a sub-system (ward), distribution point, terminal cabinet, or all call system to be inoperable at anytime.
      4) If a HDTV TV component failure cannot be corrected within 6 hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate HDTV TV equipment. The alternate equipment/system shall be operational within a maximum of 18 hours after the 6 hour trouble shooting time and restore the effected location operation to meet the system performance standards. If any

sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the system or sub-system to full operational capability, as described herein, until repairs are complete.

b. Required On-Site Visits during the One Year Guarantee Period:

1) The Contractor shall visit, on-site, as necessary, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the system according the descriptions identified in this document.
2) The Contractor shall arrange all Facility visits with the COTR (or Facility Contracting Officer) prior to performing the required maintenance visits.
3) Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the COTR (or Facility Contracting Officer) and Contractor.
4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the COTR (or Facility Contracting Officer).
5) The Contractor shall provide the COTR (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the COTR with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:
   a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to COTR (or Facility Contracting Officer) by the fifth (5th) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
   b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the system. The

log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

6) The COTR (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, 2 copies of actual reports for evaluation.
   a) The COTR (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the system's official acquisition documents.
   b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the system's official technical record documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or VA tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the COTR or Facility Contracting Officer in writing upon the discovery of these incidents. The COTR or Facility Contracting Officer will investigate all reported incidents and render

4.4 TRAINING

A. Provide thorough training of the VA's engineering and maintenance staff.

B. Provide the following minimum training times and durations:
   1. 24 hours prior to opening
   2. 24 hours during the opening week
   3. 24 hours for supervisors and system administrators

- - - E N D - - -

SECTION 27 51 16

PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS

PART 1 - GENERAL

1.1 SECTION SUMMARY

A. Work covered by this document includes design, engineering, labor, material, products, guaranty, training and services for, and incidental to, the complete installation of a new and fully operating National Fire Protection Association (NFPA) Listed Emergency/Public Safety Public Address and Mass Notification communication (PA) system as detailed herein.

B. Work shall be complete, tested, labeled, certified and ready for operation

1.2 RELATED SECTIONS

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below)

C. Section 26 41 00, FACILITY LIGHTNING PROTECTION

D. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNCATIONS SYSTEMS

E. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS

1.3 DEFINITIONS

A. Provide: Design, engineer, furnish, install, connect complete, test, certify and guarantee.

B. Work: Materials furnished and completely installed.

C. Review of contract drawings: A service by the engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.

D. Headquarters Technical Review, for National and VA communications and security, codes, frequency licensing, standards, guidelines compliance:

Office of Telecommunications
Special Communications Team (005OP2B)
1335 East West Highway – 3rd Floor
Silver Spring, Maryland 20910
(O) 301-734-0350, (F) 301-734-0360

E. Engineer: //XXXXXXX//

//XXXXXXX//
//XXXXXXX//
//XXXXXXX//
//XXXXXXX//

F. VA: //XXXXXXX//

G. General Contractor (GC): //XXXXXXX//

H. Contractor: Radio Contractor; you; successful bidder

1.4 REFERENCES

A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:

1. United States Federal Law/Codes:

a. Departments of:

1) CFR, Title 15 – Department of Commerce, Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the:

a) Chapter II, National Institute of Standards Technology (NIST – formerly the National Bureau of Standards). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (Public Law 107-347), NIST develops – Federal Information Processing Standards Publication (FIPS) 140-2—Security Requirements for Cryptographic Modules.

b) Chapter XXIII, National Telecommunications and Information Administration (NTIA – aka 'Red Book') Chapter 7.8/9 Federal communications Commission (FCC) Title 47 (CFR), Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions and Locations.

2) CFR, Title 29, Department of Labor, Chapter XVII - Occupational Safety and Health Administration (OSHA), Part 1910 – Occupational Safety and Health Standard:

a) Subpart 7 - Definition and requirements for a National Recognized Testing Laboratory (NRTL – 15 Laboratory's, for complete list, contact http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)

(1) Underwriter's Laboratories (UL):

65	Standard for Wired Cabinets.
468	Standard for Grounding and Bonding Equipment.
1449	Standard for Transient Voltage Surge Suppressors.
1069	Hospital Signaling and Nurse Call Equipment.
60950-1/2	Information Technology Equipment – Safety.

(2) Canadian Standards Association (CSA): same tests as for UL.

(3) Communications Certifications Laboratory (CCL): same tests as for UL.

(4) Intertek Testing Services NA, Inc. (ITSNA formerly Edison Testing Laboratory [ETL]): Same tests as for UL.

b) Subpart 35, Compliance with NFPA 101, Life Safety Code.

c) Subpart 36, Design and construction requirements for exit routes.

d) Subpart 268, Telecommunications.

e) Subpart 305, Wiring methods, components, and equipment for general use.

3) Title 42, CFC, Department of Health, Chapter IV Health and Human Services, Subpart 1395(a)(b) Joint Commission on Accreditation of Healthcare Organizations (JCAHO) "a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:" All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.

4) All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.

5) CFR, Title 47 - Telecommunications, FCC: Part 15 – Restrictions of use for Part 15 listed Radio Equipment in Safety of Life/Emergency Functions/Equipment/Locations (also see CFR, Title 15 – Department of Commerce, Chapter XXIII – NTIA).

6) Public Law No. 100-527, Department of Veterans Affairs:

a) Office of Telecommunications:

(1) Handbook 6100, Telecommunications.

b) Office of Cyber and Information Security (OCIS):

(1) Handbook 6500, Information Security Program.

(2) Wireless and Handheld Device Security Guideline Version 3.2, August 15, 2005.

c) Spectrum Management FCC and NTIA Radio Frequency Compliance and Licensing Program.

2. National Codes:

a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.

b. American National Standards Institute/Electronic Industries Association and Telecommunications Industry Association (ANSI/EIA/TIA):

568-B	Commercial Building Telecommunications Wiring Standards:
569	Commercial Building Standard for Telecommunications Pathways and Spaces.
606	Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
REC 127-49	Power Supplies.
RS 27	Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.

c. Institute of Electrical and Electronics Engineers (IEEE):

SO/TR 21730:2007	Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices.
0739-5175/08/$25.00©2008IEEE	Medical Grade – Mission Critical – Wireless Networks.
C62.41	Surge Voltages in Low-Voltage AC Power Circuits.

d. NFPA:

70	National Electrical Code (current date of issue) – Articles 517, 645 and 800.
75	Standard for Protection of Electronic Computer Data- Processing Equipment.
77	Recommended Practice on Static Electricity.
99	Healthcare Facilities.
101	Life Safety Code.

3. State Hospital Code(s).
4. Local Codes.

1.5 QUALIFICATIONS

A. The OEM shall have had experience with 3 or more installations of Public Address Systems of comparable size and complexity with regards to type and design as specified herein. Each of these installations shall have performed satisfactorily for at least 1 year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.

B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of 3 years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the system. This documentation, along with the system Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.

C. The Contractor's Communications Technicians assigned to the system shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the system. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the COTR before being allowed to commence work on the system.

D. Applicable national, state and local licenses.

E. Certificate of successful completion of OEM's installation/training school for installing technicians of the equipment being proposed.

1.6 CODES AND PERMITS

A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is

proof of performance tested and ready for operation on a date directed by the VA.

B. The Contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.

1.7 SCHEDULING

A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using “Microsoft Project” software or equivalent. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.

B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The VA will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

1.8 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS

A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.

B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.

C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (005OP3B – herein after referred to as 005OP3B) will not review any submittal that does not have this list.

D. Provide four copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C and D, at a minimum for compliance review as described herein where each responsible individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).

1.9 PROJECT RECORD DOCUMENTS (AS BUILTS)

A. Throughout progress of the work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.

B. The floor plans shall be marked in pen to include the following:

1. All device locations with labels.
2. Conduit locations.
3. Head-end equipment and specific location.
4. Wiring diagram.
5. Labeling and administration documentation.
6. Warranty certificate.
7. System test results.

1.10 WARRANTIES AND GUARANTY

A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of 1 year from the date of acceptance of the project by the VA. The Contractor shall agree to remedy covered defects within eight (8) hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.

B. Refer to Part 4 for applicable System Guarantee requirements.

1.11 USE OF THE SITE

A. Use of the site shall be at the GC’s direction.

B. Coordinate with the GC for lay-down areas for product storage and administration areas.

C. Coordinate work with the GC and their sub-contractors.

D. Access to buildings wherein the work is performed shall be directed by the GC.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.

B. Store products in original containers.

C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.

D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the VA.

1.13 PROJECT CLOSE-OUT

A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.

B. Before the project closeout date, the Contractor shall submit:

1. Warranty certificate.
2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
3. Project record documents.
4. Instruction manuals and software that is a part of the system.

C. Contractor shall submit written notice that:

1. Contract Documents have been reviewed.
2. Project has been inspected for compliance with contract.
3. Work has been completed in accordance with the contract

PART 2 – PRODUCTS AND FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.

C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

D. Weather-Resistant Equipment: Listed and labeled by an OSHA certified National Recognized Testing Laboratory (NRTL – i.e. UL) for duty outdoors or in damp locations.

2.2 SYSTEM DESCRIPTION

A. System hardware shall consist of a public address communications network comprised of amplifiers, mixers, speakers, volume controls, test sets, telephone private branch exchange (PBX) interface equipment, equipment cabinets/racks, wiring and other options such as, sub zoning in addition to “all call” functions, computer interfaces, and printer interfaces as shown on drawings. All necessary equipment required to meet the intent of these specifications, whether or not enumerated

within these specifications, shall be supplied and installed to provide a complete and operating nurse/patient communications network.

B. Systems firmware shall be the product of a reputable firmware OEM of record with a proven history of product reliability and sole control over all source code. Manufacturer shall provide, free of charge, product firmware/software upgrades for a period of two years from date of acceptance by VA for any product feature enhancements. System configuration programming changes shall not require any exchange of parts and shall be capable of being executed remotely via a modem connection (when specifically approved by 005OP3B).

C. The Public Address System (PAS) Head End Equipment shall be located in electrical room. The PAS shall cover the entire building. The PAS shall provide zoned, one-way voice paging through distributed, ceiling mounted loudspeakers. Voice input into the PAS shall be by zone using the telephone system. The Nurse Call/Code Blue System may interface the PAS system when specifically approved by VA Headquarters Spectrum Management 005OP3B during the project approval process prior to contract bidding.

D. The PAS System is defined as an Emergency Communications Systems by NFPA and VA elevates it to Life Safety Communications System when carrying Code Blue signal and so evaluated by JCAHCO. Therefore, the system shall have a minimum of 2 remote enunciation points in order to satisfy NFPA's Life Safety Code 101.

   1. These functions shall be the minimum required of the PAS system:
      a. The Microphone Control Console locations shall be fully manned as long as the Facility is in operation.
      b. One global (aka "all call") hard wired zone shall be provided that connects to every system speaker.
      c. The Hospice building has one hard-wired zone.
      d. The PAS shall have a minimum of 3, unused zones.
   2. The PAS shall allow voice pages to be made within a single zone, across programmed multiple zones or a global page (all zones) by using preset codes entered into the keypad of any telephone attached to the PBX.

E. The PAS shall interface with any existing paging system so that a global page (aka "all call" page) is communicated to the existing paging system and the new PAS of this project. Arrangements for

interconnection of the PAS and the telephone system(s) shall be coordinated with the VA and the PBX provider.

F. Each PAS system shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. light bulbs, wires, contact switch connections, master control stations, wall stations, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the nurse control station and all remote locations.

G. When the PAS system is approved to connect to a separate communications system (i.e. LAN, WAN, Telephone, Nurse Call, radio raging, wireless systems, etc) the connection point shall meet the following minimum requirements for each hard wired connection (note each wireless system connection must be approved prior to contract bid by VA Headquarters Spectrum Management 005OP3B and 005OP2B):

1. UL 60950-1/2.
2. FIPS 142.
3. FCC Part 15 Listed Radio Equipment is not allowed.

H. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. Unless otherwise noted in this Part, equipment quantities shall be as indicated on the drawings.

2.3 MANUFACTURERS

A. The products specified shall be new, UL Listed, and produced by OEM manufacturer of record.

B. The following equipment items are the salient requirements of VA to provide an acceptable system described herein.

2.4 TELEPHONE INTERFACE EQUIPMENT

A. Paging Adaptor:

1. The Contractor shall coordinate the installation of the paging adapter(s) designed for use with the Facility’s telephone system with the Facility Telephone Contractor or local telephone company.
2. The Contractor shall provide and install a paging adapter(s) for each zone and sub zone. The paging adapter(s) shall be accessible by

dialing a telephone number provided by the Facility's Telephone Contractor. The Paging Adapter shall:

a. Monitor each audio input and output on the unit.
b. Be provided with an electrical supervision panel to provide both audio and visual trouble alarms.
c. Be provided as part of the Head End equipment and shall be located in the Electrical Room.
d. Be provide with Executive Paging Override of all routine paging calls in progress or being accessed to allow system "all call" (aka global) calls designated as C**ODE ONE** Blue) functions.
e. Be capable of internal time out capability.
f. Function completely with the interface module.

B. Time Out Device:

1. A time out device/capability shall be provided to prevent system "hang-up" due to an off-hook telephone. The device shall be able to be preset from 30 seconds to 2 minutes. Its function shall not interfere with or override the required "all call" (aka global) operational capability.
2. Audio Monitor Panel:
   a. The panel shall be EIA/TIA standard for 483 mm (19") cabinet mounting.
   b. It shall be provided in the upper portion of the head-end equipment cabinet

C. Interface Module:

1. Universal telephone port interface with input for background music.
2. Gain control for telephone and background music inputs.
3. Emergency page override.

D. Microphone Paging Console:

1. A console shall be provided in the team station.
2. The console shall contain visual enunciators for each connection to the telephone system's Public Address Paging Adapter. The visual enunciators shall display all the system connections to the telephone system being used.
3. The console shall be fully independent of the facility's telephone system so if the telephone system has a catastrophic failure (aka partial, multiple or total system failure) the microphone console will function normally as if the facility's telephone system was

operating normally. The restoration of the facility’s telephone system shall not affect the PAS.

4. Each microphone console shall:
   a. Be Mounted: Flush unless otherwise indicated, and suitable for mounting conditions indicated.
   b. Have a Faceplate: Stainless steel or anodized aluminum with tamperproof mounting screws.
   c. Have a system interface Back Box: Two-gang galvanized steel with 2-1/2-inch minimum depth.
   d. Have an Internal Speaker: 3 inches, 2.3 oz. minimum; permanent magnet.
   e. Have Tone Annunciation: Recurring momentary tone indicates incoming calls.
   f. Have a Call Switch: Mount on faceplate. Permits calls to master station.
   g. Have a Privacy Switch: Mount on faceplate. When in on position, switch prevents transmission of sound from remote station to system; when in off position, without further switch manipulation, response can be made to incoming calls.
   h. Have a Handset with Hook Switch: Telephone type with 24-inch long, permanently coiled cord. Arrange to disconnect speaker when handset is lifted.
   i. Monitor each audio input and output on the unit.
   j. Be provided with an electrical supervision panel to provide both audio and visual trouble alarms to the Nurse Call /Code Blue electrical supervision system.
   k. Be capable of internal time out capability.
   l. Be completely compatible with the Telephone Interface unit(s).

E. Central Processor Module:
   1. Controls system operations and holds all programmed parameters.
   2. Data link connection to additional CPU modules.

F. Zone Module:
   1. Provides paging zone outputs at 70V.
   2. Background Music inhibit switch for each zone.

G. Power Module: Provides 12V DC @ 800mA to Central Processor Module.

H. Rack mounting: Provide rack mount kit.

2.5 HEAD-END EQUIPMENT

A. Provide all required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system listed in Paragraph 2.3. Head-end components may be rack mounted or wall mounted in a metal enclosure.

B. Provide the head end equipment in the electrical room where the PAS system is installed to include the minimum equipment listed in Paragraph 2.3.

C. Provide minimum of 15 minute battery back-up to system components.

D. Equipment Cabinet: Comply with TIA/EIA-310-D. Lockable, ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions

E. Vertical Equipment Rack, Wall Mounted (to be included inside of the Equipment Cabinet):

1. 74” (48RU) rack space. Welded Steel construction. Minimum 20” usable depth. Adjustable front mounting rails.
2. Install the following products in rack provided by same manufacturer or as specified:
   a. Security screws w/ nylon isolation bushings.
   b. Textured blank panels.
   c. Custom mounts for components without rack mount kits.
   d. Security covers.
   e. Copper Bus Bar.
   f. Power Sequencer- rack-mounted power conditioner and (provide as-needed) delayed sequencer(s) with two unswitched outlets each and contact closure control inputs.

2.6 AMPLIFIER EQUIPMENT

A. Paging:

1. Inputs for 600-ohm balanced telephone line, LO-Z balanced microphone, and background music.
2. Input Sensitivity: Compatible with master stations and central equipment so amplifier delivers full rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on master stations, speaker microphones, or handset transmitters
3. Automatic Level Control (ALC) for pages, adjustable background music muting level during, page, wall or rack mountable.

4. 16-ohm, 25V, 25V center tapped (CT), and 70V outputs. Amplifier quantity and size (output power) as needed. Continuous amplifier power rating shall exceed loudspeaker load on amplifier by at least 25 percent.
5. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus an allowance for future stations.
6. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to quantity of stations connected in all-call mode of operation.
7. Minimum Signal-to-Noise Ratio: 45 dB, at rated output.
8. Frequency Response: Within plus or minus 3 dB from 70 to 12,000 Hz.
9. Output Regulation: Maintains output level within 2 dB from full to no load.
10. Amplifier Protection: Prevents damage from shorted or open output.
11. Be provided with electronic supervision function(s).
12. Provide one spare amplifier.

B. Distributed:

1. Refer to the Head End Amplifier characteristics in paragraph 2.4.A. for each amplifier used in the distribution system.
2. Provide one spare amplifier in addition to the spare Head End amplifier.

2.7 SYSTEM SPEAKERS

A. Ceiling Cone-Type:

1. Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.
2. Frequency Response: Within plus or minus 3 dB from 70 to 15,000 Hz.
3. Minimum Dispersion Angle: 100 degrees.
4. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
5. Enclosures: Steel housings or back boxes, acoustically dampened, with front face of at least 0.0478-inch steel and whole assembly rust proofed and factory primed; complete with mounting assembly and suitable for surface ceiling, flush ceiling, pendant or wall mounting; with relief of back pressure.
6. Baffle: For flush speakers, minimum thickness of 0.032-inch aluminum with textured white finish. Completely fill the baffle with fiberglass.

7. Size: 8 inches with 1-inch voice coil and minimum 5-oz. ceramic magnet.
8. Have a minimum of 2 safety wires installed to a solid surface or use a flexible conduit from ceiling/wall back box to the speaker back box.
9. The speakers and mounting shall be self contained and wall mounted with flush back box at a minimum of 10 meter intervals and shall match (or contrast with, at the direction of the COTR) the color of the adjacent surfaces.
10. Provide one spare speaker, mount, and back box for each 50 speakers or portion thereof.

B. Wall Mounted Horn-Type:
1. Each horn speaker shall be provided with a means of adjusting the output level over the rated horn speaker range to an appropriate audio level in the area installed.
2. Provide horn speakers in equipment rooms, mechanical room, and at other areas as indicated on the drawings.
3. Speakers shall be all-metal, weatherproof construction; complete with universal mounting brackets.
4. Frequency Response: Within plus or minus 3 dB from 275 to 14,000 Hz.
5. Minimum Power Rating of Driver: 15 W, continuous.
6. Minimum Dispersion Angle: 110 degrees.
7. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
8. Provide one spare speaker, mount, and back box for each 20 speakers or portion thereof.

2.8 SYSTEM CABLES

A. Refer to OFM approved Construction Specification 27 10 00, STRUCTURED CABLING for specific installation and testing requirements.

B. Line Level Audio and Microphone Cable:
1. Line level audio and microphone cable for inside racks and conduit.
2. Shielded, twisted pair Minimum 22AWG, stranded conductors and 24AWG drain wire with overall jacket.

C. Speaker Level Audio Cable (70v):
1. For use with 70-volt speaker circuits.
2. 18AWG stranded pair, minimum.

D. Speaker Level Audio Cable, Plenum Rated (70v):
1. For use with 70-volt speaker circuits.

2. 18AWG stranded pair, minimum.

E. All cabling shall be plenum rated.

F. Provide 1 spare 1,000 foot roll of approved system (not microphone) cable only.

2.9 RACEWAYS

A. Intercommunication and Program System Raceways and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Each raceway that is open top, shall be: UL certified for telecommunications systems, partitioned with metal partitions in order to comply with NEC Parts 517 and 800 to “mechanically separate telecommunications systems of different service, protect the installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface “drop” type conduit cable feeds.

C. Intercommunication System cable infrastructure: EMT or in J-hooks above accessible ceilings, 24 inches on center.

D. Junction boxes shall be not less than 2-1/2 inches deep and 6 inches wide by 6 inches long.

E. Flexible metal conduit is prohibited unless specifically approved by 005OP3B.

2.10 CONDUIT SLEEVES

A. The Engineer has made a good effort to identify where conduit sleeves through full-height and fire rated walls on the drawings, and has instructed the electrician to provide the sleeves as shown on the drawings.

B. While the sleeves shown on the drawings will be provided by others, the contractor is responsible for installing conduit sleeves and fireproofing where necessary. It is often the case, that due to field conditions, the nurse-call cable may have to be installed through an alternate route. Any conduit sleeves required due to field conditions or those omitted by the engineer shall be provided by the cabling contractor.

2.11 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide a backup battery or a UPS for the system to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of 15 minutes.

B. The PA Contractor shall not make any attachments or connection to the telephone system until specifically directed to do so, in writing, by the COTR.

C. Provide UPS for all active system components including but not limited to:

1. System Amplifiers.
2. Microphone Consoles.
3. Telephone Interface Units.
4. PBX and Head End Equipment Rack(s).

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

A. Assign a single project manager to this project who will serve as the point of contact for the VA, the General Contractor, and the Engineer.

B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with the general contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.

C. Contact the Office of Telecommunications, Special Communications Team (005OP3B) at (301) 734-0350 to have a VA Certified Telecommunications COTR assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and OCIS Teams.

3.2 COORDINATION WITH OTHER TRADES

A. Coordinate with the cabling contractor the location of the faceplate and the faceplate opening for the MATV backbox.

B. Coordinate with the cabling contractor the location of MATV equipment in the Telecommunications Closets.

C. Before beginning work, verify the location, quantity, size and access for the following:

Isolated ground AC power circuits provided for systems.

Primary, emergency and extra auxiliary AC power generator requirements.

Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.

System components installed by others.

Overhead supports and rigging hardware installed by others.

D. Immediately notify the VA, General Contractor and Consultant in writing of any discrepancies.

3.3 INSTALLATION

A. General:

1. Execute work in accordance with National, State and local codes, regulations and ordinances.
2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the VA.
3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc:
   a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
   b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
   c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
   d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
5. Locate overhead ceiling-mounted loudspeakers as shown on drawings, with minor changes not to exceed 12" in any direction:
   a. Mount transformers securely to speaker brackets or enclosures using screws. Adjust torsion springs as needed to securely support speaker assembly.
   b. Speaker back boxes shall be completely filled with fiberglass insulation.
   c. Seal cone speakers to their enclosures to prevent air passing from one side of the speaker to the other.
6. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, VA and 005OP3B.
7. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors,

provide grommeted holes in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.

B. Equipment Racks:

1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
2. Provide security covers for all devices not requiring routine operator control.
3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer’s recommendations regarding ventilation space between amplifiers.
4. Provide insulated connections of the electrical raceway to equipment racks.
5. Provide continuous raceway/conduit with no more than 40 percent fill between wire troughs and equipment racks for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.

C. Wiring Practice: In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:

1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Wiring shall be classified according to the following low voltage signal types:
   a. Balanced microphone level audio (below -20dBm) or Balanced line level audio (-20dBm to +30dBm)
   b. 70V loudspeaker level audio.
   c. Low voltage DC control or power (less than 48VDC)
4. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share the same enclosure shall be mechanically partitioned and separated by at least four inches.

Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.

5. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
7. Replace the entire length of the run of any wire or cable that is damaged or abraided during installation. There are no acceptable methods of repairing damaged or abraided wiring.
8. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
9. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
10. Do not use tape-based or glue-based cable anchors.
11. Ground shields and drain wires as indicated by the drawings.
12. Field wiring entering equipment racks shall be terminated as follows:
    a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
    b. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see “Products”). Provide 15percent spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
    c. If specified terminal blocks are not designed for rack mounting, utilize 3/4” plywood or 1/8” thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
    d. Employ permanent strain relief for any cable with an outside diameter of 1” or greater.
13. Use only balanced audio circuits unless noted otherwise
14. Make all connections as follows:
    a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
    b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.

c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.

d. Wire nuts, electrical tape or “Scotch Lock” connections are not acceptable for any application.

D. Cable Installation: In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:

1. Support cable on maximum 4’-0” centers. Acceptable means of cable support are cable tray, j-hooks, and bridal rings. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
2. Run cables parallel to walls.
3. Install maximum of 10 cables in a single row of J-hooks. Provide necessary rows of J-hooks as required by the number of cables.
4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2’-0” clearance from all shielded electrical apparatus.
5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the VA.
6. Ends of cables shall be properly terminated on both ends per industry and OEM’s recommendations.
7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until you are ready to terminate.
8. Cover the end of the overall jacket with a 1” (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2” (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2” (minimum) past the Heat-shrink and serve as indicated below.

9. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing ¼” past the end of unused wires, fold back over jacket and secure with cable tie.
10. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
11. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
12. 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.
13. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
14. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
15. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
16. Separation of Wires: (REFER TO RACEWAY INSTALLATION) 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 apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
17. Serve all cables as follows:
    a. Cover the end of the overall jacket with a 1” (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2” (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield and drain wires 2” (minimum) past the Heat-shrink and serve as indicated below.
    b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing ¼” past the end of unused wires, fold back over jacket and secure with cable tie.
    c. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.

E. Labeling:

1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
2. Engrave and paint fill all receptacle panels using 1/8” (minimum) high lettering and contrasting paint.
3. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8” (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
4. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
5. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
6. Contractor’s name shall appear no more than once on each continuous set of racks. The Contractor’s name shall not appear on wall plates or portable equipment.
7. Ensure each OEM supplied equipment has appropriate UL Labels/Marks for the service the equipment is performed permanently attached/marked. Equipment installed not bearing these UL marks will not be allowed to be part of the system. The Contractor shall bear all costs required to provide replacement equipment with approved UL marks.

3.4 PROTECTION OF NETWORK DEVICES

Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved electrostatic discharge (ESD) wrist straps tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician come in contact with high voltage.

3.5 CLEANING AND PATCHING

A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.
B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.

C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the work or to make its parts fit together properly.

D. The Contractor shall not damage or endanger a portion of the work or fully or partially completed construction of the VA or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the VA or a separate contractor except with written consent of the VA and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the VA or a separate Contractor, the Contractor's consent to cutting or otherwise altering the work.

E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

3.6 FIREPROOFING

A. Where cables penetrate fire rated walls, floors and ceilings, fireproof the opening.

B. Provide conduit sleeves (if not already provided by Electrical Contractor) for cables that penetrate fire rated walls. After the cabling installation is complete, install fire proofing material in and around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.

C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.

3.7 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, commonmode 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 26, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

D. Do not use "3rd or 4th" wire internal electrical system conductors for ground.

E. Do not connect system ground to the building's external lightning protection system.

F. Do not "mix grounds" of different systems.

PART 4 - TESTING/GUARANTY/TRAINING

4.1 SYSTEM CLASSIFICATION

The PAS System is NFPA listed as an "Emergency and Public Safety" Communications system. Where Code Blue signals are transmitted, that listing is elevated to "Life Support." Therefore, the following testing and guaranty provisions are the minimum to be performed and provided by the contractor and OEM.

4.2 PROOF OF PERFORMANCE TESTING

A. Intermediate Testing:

1. After completion of 25 – 30 percent the installation of a head end cabinet(s) and equipment, one microphone console, local and remote enunciation stations, 2 zones, 2 sub zones prior to any further work, this portion of the system must be pre-tested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed, NFPA, Life Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.
2. The inspection and test will be conducted by a factory-certified representative and witnessed by a VA Representative. The results of the inspection will be officially recorded by the VA Representative and maintained on file by the COTR, until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75 percent of the system construction phase, at the direction of the COTR.

B. Pretesting:

1. Upon completing installation of the PAS System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
2. Pretesting Procedure:
   a. During the system pretest the Contractor shall verify (utilizing approved test equipment) that the system is fully operational and meets all the system performance requirements of this standard.

b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc., are present. At a minimum, each of the following locations shall be fully pre-tested:

1) Central Control Cabinets.
2) PA Control Stations.
3) Zone Equipment/Systems.
4) Sub-Zone Equipment/Systems.
5) Local and Remote Enunciation Panels.
6) All Networked locations.
7) System interface locations (i.e. TELCO, two way radio, etc.).
8) System trouble reporting.
9) System Electrical Supervision.
10) UPS operation.

3. The Contractor shall provide four copies of the recorded system pretest measurements and the written certification that the system is ready for the formal acceptance test shall be submitted to the COTR.

C. Acceptance Test:

1. After the system has been pre-tested and the Contractor has submitted the pretest results and certification to the COTR, then the Contractor shall schedule an acceptance test date and give the COTR 30 days written notice prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a VA Representative and an OEM certified representative. The system shall be tested utilizing the approved test equipment to certify proof of performance and Emergency and Public Safety compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed system does comply with all requirements of this specification under operating conditions. The system shall be rated as either acceptable or unacceptable at the conclusion of the test.

Failure of any part of the system that precludes completion of system testing, and which cannot be repaired in 4 hours, shall be cause for terminating the acceptance test of the system. Repeated failures that result in a cumulative time of 8 hours to affect repairs shall cause the entire system to be declared unacceptable. Retesting of the entire system shall be rescheduled at the convenience of the VA.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:
   a. The VACO VA Representative will tour all major areas where the system is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
   b. The system diagrams, record drawings, equipment manuals, Telecommunications Infrastructure Plant (TIP) Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
   c. Failure of the system to meet the installation requirements of this specification shall be grounds for terminating all testing.
2. Operational Test:
   a. After the Physical and Mechanical Inspection, the central terminating and nurse call master control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be utilized to accomplish this requirement.
   b. Following the central equipment test, a pillow speaker (or on board speaker) shall be connected to the central terminating and nurse call master control equipment’s output tap to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.
   c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last intersectional, room, and bed dome light in each leg to verify that the nurse call distribution system meets all system performance standards.

d. Additionally, each installed head end equipment, microphone console, amplifier, mixer, distributed speaker/amplifier, monitor speaker, telephone interface, power supply and remote amplifiers shall be checked insuring they meet the requirements of this specification.

e. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system. The typical functions are: “all call,” three sub-zoned, minimum of 10 minutes of UPS operation, electrical supervision, trouble panel, corridor speakers and audio paging.

f. Individual Item Test: The VA Representative will select individual items of equipment for detailed proof of performance testing until 100 percent of the system has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.

3. Test Conclusion:

a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the COTR. Any retesting to comply with these specifications will be done at the Contractor's expense.

b. If the system is declared unacceptable without conditions, all rescheduled testing expenses will be born by the Contractor.

E. Acceptable Test Equipment

1. The test equipment shall furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:

a. Spectrum Analyzer.

b. Signal Level Meter.

c. Volt-Ohm Meter.

d. Sound Pressure Level (SPL) Meter.

e. Oscilloscope.

f. Random Noise Generator.

g. Audio Amplifier with External Speaker.

4.3 SYSTEM GUARANTEE PERIOD OF SERVICE

A. Contractor’s Responsibility:

1. The Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the system by the VA. The Contractor shall provide OEM’s equipment warranty documents, to the COTR (or Facility Contracting Officer if the Facility has taken procession of the building), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.
3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide 2 copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the two year guarantee period:
   a. Response Time during the Two Year Guarantee Period:
      1) The COTR (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor’s only official reporting and contact official for MATV system trouble calls, during the guarantee period.
      2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the COTR (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
      3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
         a) A routine trouble call within 1 working day of its report. A routine trouble is considered a trouble which causes a pillow speaker or cordset, 1 master IC control station, room station or emergency station to be inoperable.
         b) Routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units,

etc.) shall also be deemed as an emergency trouble call. The COTR (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.

c) An emergency trouble call within 4 hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, or all call system to be inoperable at anytime.

4) If a PAS component failure cannot be corrected within four hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate nurse call equipment. The alternate equipment/system shall be operational within a maximum of 20 hours after the four hour trouble shooting time and restore the effected location operation to meet the system performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the system or sub-system to full operational capability, as described herein, until repairs are complete.

b. Required On-Site Visits during the Two Year Guaranty Period

1) The Contractor shall visit, on-site, as necessary, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the system according the descriptions identified in this document.

2) The Contractor shall arrange all Facility visits with the COTR (or Facility Contracting Officer) prior to performing the required maintenance visits.

3) Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the COTR (or Facility Contracting Officer) and Contractor.

4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the COTR (or Facility Contracting Officer).

5) The Contractor shall provide the COTR (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit

or official reported trouble call. The Contractor shall provide the COTR with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:

a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to COTR (or Facility Contracting Officer) by the fifth (5th) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.

b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the system. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

6) The COTR (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, 2 copies of actual reports for evaluation.

a) The COTR (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the system's official acquisition documents.

b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the system's official technical record documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or VA tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the COTR or Facility Contracting Officer in writing upon the discovery of these incidents. The COTR or Facility Contracting Officer will investigate all reported incidents and render

4.4 TRAINING

A. Provide thorough training of the VA's engineering and maintenance staff.

B. Provide the following minimum training times and durations:

1. 24 hours prior to opening
2. 24 hours during the opening week
3. 24 hours for supervisors and system administrators

- - - E N D - - -

SECTION 27 51 23

INTERCOM SYSTEM

PART 1 - GENERAL

1.1 SECTION SUMMARY

A. Work covered by this document includes design, engineering, labor, material, products, guaranty, training and services for, and incidental to, the complete installation of a new and fully operating Intercom System (IC).

B. Work shall be complete, tested, labeled, certified and ready for operation

1.2 RELATED SECTIONS

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below)

C. Section 26 41 00, FACILITY LIGHTNING PROTECTION

D. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNCATIONS SYSTEMS

E. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS

1.3 DEFINITIONS

A. Provide: Design, engineer, furnish, install, connect complete, test, certify and guarantee.

B. Work: Materials furnished and completely installed.

C. Review of contract drawings: A service by the engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.

D. Headquarters Technical Review, for National/VA communications and security, codes, frequency licensing, standards, guidelines compliance:

Office of Telecommunications
Special Communications Team (005OP2B)
1335 East West Highway - 3rd Floor
Silver Spring, Maryland 20910
(O) 301-734-0350, (F) 301-734-0360

E. Engineer: //XXXXXXX//
//XXXXXXX//
//XXXXXXX//
//XXXXXXX//

//XXXXXXX//

F. VA: //XXXXXXX//

G. General Contractor (GC): //XXXXXXX//

H. Contractor: Radio Contractor; you; successful bidder.

1.4 REFERENCES

A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:

1. United States Federal Law and Codes:

a. Departments of:

1) CFR, Title 15 – Department of Commerce, Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the:

a) Chapter II, National Institute of Standards Technology (NIST – formerly the National Bureau of Standards). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (Public Law 107-347), NIST develops – Federal Information Processing Standards Publication (FIPS) 140-2— Security Requirements for Cryptographic Modules.

b) Chapter XXIII, National Telecommunications and Information Administration (NTIA – aka 'Red Book') Chapter 7.8/9 Federal communications Commission (FCC) Title 47 (CFR), Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions and Locations.

2) CFR, Title 29, Department of Labor, Chapter XVII - Occupational Safety and Health Administration (OSHA), Part 1910 – Occupational Safety and Health Standard:

a) Subpart 7 - Definition and requirements for a National Recognized Testing Laboratory (NRTL – 15 Laboratory's, for complete list, contact http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)

(1) Underwriter's Laboratories (UL):

65	Standard for Wired Cabinets.
468	Standard for Grounding and Bonding Equipment.
1449	Standard for Transient Voltage Surge Suppressors.

1069	Hospital Signaling and Nurse Call Equipment.
60950-1/2	Information Technology Equipment – Safety.

(2) Canadian Standards Association (CSA): same tests as for UL.

(3) Communications Certifications Laboratory (CCL): same tests as for UL.

(4) Intertek Testing Services NA, Inc. (ITSNA formerly Edison Testing Laboratory [ETL]): same tests as for UL.

b) Subpart 35, Compliance with NFPA 101 – Life Safety Code.

c) Subpart 36, Design and construction requirements for exit routes.

d) Subpart 268, Telecommunications.

e) Subpart 305, Wiring methods, components, and equipment for general use.

3) Title 42, CFC, Department of Health, Chapter IV Health and Human Services, Subpart 1395(a)(b) Joint Commission on Accreditation of Healthcare Organizations (JCAHO) "a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:" All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.

4) All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.

5) CFR, Title 47, Telecommunications, FCC: Part 15 – Restrictions of use for Part 15 listed Radio Equipment in Safety of Life/Emergency Functions/Equipment/Locations (also see CFR, Title 15, Department of Commerce, Chapter XXIII – NTIA).

6) Public Law No. 100-527, Department of Veterans Affairs:

a) Office of Telecommunications:

(1) Handbook 6100, Telecommunications.

b) Office of Cyber and Information Security (OCIS):

(1) Handbook 6500, Information Security Program.

(2) Wireless and Handheld Device Security Guideline Version 3.2, August 15, 2005.

c) Spectrum Management FCC and NTIA Radio Frequency Compliance and Licensing Program.

2. National Codes:

a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.

b. American National Standards Institute and Electronic Industries Association/Telecommunications Industry Association (ANSI/EIA/TIA):

568-B	Commercial Building Telecommunications Wiring Standards:
569	Commercial Building Standard for Telecommunications Pathways and Spaces.
606	Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
REC 127-49	Power Supplies.
RS 27	Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.

c. Institute of Electrical and Electronics Engineers (IEEE):

SO/TR 21730:2007	Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices.
0739-5175/08/$25.00©2008IEEE	Medical Grade – Mission Critical – Wireless Networks.
C62.41	Surge Voltages in Low-Voltage AC Power Circuits.

d. NFPA:

70	National Electrical Code (current date of issue) – Articles 517, 645 and 800.
75	Standard for Protection of Electronic Computer Data- Processing Equipment.
77	Recommended Practice on Static Electricity.
99	Healthcare Facilities.
101	Life Safety Code.

3. State Hospital Code(s).
4. Local Codes.

1.5 QUALIFICATIONS

A. The OEM shall have had experience with three or more installations of Intercom System of comparable size and complexity with regards to type and design as specified herein. Each of these installations shall have performed satisfactorily for at least 1 year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.

B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of 3 years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the system. This documentation, along with the system Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.

C. The Contractor's Communications Technicians assigned to the system shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the system. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the COTR before being allowed to commence work on the system.

D. Applicable national, state and local licenses.

E. Certificate of successful completion of OEM's installation and training school for installing technicians of the equipment being proposed.

1.6 CODES AND PERMITS

A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by the VA.

B. The Contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.

1.7 SCHEDULING

A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using "Microsoft Project" software or equivalent. The Contractor Project Schedule (CPS) shall indicate

detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.

B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The VA will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

1.8 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS

A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.

B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.

C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (005OP3B – herein after referred to as 005OP3B) will not review any submittal that does not have this list.

D. Provide four copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C and D, at a minimum for compliance review as described herein where each responsible individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).

1.9 PROJECT RECORD DOCUMENTS (AS BUILTS)

A. Throughout progress of the work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.

B. The floor plans shall be marked in pen to include the following:

1. All device locations with labels.
2. Conduit locations.
3. Head-end equipment and specific location.
4. Wiring diagram.

5. Labeling and administration documentation.
6. Warranty certificate.
7. System test results.

1.10 WARRANTIES AND GUARANTY

A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of 1 year from the date of acceptance of the project by the VA. The Contractor shall agree to remedy covered defects within 8 hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.

B. Refer to Part 4 for applicable System Guarantee requirements.

1.11 USE OF THE SITE

A. Use of the site shall be at the GC's direction.

B. Coordinate with the GC for lay-down areas for product storage and administration areas.

C. Coordinate work with the GC and their sub-contractors.

D. Access to buildings wherein the work is performed shall be directed by the GC.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.

B. Store products in original containers.

C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.

D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the VA.

1.13 PROJECT CLOSE-OUT

A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.

B. Before the project closeout date, the Contractor shall submit:
1. Warranty certificate.
2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
3. Project record documents.
4. Instruction manuals and software that is a part of the system.

C. Contractor shall submit written notice that:
   1. Contract Documents have been reviewed.
   2. Project has been inspected for compliance with contract.
   3. Work has been completed in accordance with the contract

PART 2 – PRODUCTS AND FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.

C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

D. Weather-Resistant Equipment: Listed and labeled by an OSHA certified National Recognized Testing Laboratory (NRTL – i.e. UL) for duty outdoors or in damp locations.

2.2 SYSTEM DESCRIPTION

A. The intercom system shall allow voice/video communication between wall-mounted intercom stations and desktop (or wall-mounted) master stations.

B. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse and patient communications network.

C. Systems firmware shall be the product of a reputable firmware OEM of record with a proven history of product reliability and sole control over all source code. Manufacturer shall provide, free of charge, product firmware and software upgrades for a period of twos year from date of acceptance by VA for any product feature enhancements. System configuration programming changes shall not require any exchange of parts and shall be capable of being executed remotely via a modem connection (when specifically approved by 005OP3B).

D. The Intercom System (IC) equipment shall be located in electrical room. The IC shall provide zoned, one-way voice paging through distributed, wall-mounted units. Voice input into the IC shall be by zone from the main console at the team station.

E. When the IC system is approved to connect to a separate communications system (i.e. LAN, WAN, Telephone, Nurse Call, wireless systems, etc) the connection point shall meet the following minimum requirements for each hard wired connection (note each wireless system connection MUST BE APPROVED PRIOR TO CONTRACT BID BY VA HEADQUARTERS 005OP3B AND 005OP2B):
   1. UL 60950-1/2.
   2. FIPS 142.
   3. FCC Part 15 Listed Radio Equipment is not allowed.
F. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. Unless otherwise noted in this Part, equipment quantities shall be as indicated on the drawings.

2.3 MANUFACTURERS

A. The products specified shall be new, UL Listed, and produced by OEM manufacturer of record.
B. The following equipment items are the salient requirements of VA to provide an acceptable system described herein.

2.4 FUNCTIONAL DESCRIPTION OF SYSTEMS

A. Components:
   1. Door stations.
   2. Master Stations.
   3. Central Exchange Units (CEU).
   4. Power supply.
B. Capacities:
   1. Door Stations: Maximum 12.
   2. Master Stations:
      a. Maximum 4 stations with CEU.
   3. Power Supply:
      a. 24 V DC, 2 A.
      b. For Audio: 1.
      c. For Video: 2.
   4. Number of Talk Paths: 2.
   5. Number of Video Paths: 2.
   6. All Call: 1, to master stations only.
   7. Video Monitor: 2, same as talk paths and video paths.
   8. Scan Monitor: 1.
C. Calling Master Station from Door Station and Communicating:

1. Priority Levels for Calls from Door Stations:
   a. Normal.
   b. Priority.
2. Press door station CALL button.
3. Calling tone rings on master station (for normal call, intermittent tremolo sound; for priority call, rapid intermittent tremolo sound) and selector button LED for individual door station flashes (double-flash for priority call). If door station has camera, video from door station shall be displayed on master station monitor. Call tone continues to ring until answered or is timed out (based on setting). You can stop calling tone by pressing OFF button.
4. If you press individual door station selector button, LED stops flashing and stays lit and you can talk hands-free to that station. If only TALK button is pressed to answer call, hands-free communication initiates with door station at highest priority call. Talk LED lights when you talk and goes off as you listen to caller.
5. Press OFF button again to end communication. Call also ends automatically when set talk limit is reached.
6. If you hold down TALK button for a minimum of 1 second, communication switches to press-to-talk mode. Hold down TALK button to talk and release to listen to caller. You cannot switch back from press-to-talk communication to hands-free communication.
7. If other master station presses selector button of in-use door station or in-use master station, busy signal is heard at master station.
8. Microphone is muted while you hold down privacy button on master station while in communication.
9. You can connect footswitch and use it the same manner as TALK button.
10. Master station can display calls up to 8 stations at the same time. If there are more than 8 incoming calls, they will be displayed in order of priority and time of call.
11. You can adjust calling tone, transmit volume, and receive volume with volume controls at bottom of master station.
12. You can use a headset (not included in system) instead of built-in master station’s speaker and microphone.

D. Calling Master Station from Another Master Station and Communicating:
   1. Press individual selector button of master station.

2. Pre-tone sounds both master stations and starts hands-free communication. Talk LED lights when you talk and goes off as you listen to caller.
3. Press OFF button to end communication. You can end call from either master station. Call also ends automatically when set communication end time is reached.
4. If called master station has privacy mode set (privacy settings button is lit), communication is only 1-way, from calling master station to called master station, and nothing can be heard from called master side. Press TALK button on called master station for a minimum of 1 second. Press-to-talk communication starts. Hold down TALK button to talk and release to listen to caller.
5. You cannot call master station while it is communicating. You will hear a busy signal.

E. Privacy (PRIV) Function:

1. To make master into privacy mode (prevent monitoring from other stations), press privacy button (LED lights up).
2. To cancel privacy mode, press privacy button again (LED goes out).
3. Privacy setting cannot be changed while in communication.

F. CO Line Call from Door Station and Communication:

1. If CALL button is pressed at door station while CO Transfer feature is set (with CO Transfer button lit), call tone rings on master station (for normal call, intermittent tremolo sound; for priority call, rapid intermittent tremolo sound) and selector button LED for individual door station flashes (double-flash for priority call). At same time, telephone call is placed to programmed CO line number.
2. You can communicate with door station from telephone.
3. You can end communication at telephone. Communication also ends automatically when set talk time limit is reached. About 10 seconds before end of call, you will hear alarm sound on telephone.
4. Maximum duration for CO line call is 300 seconds, even if call timer is set to “Infinite”.
5. Using this function requires Viking Electronics, Inc. “K-1900-5 Hot-Line Pulse Dialer”.
6. If there are multiple calls, call from door station with highest call priority is transferred.
7. Answering at any master station during CO transfer feature will stop CO transfer.

8. There are no functions, such as for door release and dial-in, from telephone.

G. All Call (Normal Master Station Paging):

1. When you press ALL CALL button on master station, all individual master station selector button LEDs flash slowly. You can clear undesired master station from All Call by pressing individual master station selector button with flashing LED, which will turn off LED. Pressing that button again makes that master station part of All Call again and makes LED flash.
2. If you press TALK button, send LED lights up and all individual master station selector buttons stop flashing and stay lit. Pre-tone sounds on target master stations and they can be talked to. At this time, you cannot hear audio from other master stations.
3. Press OFF button to end. You can end call for individual master station by pressing its OFF button.
4. All Call announcements do not go to master stations that are in use.
5. During All Call, if you press individual master station selector button on calling master station or press individual master station selector button or TALK button on 1 of the other master stations, communications switch to hands-free between master stations.
6. There is no function for hands-free reply from called master station during All Call mode.
7. If you press down ALL CALL button but do not start talking within 30 seconds, system goes back to standby mode. You can also return to standby by pressing OFF button.

H. All Call (Priority Master Station Paging):

1. When you press ALL CALL button on master station, all individual master station selector button LEDs flash slowly.
2. If you press ALL CALL button again, flash rate increases. You can clear undesired master station from All Call by pressing individual master station selector button with flashing LED, which will turn off LED. Pressing that button again makes that master station part of All Call again and makes LED flash.
3. If you press TALK button, TALK LED lights up and all individual master station selector buttons stop flashing and stay lit. Pre-tone sounds on all master stations and all can be called. At this time, you cannot hear audio from other master stations.

4. Press OFF button to end. You can end call for individual master station by pressing its OFF button.
5. Communication of master station being used is cancelled and All Call takes priority. Before communication of master station being used is cancelled, you hear cancel warning sound.
6. During All Call, if you press an individual master station selector button on calling master station or press individual master station selector button or TALK button on one of the other master stations, communications switch to hands-free between those two master stations.
7. There is no function for talk back from master station receiving an All Call announcement.
8. If you press down ALL CALL button but do not start talking within 30 seconds, system goes back to standby mode. You can also return to standby by pressing OFF button.

I. Monitor:

1. If you press individual door station selector button, you can hear audio and if that door station has a camera, you can see image.
2. Press OFF button to end. Call also ends automatically when set communication end time is reached.
3. While door station is communicating with or monitored by a master station, you cannot monitor that door station from another master station.
4. If you press TALK button while monitoring, hands-free communication mode starts with that door station.

J. Scan Monitor:

1. When scan monitor button is pressed, door stations that have been enabled for “Scan Monitor” in programming can be monitored sequentially for a specified time interval (configured in programming).
2. Monitoring always initiates from target door station with lowest number.
3. If you press scan monitor button while individually monitoring target door station, monitoring starts with the next door station in line.
4. If you press scan monitor button while monitoring non-target door station, monitoring starts with the first door station enabled for scan monitoring.

5. Press OFF button to end.
6. Communication/video channel 2 is always used for scan monitoring. During scan monitoring, video signal is always outputted from video output port 2 (V2). Scan monitoring is not possible when communication/video channel 2 is being used, even if busy LED is not illuminated.
7. Only one master station at a time can perform scan monitoring.
8. If you press TALK button during scan monitoring, hands-free communication mode starts with that door station.
9. If you press individual door station selector button or scan monitor button during scan monitoring, monitoring switches to monitoring individual door station.
10. If master station receives call from door station during scan monitoring, scan monitor function ends automatically and shall be restarted manually.
11. Scan monitoring continues without limit until it is cancelled, but master station LCD monitor goes out after 10 minutes. Outside video output continues even with LCD off. If you press scan monitor button with LCD off, LCD lights up again.
12. If you press TALK button during scan monitoring, communication mode starts with door station being monitored.

K. Activating Door Release:

1. Press door release button during communication or monitoring with door station.
2. Door release function will be activated, releasing door lock.
3. You cannot operate door from outside telephone.
4. LED stays lit while door release function is activated.
5. Door release contacts can be set to Normally Open or Normally Closed via program configuration.
6. Coordinate with door access control system for door release.

L. Priority:

1. Calls have priority based on the time the call was initiated. (Earlier call has priority over later call).
2. Communication Priority, from Highest to Lowest:
   a. Door station, telephone line communication.
   b. Priority All Call.
   c. Door station to master station communication.
   d. Master station to master station communication.

e. Normal All Call.

f. Monitor.

g. Scan monitor.

2.5 EQUIPMENT

A. Central Exchange Unit:

a. Connect: Maximum of 4 master stations and 8 door stations.

b. Current Consumption:

1) Video: 620 mA maximum.

2) Audio: 650 mA maximum.

c. Video Output:

1) NTSC standard 1 Vpp (0.7 to 1.4 Vpp).

2) Two BNC.

d. Video Output Trigger:

1) Open collector output.

2) 24 V DC, 30 mA.

3) Two RJ-45.

B. Master Stations:

1. Master Stations: [Audio/Color Video]

a. CAT-5e homerun wired to CEU.

b. Buttons:

1) 8 individual door station selector buttons with LED.

2) 8 individual master station selector buttons with LED.

3) Door release button with LED.

4) Scan monitor button with LED.

5) CO line transfer button with LED.

6) Privacy button with LED.

7) Oversized TALK button with LED to activate VOX or PTT style communication.

8) ALL CALL button.

9) OFF button.

c. Occupied LED.

d. Speaker.

e. Microphone.

f. Volume Controls:

1) Receive Switch: Low, medium, high.

2) Transmit Switch: Low, medium, high.

3) Call tone.

g. LCD brightness control.

h. Jacks:

1) Headset receiver.

2) Headset microphone.

i. Headset Volume Controls:

1) Receiver.

2) Microphone.

j. Directory Cards and Covers:

1) Master station.

2) Door station.

k. Reset switch.

l. RJ-45 jack for connection to CEU.

m. Connector for add-on selector on master station.

n. Door call-in indicator.

o. Hands-free or push-to-talk communication.

p. All Call to master stations.

q. Scan monitoring.

r. Selective door release.

s. Privacy and mute functions.

t. Wall or desk mount. Metal bracket included for wall mounting.

u. Multi-Pin Connector:

1) Video output from master station.

2) External signaling of call tones (through IER-2 or activation of TAR-3).

3) Footswitch activation for TALK function.

v. Operating Temperature: 32 degrees F to 104 degrees F (0 degrees C to 40 degrees C).

w. Monitor: 3.5-inch color LCD, master station.

x. Outside Video Output: NTSC standard 1 Vpp (0.7 to 1.4 Vpp.

C Door Stations:

1. Fixed Color Video Door Station.

a. Faceplate: Aluminum die cast.

b. Surface mount.

c. Call Button: Metal.

d. Camera.

e. Camera Protection: Clear Lexan lens cover.

f. RJ-45 jack.

g. Speaker.

h. Microphone.

i. Directory card.

j. White Illumination LEDs: Automatically turn on in low-light conditions.

k. CAT-5e homerun wired to CEU.

l. Operating Temperature: 14 degrees F to 140 degrees F (minus 10 degrees C to 60 degrees C).

m. Vandal resistant.

2.6 SYSTEM CABLES

A. Refer to OFM approved Master Construction Specification, SECTION 27 10 00, STRUCTURED CABLING for specific installation and testing requirements.

B. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper. Sizes as recommended by system manufacturer, but no smaller than No. 22 AWG.

C. Insulation: Thermoplastic, not less than 1/32 inch thick.

D. Shielding: For speaker-microphone leads and elsewhere where recommended by manufacturer; No. 34 AWG, tinned, soft-copper strands formed into a braid or equivalent foil.

E. Minimum Shielding Coverage on Conductors: 60 percent.

F. All cabling shall be plenum rated.

G. Provide one spare 1,000 foot roll of approved system (not microphone) cable only.

2.7 RACEWAYS

A. Intercom Program System Raceways and Boxes: Comply with requirements in Division 26, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

B. Each raceway that is open top, shall be: UL certified for telecommunications systems, partitioned with metal partitions in order to comply with NEC Parts 517 and 800 to “mechanically separate telecommunications systems of different service, protect the installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface “drop” type conduit cable feeds.

C. Intercom System Cable Infrastructure: EMT or in J-hooks above accessible ceilings, 24 inches on center.

D. Junction boxes shall be not less than 2-1/2 inches deep and 6 inches wide by 6 inches long.

E. Flexible metal conduit is prohibited unless specifically approved by 005OP3B.

F. Install manufactured conduit sweeps and long-radius elbows whenever possible

2.8 SYSTEM CONDUIT

A. The entire system to be installed in a separate conduit system.

B. The use of centralized mechanically partitioned wireways may be used to augment main distribution conduit on a case by case basis when specifically approved by VA Headquarters (005OP3B).

2.9 CONDUIT SLEEVES

A. The Engineer has made a good effort to identify where conduit sleeves through full-height and fire rated walls on the drawings, and has instructed the electrician to provide the sleeves as shown on the drawings.

B. While the sleeves shown on the drawings will be provided by others, the contractor is responsible for installing conduit sleeves and fire-proofing where necessary. It is often the case, that due to field conditions, the nurse-call cable may have to be installed through an alternate route. Any conduit sleeves required due to field conditions or those omitted by the engineer shall be provided by the cabling contractor.

2.10 DEVICE BACKBOXES

A. Furnish to the electrical contractor all backboxes required for the PAS devices.

B. The electrical contractor shall install the backboxes as well as the system conduit. Coordinate the delivery of the backboxes with the construction schedule.

2.11 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide a backup battery or a UPS for the system to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of 15 minutes.

B. Provide UPS for all active system components.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

A. Assign a single project manager to this project who will serve as the point of contact for the VA, the General Contractor, and the Engineer.

B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with the general contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.

C. Contact the Office of Telecommunications, Special Communications Team (005OP3B) at (301) 734-0350 to have a VA Certified Telecommunications COTR assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and OCIS Teams.

3.2 COORDINATION WITH OTHER TRADES

A. Coordinate with the cabling contractor the location of intercom equipment in the Electrical Room.

B. Before beginning work, verify the location, quantity, size and access for the following:

1. Isolated ground AC power circuits provided for systems.
2. Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
3. System components installed by others.
4. Overhead supports and rigging hardware installed by others.

C. Immediately notify the VA, General Contractor and Consultant in writing of any discrepancies.

3.3 INSTALLATION

A. General:

1. Execute work in accordance with National, State and local codes, regulations and ordinances.
2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the VA.
3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc.:
   a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.

b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.

5. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, VA and 005OP3B.
6. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommeted holes in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.

B. Wiring Practice: In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:

1. Comply with requirements for raceways and boxes specified in Division 26, Section 27 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share the same enclosure shall be mechanically partitioned and separated by at least 4 inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
4. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
5. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.

6. Replace the entire length of the run of any wire or cable that is damaged or abraided during installation. There are no acceptable methods of repairing damaged or abraided wiring.
7. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
8. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
9. Do not use tape-based or glue-based cable anchors.
10. Ground shields and drain wires as indicated by the drawings.
11. Field wiring entering equipment racks shall be terminated as follows:
    a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
    b. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see “Products.”) Provide 15 percent spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
    c. If specified terminal blocks are not designed for rack mounting, utilize 3/4 inch plywood or 1/8 inch thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
    d. Employ permanent strain relief for any cable with an outside diameter of 1 inch or greater.
12. Use only balanced audio circuits unless noted otherwise
13. Make all connections as follows:
    a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
    b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
    c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
    d. Wire nuts, electrical tape or “Scotch Lock” connections are not acceptable for any application.

C. Cable Installation - In addition to the mandatory infrastructure requirements outlined in VA Master Construction Specification, Section

27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:

1. Support cable on maximum 4’-0” centers. Acceptable means of cable support are cable tray, j-hooks, and bridal rings. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
2. Run cables parallel to walls.
3. Install maximum of 10 cables in a single row of J-hooks. Provide necessary rows of J-hooks as required by the number of cables.
4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2’-0” clearance from all shielded electrical apparatus.
5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the VA.
6. Ends of cables shall be properly terminated on both ends per industry and OEM’s recommendations.
7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until you are ready to terminate.
8. Cover the end of the overall jacket with a 1 inch (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2 inches (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2 inches (minimum) past the Heat-shrink and serve as indicated below.
9. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing 1/4 inch past the end of unused wires, fold back over jacket and secure with cable tie.
10. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
11. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.

12. 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.
13. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
14. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
15. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
16. Separation of Wires: (Refer to Raceway Installation) 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 apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
17. Serve all cables as follows:
    a. Cover the end of the overall jacket with a 1 inch (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2 inches (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2 inches (minimum) past the Heat-shrink and serve as indicated below.
    b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing 1/4 inch past the end of unused wires, fold back over jacket and secure with cable tie.
    c. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.

D. Labeling:
1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
2. Engrave and paint fill all receptacle panels using 1/8” (minimum) high lettering and contrasting paint.
3. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8 inch (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment

4. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
5. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
6. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
7. Ensure each OEM supplied equipment has appropriate UL Labels/Marks for the service the equipment is performed permanently attached and marked. Equipment installed not bearing these UL marks will not be allowed to be a part of the PAS System. The Contractor shall bear all costs required to provide replacement equipment with approved UL marks.

3.4 PROTECTION OF NETWORK DEVICES

Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved electrostatic discharge (ESD) wrist straps tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician come in contact with high voltage.

3.5 CUTTING AND PATCHING

A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.
B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.
C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the Work or to make its parts fit together properly.
D. The Contractor shall not damage or endanger a portion of the work or fully or partially completed construction of the VA or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the VA or a separate contractor except with written consent of the VA and of such separate contractor;

such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the VA or a separate Contractor the Contractor's consent to cutting or otherwise altering the work.

E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

3.6 FIREPROOFING

A. Where cables penetrate fire rated walls, floors and ceilings, fireproof the opening.

B. Provide conduit sleeves (if not already provided by electrical contractor) for cables that penetrate fire rated walls. After the cabling installation is complete, install fire proofing material in and around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.

C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.

3.7 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, commonmode 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 26 Section "Grounding and Bonding for Electrical Systems."

D. Do not use "3rd or 4th" wire internal electrical system conductors for ground.

E. Do not connect system ground to the building's external lightning protection system.

F. Do not "mix grounds" of different systems.

PART 4 – TESTING, GUARANTY AND TRAINING

4.1 PROOF OF PERFORMANCE TESTING

A. Acceptance Test:

1. The Contractor shall schedule an acceptance test date and give the RE 30 days written notice prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a VA Representative and an OEM certified representative. The system

shall be tested utilizing the approved test equipment to certify proof of performance and Emergency compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

B. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:
   a. The VA Representative will tour all areas where the system and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
   b. The system diagrams, record drawings, equipment manuals, Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
   c. Failure of the system to meet the installation requirements of this specification shall be grounds for terminating all testing.
2. Operational Test:
   a. The Contractor shall demonstrate the full functionality of the system.
3. Test Conclusion:
   a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the RE. Any retesting to comply with these specifications will be done at the Contractor's expense.
   b. If the system is declared unacceptable without conditions, all rescheduled testing expenses will be born by the Contractor.

4.2 SYSTEM GUARANTEE PERIOD OF SERVICE

A. Contractor’s Responsibility:

1. The Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the system by the VA. The Contractor shall provide OEM’s equipment warranty documents, to the RE (or Facility Contracting Officer if the Facility has taken procession of the building), that certifies each

item of equipment installed conforms to OEM published specifications.

2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.
3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide two copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the two year guaranty period:
   a. Response Time during the Two Year Guaranty Period:
      1) The RE (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor’s ONLY OFFICIAL reporting and contact official for nurse call system trouble calls, during the guaranty period.
      2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the RE (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
      3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
         a) A routine trouble call within 1 working day of its report. A routine trouble is considered a trouble which causes a pillow speaker or cordset, one master IC control station, room station or emergency station to be inoperable.
         b) Routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as an emergency trouble call. The RE (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.
         c) An emergency trouble call within 4 hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, or all call system to be inoperable at anytime.

4) If a IC component failure cannot be corrected within 4 hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate IC equipment. The alternate equipment/system shall be operational within a maximum of 20 hours after the 4 hour trouble shooting time and restore the effected location operation to meet the system performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the system or sub-system to full operational capability, as described herein, until repairs are complete.

b. Required On-Site Visits during the Two Year Guaranty Period

1) The Contractor shall visit, on-site, for a minimum of 8 hours, once every 12 weeks, during the guaranty period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the system according the descriptions identified in this document.
2) The Contractor shall arrange all Facility visits with the RE (or Facility Contracting Officer) prior to performing the required maintenance visits.
3) Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the RE (or Facility Contracting Officer) and Contractor.
4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE (or Facility Contracting Officer).
5) The Contractor shall provide the RE (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the RE with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:
   a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to RE (or Facility Contracting Officer) by the fifth

(5th) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.

b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the system. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

6) The RE (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, 2 copies of actual reports for evaluation.

a) The COTR shall ensure a copy of these reports is entered into the system's official acquisition documents.

b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the system's official technical record documents.

B. Work Not Included:

Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or VA tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the COTR or Facility Contracting Officer in writing upon the discovery of these incidents. The COTR or Facility Contracting Officer will investigate all reported incidents and render

4.3 TRAINING

A. Provide thorough training of the VA's engineering and maintenance staff.

B. Provide the following minimum training times and durations:

1. 24 hours prior to opening
2. 24 hours during the opening week
3. 24 hours for supervisors and system administrators

- - - E N D - - -

SECTION 27 52 23

NURSE CALL AND CODE BLUE SYSTEMS

PART 1 - GENERAL

1.1 SECTION SUMMARY

A. Work covered by this document includes design, engineering, labor, material, products, guaranty, training and services for, and incidental to, the complete installation of a new and fully operating National Fire Protection Association (NFPA) Listed Critical Service Nurse-Call and Life Safety Code Blue communication system as detailed herein.

B. Work shall be complete, tested, labeled, certified and ready for operation.

1.2 RELATED SECTIONS

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below).

C. Section 26 41 00, FACILITY LIGHTNING PROTECTION

D. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

E. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS

F. Section 27 41 31, CABLE TELEVISION EQUIPMENT AND SYSTEMS

1.3 DEFINITIONS

A. Provide: Design, engineer, furnish, install, connect complete, test, certify and guarantee.

B. Work: Materials furnished and completely installed.

C. Review of contract drawings: A service by the engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.

D. Headquarters (aka VACO) Technical Review, for National and VA Communications and Security, Codes, Frequency Licensing Standards, Guidelines and Compliance:

Office of Telecommunications
Special Communications Team (005OP3B)
1335 East West Highway – 3rd Floor
Silver Spring, Maryland 20910,

(O) 301-734-0350, (F) 301-734-0360

E. Engineer: // XXXXXXX //
// XXXXXXX //
// XXXXXXX //
// XXXXXXX //
// XXXXXXX //

F. VA: // XXXXXXX //

G. General Contractor (GC): // XXXXXXX //

H. Contractor: Systems Contractor; you; successful bidder.

1.4 REFERENCES

A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:

1. United States Federal Law and Codes:

a. Departments of:

1) CFR, Title 15 – Department of Commerce, Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the:

a) Chapter II, National Institute of Standards Technology (NIST – formerly the National Bureau of Standards). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (Public Law 107-347), NIST develops – Federal Information Processing Standards Publication (FIPS) 140-2—Security Requirements for Cryptographic Modules.

b) Chapter XXIII, National Telecommunications and Information Administration (NTIA – aka 'Red Book') Chapter 7.8/9 Federal communications Commission (FCC) Title 47 (CFR), Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions and Locations.

2) CFR, Title 29, Department of Labor, Chapter XVII - Occupational Safety and Health Administration (OSHA), Part 1910 – Occupational Safety and Health Standard:

a) Subpart 7, Definition and requirements for a National Recognized Testing Laboratory (NRTL – 15 Laboratory's, for

complete list, contact http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)

(1) Underwriters Laboratories (UL):

65	Standard for Wired Cabinets.
468	Standard for Grounding and Bonding Equipment.
1449	Standard for Transient Voltage Surge Suppressors.
1069	Hospital Signaling and Nurse Call Equipment.
60950-1/2	Information Technology Equipment – Safety.

(2) Canadian Standards Association (CSA): same tests as for UL.

(3) Communications Certifications Laboratory (CCL): same tests as for UL.

(4) Intertek Testing Services NA, Inc. (ITSNA formerly Edison Testing Laboratory [ETL]): same tests as for UL.

b) Subpart 35, Compliance with NFPA 101 – Life Safety Code.

c) Subpart 36, Design and construction requirements for exit routes.

d) Subpart 268, Telecommunications.

e) Subpart 305, Wiring methods, components, and equipment for general use.

3) Title 42, CFC, Department of Health, Chapter IV Health and Human Services, Subpart 1395(a)(b) Joint Commission on Accreditation of Healthcare Organizations (JCAHO) "a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:" All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.

4) All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.

5) CFR, Title 47 - Telecommunications, FCC: Part 15 – Restrictions of use for Part 15 listed Radio Equipment in Safety of Life, Emergency Functions, Equipment and Locations (also see CFR, Title 15 – Department of Commerce, Chapter XXIII – NTIA).

6) Public Law No. 100-527, Department of Veterans Affairs:
   a) Office of Telecommunications: Handbook 6100, Telecommunications.
   b) Office of Cyber and Information Security (OCIS):
      (1) Handbook 6500, Information Security Program.
      (2) Wireless and Handheld Device Security Guideline Version 3.2, August 15, 2005.
   c) Spectrum Management FCC and NTIA Radio Frequency Compliance and Licensing Program.

2. National Codes:
   a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.
   b. American National Standards Institute/Electronic Industries Association/Telecommunications Industry Association (ANSI/EIA/TIA):

568-B	Commercial Building Telecommunications Wiring Standards:
569	Commercial Building Standard for Telecommunications Pathways and Spaces.
606	Administration Standard for the Telecommunications Infrastructure of Communications Buildings.

607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
REC 127-49	Power Supplies.
RS 27	Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.

   c. Institute of Electrical and Electronics Engineers (IEEE):

SO/TR 21730:2007	Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices.
0739-5175/08/$25.	Medical Grade – Mission Critical – Wireless Networks.

00©2008IEEE	
C62.41	Surge Voltages in Low-Voltage AC Power Circuits.

d. NFPA

70	National Electrical Code (current date of issue) – Articles 517, 645 and 800.
75	Standard for Protection of Electronic Computer Data- Processing Equipment.
77	Recommended Practice on Static Electricity.
99	Healthcare Facilities.
101	Life Safety Code.

3. State Hospital Code(s).
4. Local Codes.

1.5 QUALIFICATIONS

A. The OEM shall have had experience with three or more installations of Nurse Call/Code Blue Systems of comparable size and complexity concerning type and design as specified herein. Each of these installations shall have performed satisfactorily for at least 1 year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.

B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of 3 years. The Contractor shall be authorized by the OEM to pass thru the OEM’s warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the system. This documentation, along with the system Contractor and OEM certifications must be provided in writing as part of the Contractor’s Technical submittal.

C. The Contractor’s Communications Technicians assigned to the system shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the system. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the COTR before being allowed to commence work on the system.

D. Applicable national, state and local licenses.

E. Certificate of successful completion of OEM’s installation and training school for installing technicians of the equipment being proposed.

1.6 CODES AND PERMITS

A. Provide all necessary permits and schedule all inspections as identified in the contract’s milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by the VA.

B. The Contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.

1.7 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS

A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.

B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.

C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (005OP3B – herein after referred to as 005OP3B) will not review any submittal that does not have this list.

1.8 PROJECT RECORD DOCUMENTS (AS BUILTS)

A. Throughout progress of the work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.

B. The floor plans shall be marked in pen to include the following:

1. All device locations with labels.
2. Conduit locations.
3. Head-end equipment and specific location.
4. Wiring diagram.
5. Labeling and administration documentation.
6. Warranty certificate.
7. System test results.

1.9 WARRANTIES AND GUARANTY

A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of 1 year from the date of acceptance of the project by the VA. The Contractor shall agree to remedy covered defects within 8 hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.

B. Refer to Part 4 for applicable System Guarantee requirements.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.

B. Store products in original containers.

C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.

D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the VA.

1.11 PROJECT CLOSEOUT

A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.

B. Before the project closeout date, the Contractor shall submit:

1. Warranty certificate.
2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
3. Project record documents.
4. Instruction manuals and software that is a part of the system.

C. Contractor shall submit written notice that:

1. Contract Documents have been reviewed.
2. Project has been inspected for compliance with contract.
3. Work has been completed in accordance with the contract

1.12 MANUFACTURES

A. The entire Carl Vinson VA Medical Center shall utilize the same Nurse Call Code Blue System with its current features, for maintenance and safety purposes. The currently installed system at the Carl Vinson VAMC is TekTone TEKCARE 400.

PART 2 – PRODUCTS AND FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.

C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

D. Weather-Resistant Equipment: Listed and labeled by an OSHA certified National Recognized Testing Laboratory (NRTL – i.e. UL) for duty outdoors or in damp locations.

2.2 SYSTEM DESCRIPTION

A. System hardware shall consist of a nurse and patient communications network comprised of nurse consoles, control stations, staff and duty stations, dome lights, pillow speakers and call cords, pull cord stations, emergency push button stations, wireless phones, wiring. In addition, other options such as, wireless phone interfaces, computer interfaces, printer interfaces and wireless/telephone network interfaces. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse and patient communications network. Accomodations for 8 wireless phones shall be provided as part of the nurse call system installation.

B. Systems firmware shall be the product of a reputable firmware OEM of record with a proven history of product reliability and sole control over all source code. Manufacturer shall provide, free of charge, product firmware and software upgrades for a period of two years from date of acceptance by VA for any product feature enhancements. System configuration programming changes shall not require any exchange of parts and shall be capable of being executed remotely via a modem connection (when specifically approved first by TVE - 005OP2B).

C. The Nurse Call (and Code Blue) System head end equipment shall be located in Electrical Room. The Nurse Call (and Code Blue) System shall cover the entire building. The Nurse Call / Code Blue System may

interface the PAS system when specifically approved by VA Headquarters TVE-005OP3B during the project approval process prior to contract bidding.

D. The Nurse Call system is defined as Critical Service and the Code Blue functions is defined as Life Safety/Support by NFPA (re Part 1.1.A) and so evaluated by JCAHCO. Therefore, the system shall have a minimum of two additional remote enunciation points in order to satisfy NFPA's Life Safety Code 101:
   1. These two additional remote locations shall be fully manned:
      a. 24/7/365 for certified Hospital and VAMCs.
      b. The following locations are the minimum required for Nurse Call /Code Blue Annunciation:
         1) "On Call" Rooms.
         2) Each Nurse Station.
         3) Each Staff Station.
         4) Each Duty Station.
   2. The minimum remote enunciation locations shall be:
      a. Specifically approved by VA Headquarters TVE - 005OP3B during the project development stages and prior to equipment purchase.
   3. The MAXIMUM enunciation time period from placement of the Code Blue Call to enunciation at both locations is 10 seconds; and, 15 seconds to the subsequent enunciating media stations (i.e. PA, Radio Paging, Emergency Telephone or Radio Backup, etc.).

E. Each Nurse Call and Code Blue system shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. dome light bulbs [each light will be considered supervised if they use any one or a combination of (UL) approved electrical supervision alternates, as identified in UL-1069, 1992 revision], wires, contact switch connections, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the nurse control station and all remote locations.

F. When the Nurse Call and Code Blue system is approved to connect to a separate communications system (i.e. LAN, WAN, Telephone, Public

Address, radio raging, wireless systems, etc) the connection point shall meet the following minimum requirements for each hard wired and wireless connection (note each wireless system connection must be approved prior to contract bid by VA Headquarters TVE - 005OP3B AND SPECTRUM MANAGEMENT - 005OP2B – hereinafter referred to as SM - 005OP2B):

1. UL 60950-1/2.
2. FIPS 142.
3. FCC Part 15 Listed Radio Equipment restriction compliance approved by SM – 005OP2B.

G. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. Unless otherwise noted in this Part, equipment quantities shall be as indicated on the drawings.

2.3 MANUFACTURERS

A. The products specified shall be new, UL 1069 Listed, and produced by OEM manufacturer of record.

B. The following equipment items are the salient requirements of VA to provide an acceptable system described herein.

2.4 INTERFACE EQUIPMENT

A. Telephone:

1. Code Blue Annunciation Station:
   a. The Code Blue Remote Annunciation Station shall be located as directed by VA.
   b. The Annunciation Station shall be connected to the Nurses Call Code Blue system via hard wire connection(s) that shall contain all the electrical supervisory tone signals, visual bulbs, read out panel to indicate the location of the Code and system troubles.
   c. The Nurse Call and Code Blue system shall not be connected to the Telephone system unless specifically approved by VA Headquarters (005OP3B) and (005OP2B) prior to contract bid.
   d. The Annunciation Station shall be installed in a location directly viewable and the readout is completely readable from the Public Address Microphone Control Console.
   e. Provide one spare panel.

B. Electrical Supervision Trouble Annunciator Panel:

1. The Electrical Supervision Trouble Annunciation Panel shall be located in the Nurses Station.
2. The panel(s) shall be compatible with the generated electrical and/or electronic supervising signals to monitor continuously the operating condition for the Nurse Call / Code Blue System head-end processing equipment, master stations, staff stations, patient stations, duty stations, audio power amplifier(s), UPS, power supplies, dome lights and interconnecting trunks. The panels shall generate an audible and visual signal when the system's supervising system detects a system trouble or trunk-line is malfunctioning.

C. Wireless:

1. Personal Wireless Communicator:
   a. The Nurse Call and Code Blue system will only be allowed to connect to the personal wireless communications system, pass text data and provide a 2-way communication between the Telephone Interface and the personal wireless communicator as long as it is not a FCC Part 15 listed device(s), meets or exceeds UL 60950-1/2, meets OCIS Guide Lines for FIPS 140-2 certification and the using staff shows an extensive training program along with recertification(s) according to the Facility Emergency Plan concerning HIPA requirements.
   b. VA Headquarters TVE - 005OP3B and SM - 005OP2B are the approving authority for this requirement.
2. Other Wireless Equipment and Systems:
   a. Each proposed wireless system and/or equipment to be connected to or be a part of the Nurse Call / Code Blue system, each shall meet the minimum requirements outlines in Paragraph 2.7.A.
   b. Contact TVE - 005OP3B and SM – 005OP2B for specific required PRE approvals (full or conditional) as described herein.

D. HL7 Interface:

1. The system may support downloading and updating of patient data from the hospital admission system (or other database) via the HL7 standard. The data only has to travel one way, i.e. from the admission system to the nurse-call system.
2. Coordinate with the VA the exact fields that will be populated from the admissions system in the nurse-call system.
3. The Facility's LAN/WAN is not allowed for Nurses Call and Code Blue main wiring that must be a "stand alone primary cable

infrastructure." Connections to the VA LAN/WAN will be allowed ONLY when the system has been demonstrated and certified by 005OP2B meeting the minimum guidelines and requirements of Paragraph 2.4A.

E. Bed Interface:
   1. Provide a multi-pin receptacle for bed connection.
   2. Connect cable from the multi-pin receptacle to the nurse-call system, so that alarms, such as bed exit, shall be monitored by the nurse-call system.
   3. Connect cable from the multi-pin receptacle to the nurse-call system, so that the bedside control buttons, such as nurse call, and television controls are functional and monitored.
   4. Coordinate with VA for patient beds used.

2.5 CENTRAL PROCESSING EQUIPMENT

A. Provide central processing unit complete with all required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system. Head-end components may be rack mounted or wall mounted in a metal enclosure. Include TEK-BRIDGE and any other associated equipment required for integration into the facility's wireless systems.

B. Provide minimum of 15 minute battery back-up to system components.

C. The central processing unit shall provide the following:
   1. Ample power for nurse consoles, patient, staff and duty stations and corridor lamps.
   2. Send/Receive data connections up to four nurse consoles.
   3. Come standard with radio paging interface.
   4. Come standard with management software interface.

D. Equipment Cabinet: Comply with TIA/EIA-310-D. Lockable, ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions

E. Vertical Equipment Rack, Wall Mounted (to be included inside of the Equipment Cabinet):
   1. 28" (16RU) rack space. Welded Steel construction. Minimum 20" usable depth, adjustable front mounting rails.
   2. Install the following products in rack provided by same manufacturer or as specified:
      a. Security screws w/ nylon isolation bushings.
      b. Textured blank panels.

c. Custom mounts for components without rack mount kits.
d. Security covers.
e. Copper Bus Bar.
f. Power Sequencer- rack-mounted power conditioner and (provide as-needed) delayed sequencer(s) with (2) unswitched outlets each and contact closure control inputs.

2.6 LIGHT AND TONE CALL INITIATION, ANNUNCIATION, AND RESPONSE

A. Calls may be initiated through:
1. Patient station.
2. Staff station.
3. Code Blue station.
4. Toilet Emergency Station pull cord.
5. Shower Emergency Station pull cord.
6. Bed Pillow speaker.
7. Bed Push-button cordset.
8. Bed Integrated controls.

B. Once a call is initiated, it must be annunciated at the following locations:
1. The Corridor, Intersectional and Room dome light associated with the initiating device.
2. A local master control station indicating the call location and priority.
3. Any duty stations associated with the unit.
4. Any staff stations associated with the unit.

C. All calls must be displayed until they are cleared by the nursing staff only from the initiating device location.

2.7 VOICE CALL INITIATION, ANNUNCIATION, AND RESPONSE

A. Calls may be initiated through:
1. Patient station.
2. Staff station.
3. Code Blue station.
4. Toilet Emergency pull cord station.
5. Shower Emergency pull cord station.
6. Pillow speaker.
7. Push-button cordset.
8. Integrated bed controls.

B. Once a call is initiated, it must be annunciated at the following locations:

1. The Corridor, Intersectional and Room dome light associated with the initiating device.
2. A master station indicating the call location and priority.
3. Any duty stations associated with the unit.
4. Wireless personal communicator (within the restrictions identified herein).

C. All calls must be displayed until they are cleared by the nursing staff from only the initiating device location.

D. Provide two-way voice communication between a master station and patient, staff and duty stations.

E. Failure of voice intercom portion of system shall not interfere with visual and audible signal systems.

F. All calls must be displayed on the master station until they are cleared by the nursing staff at ONLY the originating station. If multiple calls are received at the master station within a short period of time, they shall be stacked based on priority and wait time. If there are more calls than the master station screen can display at one time (four (4) minimum), the system must provide a simple scrolling feature. The nurse must be able to answer any call in any order at the master station. The nurse must also be able to forward calls to staff members. If a call is not answered within a programmable time period, then the system must forward the call to appropriate back-up staff identified by each shift supervisor in a manner technically approved by VA Headquarters 005OP3B.

2.8 AUXILIARY ALARM MONITORING

A. Each patient station must have the ability to connect an auxiliary alarm to it such as an infusion pump or data tracking / recording device (patient life support units ARE NOT allowed to be connected to the Nurse Call / Code Blue UNLESS APPROVED BY TVE - 0005OP3B DURING THE PROJECT DEVELOPMENT PHASE AS DESCRIBED HEREIN. The nurse-call system must support naming the device that is being monitored as well as display its alarms at the master station and via the room / corridor dome light(s).

B. Provide (2) alarm jacks at each patient station.

C. The requirements of Paragraph 2.8.A and B will ONLY be allowed when the system has been approved by VA Headquarters TVE - 005OP3B and TVE - 005OP2B and concurred by the appropriate Medical Service(s) indicates it meets the minimum guidelines and requirements of Paragraph 2.8.A.

2.9 PATIENT AND STAFF ASSIGNMENT

A. System may provide for transfer of one or more individual or groups of stations from one master station to another without mechanical switches or additional wiring of the stations. The transfer may be initiated manually be the nurse or automatically at certain times of the day.

B. The Facility's LAN/WAN is not allowed for Nurses Call/Code Blue main wiring that must be a "stand alone primary cable infrastructure." Connections to the VA LAN/WAN will be allowed ONLY when the system has been demonstrated and certified by TVE - 005OP3B meeting the minimum guidelines and requirements of Paragraph 2.4A.

2.10 REPORTS

A. The systems generated reports logging all calls, alarms, response time, bed, and staff assignments may be allowed to transmit these reports to a central archiving entity. Install a TEK-MMARS 400 and associated equipment for reporting purposes.

B. Reports function shall be limited by passwords and security tier level access, so that only supervisors may access it when desired.

C. Provide instructions to the VA on how to enable/disable the reporting functions.

D. The Facility's LAN/WAN is not allowed for Nurses Call/Code Blue main wiring that must be a "stand alone primary cable infrastructure." Connections to the VA LAN/WAN will be allowed only when the system has been demonstrated and certified by 005OP2B meeting the minimum guidelines and requirements of Paragraph 2.4A.

2.11 MANAGEMENT SOFTWARE

Provide and install management software on minimum of 3 VA-provided computers. The management software shall at a minimum provide all historical reporting features of the system as well as real-time monitoring of events.

2.12 SYSTEM FUNCTIONAL STATIONS

A. Master Control:

1. The master station shall have a full control capability over staff assignment to patients and beds as well as pagers and wireless personal communication devices (when specifically approved by 005OP2B on a case by case basis).
2. Speakerphone and handset communication.
3. Full English display with user prompts.

4. Display of up to 4 calls showing room numbers and call priorities on integral LCD display.
5. Programmable call-in tone type and level for each type of call priority.
6. Choice of hands-free or private handset conversation.
7. Single stroke "Hot Keys" for one button access to user function options.
8. Automatic answer of highest priority call or selective answer of any displayed call.
9. Ability to place a call on hold by double tapping a "hot key".
10. Ability to display current staff locations.
11. Easy-to-read LCD and CRT display.
12. Microprocessor-controlled operation.
13. Ability to upload and download user programmed information.
14. Ability to upload software upgrades via standard laptop COM port connection.
15. Ability to program globally, dome light colors and duty station call tone rates for different priority call types.
16. Ability to program globally, different labels for different call types as the facility sees fit.
17. Ability to bring up menu for swinging a group of rooms by touching one labeled "hot key." Room(s) and consoles may be located anywhere within the nurse/patient communications system.
18. Includes as standard a Radio Paging interface for individual master custom paging ability.
19. Ability to send current master console zone assignments to another master selectively at any time without preprogramming.
20. Push-to-talk key for taking control of speech path.
21. Full duplex master-to-master communication via handsets.
22. Self-contained unit, which shall not occupy more than 91 square inches of desk space.
23. Desk or wall-mountable.

B. Touch Screen

1. Provide a touch screen master station with 15" CRT minimum monitor size.
2. Ability to display up to 21 active calls.
3. Incoming calls are color coded by priority to increase call priority differentiation.

4. Call display includes up to a 16-character label (for EACH bed when using dual stations)
5. VGA connection at master console, which also allows user choice as to type of monitor i.e. flat screen.

C. Staff:
1. Light and Tone Only.
2. Voice Communications Enabled.
3. Provide 1 spare station.

D. Duty:
1. Light and Tone Only.
2. Voice Communications Enabled.
3. Provide 1 spare station.

E. Patient:
1. Single
2. Provide each patient station with the following minimum features:
a. Call button.
b. Call answered button.
c. Pillow speaker jack.
d. Auxiliary alarm monitoring jack.
e. Hospital bed interface jack (when specially approved by TVE - 005OP3B).
f. Provide 1 spare station.
g. Full code blue supervision.

2.13 LIGHTING INTERFACE MODULE

A. Provide an interface module for the pillow speakers to control up to 2 lights. Coordinate with the electrical Contractor the exact voltage requirements.

B. Provide 1 spare module for each 10 modules installed.

2.14 PILLOW SPEAKERS

A. The pillow speaker shall have the following TV control capability:
1. Play the TV audio through the pillow speaker
2. Change channels up and down
3. Increase and decrease the volume
4. Mute

B. Provide (1) pillow speaker for each patient station.

C. Provide one spare pillow speaker.

2.15 TV CONTROL INTERFACE

A. The pillow speaker shall have the following TV control capability:

1. Play the TV audio through the pillow speaker.
2. Change channels up and down.
3. Increase and decrease the volume.
4. TV audio mute.
5. UL certified for direct patient contact.

2.16 TV CONTROL JACK AND WIRING

A. Provide connection from the pillow speaker to the TV location. Terminate wire on a jack in the TV low voltage faceplate. Coordinate faceplate opening with the Cabling Contractor. Coordinate jack type with the TV (typically it is a 1/4 inch jack, but verify prior to installation).

B. Provide patch cord from the TV control jack to the TV.

C. Provide 1 spare complete assembly.

2.17 CORRIDOR LAMP SETS

A. Provide as shown on plans the proper type of corridor lamp. All corridor lamps shall have a 2 gang mounting plate with bulbs replaceable from the front with snap on lenses.

B. It shall be possible to change the color of any lamp by simply exchanging the color filter.

2.18 PERIPHERAL DEVICES

A. Provide as shown on plans peripheral devices wired via plug-in connectors, including but not limited to the following:

a. Emergency pull cord switch
b. Addressable pull cord switch for stand alone areas
c. Code blue switch
d. Staff presence switch

2.19 PHONE WIRELESS EQUIPMENT

A. Provide a complete wireless phone system as part of the nurse call system.

B. Provide 8 phones with the following features:

1. Alphanumeric.
2. 2-line backlit display.
3. Easy to use large button design.
4. Configurable for audio or vibration alerts.
5. Field programmable.
6. Includes holster belt clip and safety card.
7. Ability to store up to 60 messages.
8. Programmable to turn on and off at preset times each day.

C. Provide associated TEK-BRIDGE equipment and all other TEK-TONE equipment required to integrate the nurse call system into the facility wireless system.

D. Provide a voltage interface unit.

2.20 SYSTEM CABLES

A. Refer to OFM approved Construction Specification, Section 27 10 00, STRUCTURED CABLING for specific installation and testing requirements.

B. Provide all cabling required for the nurse-call system; typically standard 4-pair unshielded twisted pair cable.

C. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper.

D. All cabling shall be plenum rated.

2.21 SYSTEM CONDUIT

A. The nurse call and code blue system is NFPA listed as Emergency and Public Safety Communication System which requires the entire system to be installed in a separate conduit system.

B. The use of centralized mechanically partitioned wireways may be used to augment main distribution conduit on a case by case basis when specifically approved by VA Headquarters (005OP3B).

2.22 CONDUIT SLEEVES

A. The Engineer has made a good effort to identify where conduit sleeves through full-height and fire rated walls on the drawings, and has instructed the electrician to provide the sleeves as shown on the drawings.

B. While the sleeves shown on the drawings will be provided by others, the Contractor is responsible for installing conduit sleeves and fire-proofing where necessary. It is often the case, that due to field conditions, the nurse-call cable may have to be installed through an alternate route. Any conduit sleeves required due to field conditions or those omitted by the engineer shall be provided by the Cabling Contractor.

2.23 DEVICE BACKBOXES

A. Furnish to the electrical Contractor all backboxes required for the Nurse Call devices.

B. The electrical Contractor shall install the backboxes as well as the system conduit. Coordinate the delivery of the backboxes with the construction schedule.

2.24 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide a backup battery or a UPS for the system to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of 15 minutes.

B. Provide UPS for all active system components including but not limited to:

1. Control Panels.
2. Personal Computers (used for nurse-call).
3. Master Stations and Video Monitors.

C. Provide 1 spare UPS unit for each 10 units installed.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

A. Assign a single project manager to this project who will serve as the point of contact for the VA, the General Contractor, and the Engineer.

B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with the General Contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.

C. Contact the Office of Telecommunications, Special Communications Team (005OP3B) at (301) 734-0350 to have a VA Certified Telecommunications COTR assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA’s Spectrum Management and OCIS Teams.

3.2 COORDINATION WITH OTHER TRADES

A. Coordinate with the Cabling Contractor the location of all nurse call devices and switches.

B. Coordinate with the Cabling Contractor the location of nurse call equipment in the electrical room.

C. Before beginning work, verify the location, quantity, size and access for the following:

1. Isolated ground AC power circuits provided for systems.
2. Primary, emergency and extra auxiliary AC power generator requirements.
3. Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
4. System components installed by others.
5. Overhead supports and rigging hardware installed by others.

D. Immediately notify the VA, General Contractor and Consultant in writing of any discrepancies.

3.3 NEEDS ASSESSMENT

Provide a one-on-one meeting with the particular nursing manager of each unit affected by the installation of the new nurse call/code blue system. Review the floor plan drawing, educate the nursing manager with the functions of the equipment that is being provided and gather details specific to the individual units; coverage and priorities of calls; staffing patterns; and other pertinent details that will affect system programming and training.

3.4 INSTALLATION

A. General:

1. Execute work in accordance with National, State and local codes, regulations and ordinances.
2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the VA.
3. Install equipment according to OEM’s recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc:
   a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
   b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
   c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
   d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
5. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, VA and 005OP3B.
6. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and

surrounding wall. Where cover plates are not fitted with connectors, provide grommeted holes in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.

B. Equipment Racks:

1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
2. Provide security covers for all devices not requiring routine operator control.
3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer’s recommendations regarding ventilation space between amplifiers.
4. Provide insulated connections of the electrical raceway to equipment racks.
5. Provide continuous raceway/conduit with no more than 40 percent fill between wire troughs and equipment racks for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.

C. Wiring Practice - in addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING the following additional practices shall be adhered to:

1. Comply with requirements for raceways and boxes specified in Division 26, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share the same enclosure shall be mechanically partitioned and separated by at least 4 inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.

4. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
5. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
6. Replace the entire length of the run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
7. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
8. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
9. Do not use tape-based or glue-based cable anchors.
10. Field wiring entering equipment racks shall be terminated as follows:
    a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
    b. If specified terminal blocks are not designed for rack mounting, utilize 3/4” plywood or 1/8” thick aluminum plates and blank panels as a mounting surface. Do not mount on the bottom of the rack.
    c. Employ permanent strain relief for any cable with an outside diameter of 1” or greater.

D. Cable Installation: In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:
1. Support cable on maximum 4’-0” centers. Acceptable means of cable support are cable tray, j-hooks, and bridal rings. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
2. Run cables parallel to walls.
3. Install maximum of 10 cables in a single row of J-hooks. Provide necessary rows of J-hooks as required by the number of cables.

4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2’-0” clearance from all shielded electrical apparatus.
5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the VA.
6. Ends of cables shall be properly terminated on both ends per industry and OEM’s recommendations.
7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until you are ready to terminate.
8. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
9. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, outlet boxes, terminal cabinets, and equipment enclosures. Cables may not be spliced.
10. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
12. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

E. Labeling:

1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
2. Engrave and paint fill all receptacle panels using 1/8” minimum high lettering and contrasting paint.
3. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8” (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.

4. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
5. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
6. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
7. Provide printed labels at both ends of the cable.
8. Ensure each OEM supplied equipment has appropriate UL Labels and Marks for the service the equipment is performed permanently attached/marked. Equipment installed not bearing these UL marks will not be allowed to be part of the system. The Contractor shall bear all costs required to provide replacement equipment with approved UL marks.

3.5 PROTECTION OF NETWORK DEVICES

Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved electrostatic discharge (ESD) wrist straps tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician come in contact with high voltage.

3.6 CLEANING AND PATCHING

A. It shall be the responsibility of the Contractor to keep their work area clear of debris and clean area daily at completion of work.
B. It shall be the responsibility of the Contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.
C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the work or to make its parts fit together properly.
D. The Contractor shall not damage or endanger a portion of the work or fully or partially completed construction of the VA or separate Contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the VA or a separate Contractor

except with written consent of the VA and of such separate Contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the VA or a separate Contractor, the Contractor's consent to cutting or otherwise altering the work.

E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

3.7 FIREPROOFING

A. Where cables penetrate fire rated walls, floors and ceilings, fireproof the opening.

B. Provide conduit sleeves (if not already provided by Electrical Contractor) for cables that penetrate fire rated walls. After the cabling installation is complete, install fire proofing material in and around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.

C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.

3.8 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, commonmode 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 26, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

D. Do not use "3rd or 4th" wire internal electrical system conductors for ground.

E. Do not connect system ground to the building's external lightning protection system.

F. Do not "mix grounds" of different systems.

PART 4 – TESTING, GUARANTY AND TRAINING

4.1 SYSTEM CLASSIFICATION

The nurse call/code blue system is NFPA listed as an "Emergency and Public Safety" Communications system. Where Code Blue signals are transmitted, that listing is elevated to "Life Support." Therefore, the

following testing and guaranty provisions are the minimum to be performed and provided by the Contractor and OEM.

4.2 PROOF OF PERFORMANCE TESTING

A. Intermediate Testing:

1. After completion of 25 – 30 percent of the installation the system must be pre-tested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed, NFPA, Life Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.
2. The inspection and test will be conducted by a factory-certified representative and witnessed by a VA Representative. The results of the inspection will be officially recorded by the VA Representative and maintained on file by the COTR, until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75 percent of the system construction phase, at the direction of the COTR.

B. Pretesting:

1. Upon completing installation of the nurse call/code blue system, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
2. Pretesting Procedure:

   During the system pretest the Contractor shall verify (utilizing approved test equipment) that the system is fully operational and meets all the system performance requirements of this standard.

   b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc., are present. At a minimum, each of the following locations shall be fully pre-tested:

      1) Central Control Cabinets.
      2) Nurse Control Stations.
      3) Patient Stations.
      4) Staff Stations.
      5) Local and Remote Enunciation Panels (code one [blue] only).
      6) All Networked locations.

7) System interface locations (i.e. two way radio, PA, etc.).
8) System trouble reporting.
9) System electrical supervision.
10) UPS operation.

3. The Contractor shall provide four copies of the recorded system pretest measurements and the written certification that the system is ready for the formal acceptance test shall be submitted to the COTR.

C. Acceptance Test:

1. After the system has been pre-tested and the Contractor has submitted the pretest results and certification to the COTR, then the Contractor shall schedule an acceptance test date and give the COTR 30 days written notice prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a VA Representative and an OEM certified representative. The system shall be tested utilizing the approved test equipment to certify proof of performance and Emergency and Public Safety compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed system does comply with all requirements of this specification under operating conditions. The system shall be rated as either acceptable or unacceptable at the conclusion of the test. Failure of any part of the system that precludes completion of system testing, and which cannot be repaired in 4 hours, shall be cause for terminating the acceptance test of the system. Repeated failures that result in a cumulative time of 8 hours to affect repairs shall cause the entire system to be declared unacceptable. Retesting of the entire system shall be rescheduled at the convenience of the VA.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:
   a. The VA Representative will tour all major areas where the system is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance

testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.

b. The system diagrams, record drawings, equipment manuals, Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.

c. Failure of the system to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

a. After the Physical and Mechanical Inspection, the central terminating and nurse call master control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be utilized to accomplish this requirement.

b. Following the central equipment test, a pillow speaker (or on board speaker) shall be connected to the central terminating and nurse call master control equipment’s output tap to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.

c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last intersectional, room, and bed dome light in each leg to verify that the nurse call distribution system meets all system performance standards.

d. Each TV outlet that is controlled by a nurse call pillow speaker shall be functionally tested at the same time utilizing the Contractor’s approved hospital grade TV receiver and TV remote control cable.

e. The red system and volume stepper switches shall be checked to insure proper operation of the pillow speaker, the volume stepper and the red system (if installed).

f. Additionally, each installed head end equipment shall be checked insuring they meet the requirements of this specification.

g. Individual Item Test: The VA Representative will select individual items of equipment for detailed proof of performance testing until 100 percent of the system has been tested and found

to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.

3. Test Conclusion:
   a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the RE. Any retesting to comply with these specifications will be done at the Contractor's expense.
   b. If the system is declared unacceptable without conditions, all rescheduled testing expenses will be born by the Contractor.

E. Acceptable Test Equipment:
   1. The test equipment shall be furnished by the Contractor, shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test.

4.3 SYSTEM GUARANTEE PERIOD OF SERVICE

A. Contractor’s Responsibility:
   1. The Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the system by the VA. The Contractor shall provide OEM’s equipment warranty documents, to the COTR (or Facility Contracting Officer if the Facility has taken procession of the building), that certifies each item of equipment installed conforms to OEM published specifications.
   2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.
   3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide 2 copies of current and qualified OEM training certificates and OEM certification upon request.
   4. Additionally, the Contractor shall accomplish the following minimum requirements during the two year guarantee period:
      a. Response Time during the Two Year Guarantee Period:

1) The COTR (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor's only official reporting and contact official for MATV system trouble calls, during the guarantee period.
2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the COTR (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
   a) A routine trouble call within 1 working day of its report. A routine trouble is considered a trouble which causes a pillow speaker or cordset, 1 master IC control station, room station or emergency station to be inoperable.
   b) Routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as an emergency trouble call. The COTR (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.
   c) An emergency trouble call within 4 hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, or all call system to be inoperable at anytime.
4) If a nurse call and/or code one (blue) component failure cannot be corrected within 4 hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate nurse call equipment. The alternate equipment/system shall be operational within a maximum of 20 hours after the 4 hour trouble shooting time and restore the effected location operation to meet the system performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the system or sub-system to full operational capability, as described herein, until repairs are complete.

b. Required On-Site Visits during the Two Year Guaranty Period:
   1) The Contractor shall visit, on-site, as necessary, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain

the system according the descriptions identified in this document.

2) The Contractor shall arrange all Facility visits with the COTR (or Facility Contracting Officer) prior to performing the required maintenance visits.
3) Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the COTR (or Facility Contracting Officer) and Contractor.
4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the COTR (or Facility Contracting Officer).
5) The Contractor shall provide the COTR (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the COTR with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:
   a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to COTR (or Facility Contracting Officer) by the fifth (5th) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
   b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the system. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.
6) The COTR (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, 2 copies of actual reports for evaluation.

a) The COTR (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the system's official acquisition documents.

b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the system's official technical record documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, Contractor, or VA tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the RE or Facility Contracting Officer in writing upon the discovery of these incidents. The RE or Facility Contracting Officer will investigate all reported incidents and render

4.4 TRAINING

A. Provide thorough training of all nursing staff assigned to those nursing units receiving new networked nurse/patient communications equipment. This training shall be developed and implemented to address two different types of staff. Floor nurses and staff shall receive training from their perspective, and likewise, unit secretaries (or any person whose specific responsibilities include answering patient calls and dispatching staff) shall receive operational training from their perspective. A separate training room will be set up that allows this type of individualized training utilizing in-service training unit, prior to cut over of the new system.

B. Provide the following minimum training times and durations:

1. 48 hours prior to opening for nursing staff (in 8-hour increments) – split evenly over 3 weeks and day and night shifts. Coordinate schedule with VA.
2. 32 hours during the opening week for nursing staff – both day and night shifts.
3. 24 hours for supervisors and system administrators.

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SECTION 28 05 11

REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section, Requirements for Electronic Safety and Security Installations, applies to all sections of Division 28.

B. Furnish and install electronic safety and security cabling, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of, 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 VA 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 eight 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 VA 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 VA.

1.5 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.

1.6 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 COTR, 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 electronic safety and security 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 conduit with other trades to minimize interferences. See Section 00 72 00, 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 VA 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 VA.
   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 VA'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 VA 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. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
3. 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.

4. 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 COTR with one sample of each of the following:

1. A 300 mm (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. Conduit 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 COTR at least 30 days prior to the planned training.

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SECTION 28 05 13

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of the conductors and cables for electronic safety and security.

1.2 RELATED WORK

A. Excavation and backfill for cables that are installed in conduit: Section 31 20 00, EARTH MOVING.

B. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.

C. General electrical requirements that are common to more than one section in Division 28: Section 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.

D. Conduits for cables and wiring: Section 28 05 33, RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY.

E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.

1.3 SUBMITTALS

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

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certificates: Two weeks prior to final inspection, deliver to the COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

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 reference in the text by the basic designation only.

B. American Society of Testing Material (ASTM):

D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

C. Federal Specifications (Fed. Spec.):

A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed Installation)

D. National Fire Protection Association (NFPA):

70-05.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-02.....Thermoset-Insulated Wires and Cables

83-03.....Thermoplastic-Insulated Wires and Cables

467-01.....Electrical Grounding and Bonding Equipment

486A-01.....Wire Connectors and Soldering Lugs for Use with Copper Conductors

486C-02.....Splicing Wire Connectors

486D-02.....Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations

486E-00.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

493-01.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable

514B-02.....Fittings for Cable and Conduit

1479-03.....Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 CONTROL WIRING

A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.

B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.2 COMMUNICATION AND SIGNAL WIRING

A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.

B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.

C. Multi-conductor cables shall have the conductors color coded.

2.3 WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

2.4 FIREPROOFING TAPE

A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.

C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.

E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Splice cables and wires only in outlet boxes, junction boxes, or pull boxes.

B. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.

C. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
2. Use ropes made of nonmetallic material 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. Pull in multiple cables together in a single conduit.

3.2 SPLICE INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure.

B. Where the VA determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the VA.

3.3 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION

A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.

B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.

C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.

E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.4 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION

A. Install a permanent wire marker on each wire at each termination.

B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

C. Wire markers shall retain their markings after cleaning.

3.5 EXISITNG WIRING

Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

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SECTION 28 05 26

GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies general grounding and bonding requirements of electronic safety and security installations for equipment operations.

B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, grounding electrodes.

F. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

A. Section 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 28.

B. Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY: Low Voltage power and lighting wiring.

C. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.

1.3 SUBMITTALS

A. Submit in accordance with Section 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:

1. Certification that the materials and installation is in accordance with the drawings and specifications.
2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.4 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 the basic designation only.

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

B1-2001.....Standard Specification for Hard-Drawn Copper Wire

B8-2004.....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

C. National Fire Protection Association (NFPA):

70-2005.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

44-2005 .....Thermoset-Insulated Wires and Cables

83-2003 .....Thermoplastic-Insulated Wires and Cables

467-2004 .....Grounding and Bonding Equipment

486A-486B-2003 .....Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

2.2 GROUND RODS

A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.

B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3 SPLICES AND TERMINATION COMPONENTS

Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

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. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
3. 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 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

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 SPLICE CASE GROUND ACCESSORIES

Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm^2 (6 AWG) insulated ground wire with shield bonding connectors.

PART 3 - EXECUTION

3.1 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.

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: 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 buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 CORROSION INHIBITORS

When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.4 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.5 WIREWAY GROUNDING

A. Ground and Bond Metallic Wireway Systems as follows:

5. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm^2 (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
6. Install insulated 16 mm^2 (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
7. Use insulated 16 mm^2 (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
8. Use insulated 16 mm^2 (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

3.6 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the VA. Final tests shall assure 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 less 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.

3.7 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

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.

3.8 GROUNDING FOR RF/EMI CONTROL

A. Install bonding jumpers to bond all conduit, cable trays, sleeves and equipment for low voltage signaling and data communications circuits. Bonding jumpers shall consist of 100 mm (4 inches) wide copper strip or two 6 mm^2 (10 AWG) copper conductors spaced minimum 100 mm (4 inches) apart. Use 16 mm^2 (6 AWG) copper where exposed and subject to damage.

B. Comply with the following when shielded cable is used for data circuits.

1. Shields shall be continuous throughout each circuit.
2. Connect shield drain wires together at each circuit connection point and insulate from ground. Do not ground the shield.
3. Do not connect shields from different circuits together.
4. Shield shall be connected at one end only. Connect shield to signal reference at the origin of the circuit. Consult with equipment manufacturer to determine signal reference.

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SECTION 28 05 33

RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, raceway systems. Raceways are required for all electronic safety and security cabling 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. Bedding of conduits: Section 31 20 00, EARTH MOVING.

B. Mounting board for communication closets: Section 06 10 00, ROUGH CARPENTRY.

C. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.

D. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

E. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.

F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.

G. General electrical requirements and items that is common to more than one section of Division 28: Section 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.

H. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.

1.3 SUBMITTALS

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

A. Shop Drawings:

1. Size and location of main feeders;
2. Size and location of panels and pull boxes
3. Layout of required conduit penetrations through structural elements.
4. The specific item proposed and its area of application shall be identified on the catalog cuts.

B. Certification: Prior to final inspection, deliver to the COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

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 Fire Protection Association (NFPA):

70-05.....National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL):

1-03.....Flexible Metal Conduit

5-01.....Surface Metal Raceway and Fittings

6-03.....Rigid Metal Conduit

50-03.....Enclosures for Electrical Equipment

360-03.....Liquid-Tight Flexible Steel Conduit

467-01.....Grounding and Bonding Equipment

514A-01.....Metallic Outlet Boxes

514B-02.....Fittings for Cable and Conduit

514C-05.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers

651-02.....Schedule 40 and 80 Rigid PVC Conduit

651A-03.....Type EB and A Rigid PVC Conduit and HDPE Conduit

797-03.....Electrical Metallic Tubing

1242-00.....Intermediate Metal Conduit

D. National Electrical Manufacturers Association (NEMA):

TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing

FB1-03.....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 19 mm (3/4 inch) unless otherwise shown.

B. Conduit:

1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.

2. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
3. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
4. Flexible galvanized steel conduit: Shall Conform to UL 1.
5. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
6. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
7. Surface metal raceway: Shall Conform to UL 5.

C. Conduit Fittings:

1. Rigid steel and IMC conduit fittings:
   a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
   a. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
   b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
   c. 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.
   d. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
   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.
2. Electrical metallic tubing fittings:
   a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.

c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
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.

3. Flexible steel conduit fittings:
   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp type, with insulated throat.
4. Liquid-tight flexible metal conduit fittings:
   a. Fittings shall meet the requirements of UL 514B and ANSI/ 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.
5. Direct burial plastic conduit fittings:
   a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
   b. As recommended by the conduit manufacturer.
6. Surface metal raceway fittings: As recommended by the raceway manufacturer.
7. Expansion and deflection couplings:
   a. Conform to UL 467 and UL 514B.
   b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
   c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
   d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

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 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) 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 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.

H. Wireways: Equip with hinged covers, except where removable covers are shown.

G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with “CAUTION BURIED ELECTRONIC SAFETY AND SECURITY CABLE BELOW”.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:
1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COTR prior to drilling through structural sections.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the COTR as required by limited working space.

B. Fire Stop: Where conduits, wireways, and other electronic safety and security raceways pass through fire partitions, fire walls, or smoke partitions, 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, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

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. Install conduit as follows:

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 8’0” on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. 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.
10. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
11. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. 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.

C. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COTR.

D. Fire Alarm:

1. Fire alarm conduit shall be painted red (a red "top-coated" conduit from the conduit manufacturer may be used in lieu of painted conduit) in accordance with the requirements of Section 28 31 00, Fire Detection and Alarm.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
   a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
   b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
   c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
4. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors 600 volts and below:
   a. Rigid steel, IMC, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
2. Align and run conduit parallel or perpendicular to the building lines.
3. Tightening set screws 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 volts and below:

1. Rigid steel, IMC, or EMT. Different type of conduits mixed 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 2400 mm (eight foot) intervals.

F. Surface metal raceways: Use only where shown.

G. Painting:

1. Paint exposed conduit as specified in Section09 91 00, PAINTING.

3.5 EXPANSION JOINTS

A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

C. Install expansion and deflection couplings where shown.

D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

3.6 CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.

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 90 kg (200 pounds). 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 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
   b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
   c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted.

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.

3.7 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 in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)

E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) 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".

3.8 ELECTRONIC SAFETY AND SECURITY CONDUIT

A. Install the electronic safety and security raceway system as shown on drawings.

B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.

C. All conduit ends shall be equipped with insulated bushings.

D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.

E. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.

F. Were drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.

G. All empty conduits located in communications closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.

H. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
¾	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

I. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specified in on the wall of communication closets where shown on drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.

J. Furnish and pull wire in all empty conduits.

- - - E N D - - -

SECTION 28 13 11

PHYSICAL ACCESS CONTROL SYSTEM (PACS)

PART 1 – GENERAL

1.1 DESCRIPTION

Provide and install a complete Physical Access Control System, hereinafter referred to as the PACS, and integrate in with the facilities main PACS system.

1.2 RELATED WORK

A. For firestopping application and use, Section 07 84 00, FIRESTOPPING.

B. For labeling and signs, Section 10 14 00, SIGNAGE.

C. For connection of high voltage, Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

D. For power cables, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).

E. For grounding of equipment, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

F. For infrastructure, Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.

G. For perimeter lighting, Section 26 56 00, EXTERIOR LIGHTING.

H. For control and operation of all security systems, Section 28 13 16, ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT.

I. For Warranty of Construction, Section 00 72 00, GENERAL CONDITIONS.

J. For General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

K. For automatic door operators, Section 08 71 13, AUTOMATIC DOOR OPERATORS.

L. For door types and requirements, refer to Architectural Hardware Schedule and Door Schedule.

1.3 QUALITY ASSURANCE

A. The Contractor shall be responsible for providing, installing, and the operation of the PACS as shown. The Contractor shall also provide certification as required.

B. The security system will be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.

C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

D. The Contractor for the PACS shall be Vick Thomas Electric, Inc., P.O. Box 1735, Dublin, GA 31040, 478-272-9347.

1.4 SUBMITTALS

A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Provide certificates of compliance with Section 1.3, Quality Assurance.

C. Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.

D. Pre-installation design and as-built packages shall include, but not be limited to:

1. Index Sheet that shall:
   a. Define each page of the design package to include facility name, building name, floor, and sheet number.
   b. Provide a complete list of all security abbreviations and symbols.
   c. Reference all general notes that are utilized within the design package.
   d. Specification and scope of work pages for all individual security systems that are applicable to the design package that will:
      1) Outline all general and job specific work required within the design package.
      2) Provide a detailed device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
   a. Include a title block as defined above.
   b. Clearly define the drawings scale in both standard and metric measurements.
   c. Provide device identification and location.
   d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).

e. Identify all pull box and conduit locations, sizes, and fill capacities.
f. Address all general and drawing specific notes for a particular drawing sheet.

3. A detailed riser drawing for each applicable security subsystem shall:
   a. Indicate the sequence of operation.
   b. Relationship of integrated components on one diagram.
   c. Include the number, size, identification, and maximum lengths of interconnecting wires.
   d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer’s name and part number for the wire/cable being installed.
4. A detailed system drawing for each applicable security system shall:
   a. Clearly identify how all equipment within the system, from main panel to device, shall be laid out and connected.
   b. Provide full detail of all system components wiring from point-to-point.
   c. Identify wire types utilized for connection, interconnection with associate security subsystems.
   d. Show device locations that correspond to the floor plans.
   e. All general and drawing specific notes shall be included with the system drawings.
5. A detailed schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
   a. Device ID.
   b. Device Location (e.g. site, building, floor, room number, location, and description).
   c. Mounting type (e.g. flush, wall, surface, etc.).
   d. Power supply or circuit breaker and power panel number.
   e. In addition, for the PACS, provide the door ID, door type (e.g. wood or metal), locking mechanism (e.g. strike or electromagnetic lock) and control device (e.g. card reader).

6. Detail and elevation drawings for all devices that define how they were installed and mounted.

E. Pre-installation design packages shall go through a full review process conducted by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:

1. 35 percent
2. 65 percent
3. 90 percent
4. 100 percent

F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.

G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) 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)/ Security Industry Association (SIA):

AC-01.....Access Control: Wiegand Card Reader Interface Standard

AC-03.....Access Control: Badging Techniques

C. American National Standards Institute (ANSI)/ International Code Council (ICC):

A117.1.....Standard on Accessible and Usable Buildings and Facilities

D. Department of Justice American Disability Act (ADA)

28 CFR Part 36-90.....ADA Standards for Accessible Design

E. VA Accountability Office (GAO):

GAO-03-8-02.....Security Responsibilities for Federally Owned and Leased Facilities

F. National Electrical Contractors Association

303-2005.....Installing Closed Circuit Television (CCTV) Systems

G. National Electrical Manufactures Association (NEMA):

250-03.....Enclosures for Electrical Equipment (1000 Volts Maximum)

H. National Fire Protection Association (NFPA):

70-05..... Article 780-National Electrical Code

I. Underwriters Laboratories, Inc. (UL):

294-99.....Standard for Access Control

305-97.....Standard for Panic Hardware

639-97.....Standard for Intrusion-Detection Units

752-05.....Standard for Bullet-Resisting Equipment

827-96.....Central Station Alarm Services

1076-95.....Standards for Proprietary Burglar Alarm Units and Systems

1981-03.....Central Station Automation System

2058-05.....High Security Electronic Locks

J. Homeland Security Presidential Directive (HSPD):

HSPD-12.....Policy for a Common Identification Standard for Federal Employees and Contractors

K. Federal Information Processing Standards (FIPS):

FIPS-201.....Personal Identity Verification (PIV) of Federal Employees and Contractors

L. National Institute of Standards and Technology (NIST):

IR 6887 V2.1.....VA Smart Card Interoperability Specification (GSC-IS)

Special Pub 800-96.....PIV Card Reader Interoperability Guidelines

M. Institute of Electrical and Electronics Engineers (IEEE):

C62.41.....IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

N. International Organization for Standardization (ISO):

7810.....Physical Characteristics of Credit Card Size Document

7811.....Physical Characteristics for Magnetic Stripe Cards

7816-1.....Physical Characteristics of the Card

7816-2.....Dimensions and Contact Position of the card

7816-3.....Electrical Signals and Transmission Protocols
7816-4.....Inter-Industry Command for Interchange
14443.....RFID cards; Contactless Proximity Cards Operating at 13.56 MHz in up to 5 inches distance
15693.....RFID cards; Contactless Vicinity Cards Operating at 13.56 MHz in up to 50 inches distance

O. Uniform Federal Accessibility Standards (UFAS) 1984
P. ADA Standards for Accessible Design 1994

1.6 WARRANTY OF CONSTRUCTION.

Warrant PACS work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment associated within the PACS shall be UL 294 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 96 hours of run time in the event of a loss of primary power to the facility.
C. The system shall be designed, installed, and programmed in a manner that will allow for easy of operation, programming, servicing, maintenance, testing, and upgrading of the system.
D. All equipment and materials for the system will be compatible to ensure correct operation as outlined in FIPS 201, March 2006 and HSPD-12.

2.2 EQUIPMENT ITEMS

A. The security system characteristics listed in this section will serve as a guide in selection of equipment and materials for the PACS. If updated or more suitable versions are available then the Contracting Officer will approve the acceptance of prior to an installation.
B. PACS equipment shall meet or exceed all requirements listed below.

C. A PACS shall be comprised of, but not limited to, the following components:

1. Control/Communications Panels
2. Electronic Security Management System
3. Card Reader and Credential Cards
4. Portal Control Devices
5. Door Status Indicators
6. Entry Control Device
7. Power Supplies
8. Wires and Cables

D. Control/Communication Panels:

1. Shall be a central point provided for monitoring, controlling, and programming the PACS.
2. Shall provide a means of controlling up to 16 doors per panel.
3. Shall be expandable and provide a means of networking multiple panels to provide overall control of all doors on the PACS via a primary panel.
4. Shall be system specific addressable, Internet Protocol (IP) addressable, and programmable via a computer.
5. Shall be able to be interfaced directly from a computer or via the Internet or Intranet. Access to the panels shall be password protected. All individuals with access to the panels shall have a user specific password.
6. Shall be of the same manufacturer and part number to ensure full compatibility within the system.
7. The operating system for the panel must utilize a single seamlessly integrated relational database for all functionality. This integration shall be provided with one operating environment. The operating environment shall be the fully multi-tasking multi-threading Microsoft Windows 2003/2000/Windows XP Operating System.
8. The panel’s web enabled client applications shall be capable of running on independent client operating systems including Windows 2003/2000, Windows XP, Windows NT, Windows 98, Windows 95, Macintosh, UNIX, Linux, and Solaris. The web-enabled applications shall utilize the same common database as the other system modules.
9. The panel programming shall be written so that all system modules (e.g. access control, alarm monitoring, credential management, visitor management, etc.) are developed and built from a unified 32-

bit source code set. There absolutely shall not be separate source code bases for the individual modules of the PACS.

10. Shall allow for the operation and control of up to 16 doors.
11. Shall consist of or have the equivalent of, at a minimum, a General Control Module and an Access Control Module. Both modules shall be programmable via a computer.
12. The General Control Module shall:
    a. Provide for full distributed processing of access control and alarm monitoring operations.
    b. Store the following information and function using a high speed, local 32-bit microprocessor:
        1) access levels
        2) hardware configurations
        3) programmed alarm outputs assigned at a administration client workstation
    c. Process all access granted/denied decisions to provide fast responses to card reader transactions. A fully configured general control module with 64 card readers shall require less than one-half (0.5) seconds to grant access to an authorized cardholder or deny access to an unauthorized cardholder.
    d. Meet the following minimum requirements:
        1) A minimum host communications speed of 115,200 bps.
        2) Support direct connect connections.
        3) Have remote dial up.
        4) Minimum on-board memory of eight (8) MB.
        5) Local Area Network (LAN) Support RJ45 (10/100baseT) Ethernet Interface Token Ring four (4) MB connectivity.
        6) Minimum memory storage of up to 5,000 cardholders and 100,000 events.
        7) Downstream ports for connecting card readers and data gathering panels via RS-485 multi-drop wiring configuration.
        8) Support of multiple card technologies.
        9) Supervised Communications with PACS system software.
        10) Support of up to eight card formats and facility codes.
        11) RS-485 Full Duplex, UL 1076 Grade AA communication channel to the system head-end.
        12) Integration with all manufacturers’ card readers.
        13) Biometric Interface Support.

14) 12 VAC or 12 volts direct current (VDC) input power via a UL certified step-down transformer or power supply.
15) Issue Code Support for both Magnetic and Wiegand Card Formats.
16) Individual Shunt Times
17) Up to Nine Digit PIN Codes.
18) Downstream serial RS-232 device support.
19) Status LED’s to identify normal component and communication status.

13. The access control module shall:
    a. Control up to 16 doors utilizing input and output relays that are fully programmable via network software.
    b. Input relays shall meet the following minimum requirements:
        1) Provide up to 16 UL 1076 analog unsupervised alarm input zones to monitor and report alarm conditions, power faults, and tampers.
        2) Operate independently and in conjunction with output relays, which will send an output signal to a corresponding output device upon alarm input activation. Once an alarm has been received, the input relay shall activate any or all alarm outputs.
        3) Contain the following features:
            a) UL 294 Certified.
            b) Alarm contact status scanning at up to 120 times per second for each zone.
            c) A low power Complementary-symmetry/metal-oxide semiconductor (CMOS) microprocessor.
            d) Filtered data for noise rejection to prevent false alarms.
            e) Up to 16 supervised inputs.
            f) 12 VAC or 12 VDC Input Power.
            g) Two (2) dedicated inputs for tamper and power status.
14. Output relays shall meet the following minimum requirements:
    a. Shall be capable of controlling a corresponding output device upon any input activation or on command from the PACS.
    b. Shall be capable of responding to:
        1) Input alarms.
        2) Commands from a System Operator.
        3) Time zone control commands for automatic operation.
    c. Shall be capable of:

1) Pulsing for a predetermined duration. Duration shall be programmable for each relay individually.
2) Responding on command from the System Operator to pulse, command on, command off, or reset to normal state.
3) Operating outputs rated at 5 amps (A) @ 30 VDC.

E. Electronic Security Management System (SMS) :

1. Shall allow the configuration of an enrollment and badging, alarm monitoring, administrative, asset management, digital video management, intrusion detection, visitor enrollment, remote access level management, and integrated client workstations or any combination of all or some.
2. Shall be expandable to support an unlimited number of individual module or integrated client workstations. All access control field hardware, including Intelligent System Controllers (ISC), shall be connected to all Windows 2003/2000/XP based access control system workstation on the network.
3. Shall have the ability to compose, file, maintain, update, and print reports for either individuals or the system as follows.
   a. Individual reports that consist of an employees name, office location, phone number or direct extension, and normal hours of operation. The report shall provide a detail listing of the employee's daily events in relation to accessing points within a facility.
   b. System reports shall be able to produce information on a daily/weekly/monthly basis for all events, alarms, and any other activity associated with a system user.
   c. All reports shall be in a date/time format and all information shall be clearly presented.
4. Shall be designed to allow it to work with any industry standard network protocol and topology listed below:
   a. Transmission Control Protocol (TCP)/IP
   b. Novell Netware (IPX/SPX)
   c. Banyan VINES
   d. IBM LAN Server (NetBEUI)
   e. Microsoft LAN Manager (NetBEUI)
   f. Network File System (NFS) Networks
   g. Remote Access Service (RAS) via ISDN, x.25, and standard phone lines.

5. Shall provide full interface and control of the PACS to include the following subsystems within the PACS:
   a. Public Key Infrastructure
   b. Card Management
   c. Identity and Access Management
   d. Personal Identity Verification
6. Shall have the following features or compatibilities:
   a. The ability to be operated locally or remotely via a LAN, WAN, internet, or intranet.
   b. Event and Alarm Monitoring
   c. Database Partitioning
   d. Ability to fully integrate with all other security subsystems
   e. Enhanced Monitoring Station with Split Screen Views
   f. Alternate and Extended Shunt by Door
   g. Escort Management
   h. Enhanced IT-based Password Protection
   i. N-man Rule and Occupancy Restrictions
   j. Open Journal Data Format for Enhanced Reporting
   k. Automated Personnel Import
   l. ODBC Support
   m. Windows 2000 Professional, Windows Server 2003, Windows XP Professionals for Servers
   n. Field-Level Audit Trail
   o. Cardholder Access Events

F. Card Readers and Credential Cards:
1. Shall be utilized for controlling the locking hardware on a door and allows for reporting back to the main control panel with the time/date the door was accessed, the name of the person accessing the point of entry, and its location.
2. Will be fully programmable and addressable, locally and remotely, and hardwired to the system.
3. Shall be individually home run to the main panel.
4. Shall be installed in a manner that they comply with:
   a. The Uniform Federal Accessibility Standards (UFAS)
   b. The Americans with Disabilities Act (ADA)
   c. The ADA Standards for Accessible Design
5. Shall support a variety of card readers that must encompass a wide functional range. The PACS may combine any of the card readers

described below for installations requiring multiple types of card reader capability (i.e., card only, card and/or PIN, supervised inputs, etc.). These card readers shall be available in the approved technology to meet FIPS 201 and is ISO 14443 A or B compliant. The reader output can be Wiegand, RS-22, 485 or TCP/IP.

6. Are to be housed in an aluminum bezel with a wide lead-in for easy card entry.
7. Shall contain read head electronics, and a sender to encode digital door control signals.
8. LED’s shall be utilized to indicate card reader status and access status.
9. Shall be able to support a user defined downloadable off-line mode of operation (e.g. locked, unlocked, or facility code), which will go in effect during loss of communication with the main control panel.
10. Shall provide audible feedback to indicate access granted/denied decisions. Upon a card swipe, two audible tones or beeps shall indicate access granted and three tones or beeps shall indicate access denied. All keypad buttons shall provide audible feedback.
11. Shall have a minimum of two programmable inputs and two programmable outputs.
12. Card readers shall come in the following formats:
    a. Contactless Smart Cards and Readers:
        1) Smart card readers shall read credential cards whose characteristics of size and technology meet those defined by ISO/IEC 7816, 14443, 15693.
        2) The readers shall have "flash" download capability to accommodate card format changes.
        3) The card reader shall have the capability of reading the card data and transmitting the data to the main monitoring panel.
        4) The card reader shall be contactless and meet or exceed the following technical characteristics:
            a) Data Output Formats: FIPS 201 low outputs the FASC-N in an assortment of Wiegand bit formats from 40 – 200 bits. FIPS 201 medium outputs a combination FASC-N and HMAC in an assortment of Wiegand bit formats from 32 – 232 bits. All Wiegand formats or the upgradeability from Low to Medium

Levels can be field configured with the use of a command card.

b) FIPS 201 readers shall be able to read, but not be limited to, DESfire and iCLASS cards.

Reader range shall comply with ISO standards 7816, 14443, and 15693, and also take into consideration conditions, are at a minimum 1” to 2” (2.5 – 5 cm).

b. Proximity (PROX) Card Reader:

1) Shall be utilized during the transition from the existing technology to the contactless smart card technology as defined in FIPS-201.

2) Shall use active/passive proximity detection and shall not require contact with the proximity credential card for operation.

a) Active detection proximity card readers shall provide power to compatible credential cards through magnetic induction and receive and decode a unique identification code number transmitted from the credential card.

b) Passive detection proximity card readers shall use a swept-frequency, radio frequency field generator to read the resonant frequencies of tuned circuits laminated into compatible credential cards. The resonant frequencies read shall constitute a unique identification code number.

3) Shall read proximity cards in a range from 0 to at least six (6) inches (0 to at least 15 cm) from the reader. The credential card design shall allow for a minimum of 32,000 unique identification codes per facility.

4) Shall be able to read cards from two (2) inches (5cm) to 6 inches (15cm).

5) The operating frequency shall be determined by the type of access control system being utilized.

G. Portal Control Devices:

1. Shall be used to assist the PACS.

2. Such devices shall:

a. Provide a means of monitoring the doors status.

b. Allow for exiting a space via either a push button, request to exit, or panic/crash bar.

c. Provide a means of override to the PACS via a keypad or key bypass.
d. Assist door operations utilizing automatic openers and closures.
e. Provide a secondary means of access to a space via a keypad.

3. Shall be connected to and monitored by the main PACS panel.
4. Shall be installed in a manner that they comply with:
   a. The Uniform Federal Accessibility Standards (UFAS)
   b. The Americans with Disabilities Act (ADA)
   c. The ADA Standards for Accessible Design
5. Shall provide a secondary means of access control within a secure area.

H. Door Status Indicators:

1. Shall monitor and report door status to the SMS.
2. Door Position Sensor:
   a. Shall provide an open or closed indication for all doors operated on the PACS and report directly to the SMS.
   b. Shall also provide alarm input for all doors operated by the PACS and all other doors that require monitoring.
   c. Switches for doors operated by the PACS shall be double pole double throw (DPDT). One side of the switch shall monitor door position and the other side if the switch shall report to the door status indicator system. For doors with electromagnetic locks a magnetic bonding sensor (MBS) can be used in place of one side of a DPDT switch, in turn allowing for the use of a single pole double throw (SPDT) switch in it place of a DPDT switch.
   d. Switches for doors not operated by the PACS shall be SPDT and report directly to the door status indicator system.
   e. Shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2” (5 cm).
3. Graphic System Annunciator:
   a. Composite lamination shall be made of clear Lexan and Lexan film graphic. Panel shall be hinged at the top with a continuous steel piano type hinge. The hinge shall be black anodized to match the background color of the graphic. Panel shall be lockable.
   b. All wiring connections to indicators and switches shall be made with connectors, thus, facilitating easy replacement in the field. The graphic picture of the floor plan, including all

accepted alternates, is to be made with Lexan graphic film, having all area background and accent colors applied to the back side of the film.

c. The working surface (face) of the graphic shall be of a textured and non-glare nature. The surface must be non-yellowing, durable, and scratch resistant. All black background areas shall be silk screened on the rear of the Lexan film. All areas, outlines that are an opaque color, shall be screened to the rear of the Lexan film.

d. The graphic film display of the area shall be photographically reproduced to a scale suitable to accommodate standard turret dimensions, using architecturally approved font.

e. System shall provide two (2) spare graphic films per panel for future replacement.

f. LED indicators are to be installed in sockets mounted in the graphic systems annunciator panel and shall be easily replaceable with all wiring terminations made with sockets for replacement without disassembly of graphic annunciator panel.

g. Panel shall have graphic floor plan as approved by VA.

h. Panel shall have lamp test and trouble silence buttons.

4. Graphic System Annunciator LED:

a. Door Status: There shall be a red LED indicator on the graphic panel at each monitored door and a list for each monitored door to indicate the status of the door. The LED shall be illuminated when the door is armed and flash when a violation occurs. All door status LEDs and their interconnecting wiring shall be supervised in their sockets such that an audible indication at the graphic panel shall be given if a LED is burned out, missing or disconnected. This supervision is typical for all LED indicators on the graphic panel.

5. Graphic System Annunciator Switches:

a. Provide low voltage two position, one form C, maintain goggle switches. These switches shall be grouped in order as approved by VA with the door identification written under each switch. Pressing down on a toggle switch shall disarm the corresponding door. Pressing up on a toggle switch shall arm the corresponding door.

6. Remote Annunciator:

a. Panel housing shall be aluminum and hinged at the top with a continuous steel piano type hinge. The hinge shall be black anodized to match. Panel shall be secured to the console with Medeco locks.
b. All wiring connections to indicators shall be made with connectors, thus, facilitating easy replacement in the field. The graphics shall be white photo-emulsion applied to smoked Plexiglass.
c. The working surface (face) of the panel shall be of a non-glare nature. The surface must be non-yellowing, durable, and scratch resistant.
d. LED indicators are to be installed in sockets mounted in the annunciator panel and shall be easily replaceable with all wiring terminations made with sockets for replacement without disassembly of the panel.
e. Panel shall have list of doors as chosen by VA with corresponding LEDs.
f. Panel shall have lamp test button.
g. Panel: 8 3/8" x 8 3/8". If panel is different size, coordinate with casework provider. Electrical Contractor is responsible for any added cost.

7. Remote Annunciator LED:
   a. Door Status: There shall be a red LED indicator for each monitored door to indicate the status of the door. The LED shall be illuminated when the door is armed and flash when a violation occurs. All door status LEDs and their interconnecting wiring shall be supervised in their sockets such that an audible indication at the panel shall be given if a LED is burned out, missing or disconnected. This supervision is typical for all LED indicators on panel.
8. Panel Audio Annunciator:
   a. An audio annunciator shall activate steadily to annunciate all abnormal or alarm conditions. This piezo may be silenced on the graphic system annunciator only, but the visual indications of the condition will persist until rectified.
9. Panic Button:
   a. Panic button shall be plunger type switch, double throw, stainless steel cover.

I. Entry Control Devices:

1. Shall be hardwired to the PACS main control panel and operated by a card reader.
2. Shall be fail-safe in the event of power failure to the PACS system.
3. Shall operate at 24 VCD, and be powered by a separate power supply dedicated to the door control system. Each power supply shall be rated to operate a minimum of two doors simultaneously without error to the system or overload the power supply unit.
4. Shall have a diode or metal-oxide veristor (MOV) to protect the controller and power supply from reverse current surges or back-check.
5. Electric Strikes/Bolts: Shall be:
   a. Made of heavy-duty construction and tamper resistant design.
   b. Tested to over one million cycles.
   c. Rated for a minimum of 1000 lbs. holding strength.
   d. Utilize an actuating solenoid for the strike/bolt. The solenoid shall move from fully open to fully closed position and back in not more than 500 milliseconds and be rated for continuous duty.
   e. Utilize a signal switch that will indicate to the system if the strike/bolt is not engaged or is unlocked when it should be secured.
   f. Flush mounted within the door frame.
6. Electric Mortise Locks: Shall be installed within the door and an electric transfer hinge shall be utilized to allow the wires to be transferred from the door frame to the lock. If utilized with a double door then the lock shall be installed inside the active leaf.
7. Electromagnetic Locks:
   a. These locks shall be without mechanical linkage utilizing no moving parts, and securing the door to its frame solely on electromagnetic force.
   b. Shall be comprised of two pieces, the mag-lock and the door plate. The mag-lock shall be surface mounted to the door frame and the door plate shall be surface mounted to the door.
   c. Ensure a diode or MOV is installed in line with the DC voltage supplying power to the unit in order to prevent back-check on the system when the mag-lock is powered.
   d. Shall utilize a magnetic bonding sensor (MBS) to monitor the door status and report that status to the SMS.

e. Electromagnetic locks shall meet the following minimum technical characteristics:

Operating Voltage		24 VDC
Current Draw		.5A
Holding Force	Swing Doors	1500 lbs (675 Kg)
	Sliding Doors	500 lbs (225 Kg)

J. Power Supplies:

1. Shall be UL rated and able to adequately power two entry control devices on a continuous base without failure.
2. Shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ 2 amp
OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC) 24 VDC Nominal (27.6 VDC) Filtered and Regulated
BATTERY	Dependant on Output Voltage shall provide up to 14 Ah
OUTPUT CURRENT	10 amp max. @ 13.8 VDC 5 amp max. @ 27.6 VDC
PRIMARY FUSE SIZE	6.3 amp (non-removable)
BATTERY FUSE SIZE	12 amp, 3AG
CHARGING CIRCUIT	Built-in standard

K. Wires and Cables

1. Shall meet or exceed the manufactures recommendations for power and signal.
2. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
3. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
4. All conduit, pull boxes, and junction boxes shall be clearly marked every with colored permanent tape or paint that will allow it to be distinguished from all other conduit and infrastructure.
5. Conduit fills shall not exceed 50 percent unless otherwise documented.
6. A pull rope shall be pulled along with signal and power cables to assist in future work.

7. At all locations where core drilling is conducted to allow for conduit to be installed, then fire stopping shall be applied to that area.
8. High power and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High power for the security system shall be defined as any cable or sets of cables carrying 30 VDC/VAC or higher.
9. Signal Cables:
   a. Shall meet or exceed all specifications and requirements called out by the manufactures.
   b. Shall be twisted pairs.
   c. All cables and conductors, except fiber optic cables, that act as a control, communication, or signal lines shall include surge protection. Surge protection shall be furnished at the equipment end and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 3 feet, (1 meter) of the building cable entrance. The inputs and outputs shall be tested in both normal and common mode using the following wave forms:
      1) A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and peak current of 60 amperes.
      2) An 8 microsecond rise time by 20 microsecond pulse width wave form with a peak voltage of 1000 volts and peak current of 500 amperes.
10. Power Cables:
   a. Shall be rated for either 110 or 220 VAC, 50 or 60 Hz, and shall comply with VA Master Spec 26 05 21 Low Voltage Electrical Power Conductors and Cables (600 Volts and Below).
   b. Shall be sized according and comply with the NEC. High voltage power cables will be a minimum of three conductors, 14 AWG, stranded, and coated with a non-conductive polyvinylchloride (PVC) jacket.
   c. Low Voltage Power Cables:
      1) All cables shall be a minimum of 18 AWG, Stranded and have a polyvinylchloride outer jacket.

2) Specific cable size shall determined using a basic voltage over distance calculation and shall comply with the NEC's requirements for low voltage cables.

d. All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used as a means of surge protection.

2.3 INSTALLATION KIT

A. General: The kit shall be provided that at, a minimum includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. All unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outlined are the minimum required installation sub-kits:

1. System Grounding:

a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.

b. This includes, but is not limited to:

1) Coaxial Cable Shields
2) Control Cable Shields
3) Data Cable Shields
4) Equipment Racks
5) Equipment Cabinets
6) Conduits
7) Cable Duct blocks
8) Cable Trays
9) Power Panels
10) Grounding
11) Connector Panels

2. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
3. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
4. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
5. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.
6. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to provide the system documentation as required by this document and explained herein.

PART 3

3.1 INSTALLATION

A. System installation shall be in accordance with UL 294, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.

B. Components shall be configured with appropriate “service points” to pinpoint system trouble in less than 30 minutes.

C. The Contractor shall install all system components including VA furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a operable system.

D. The PACS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated

with all associated security subsystems, whether the system is a stand alone or a network.

E. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system. The Contractor shall not take any corrective action without written permission from the VA.

F. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.

G. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.

H. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

I. Control Panels:
   1. Connect power and signal lines to the controller.
   2. Program the panel as outlined by the design and per the manufacturer’s programming guidelines.

J. SMS:
   1. Coordinate with the VA agency’s IT personnel to place the computer on the local LAN or Intranet and provide the security system protection levels required to insure only authorized VA personnel have access to the system.
   2. Program and set-up the SMS to ensure it is in fully operation.

K. Card Readers:
   1. Connect all signal inputs and outputs as shown and specified.

2. Terminate input signals as required.
3. Program and address the reader as per the design package.
4. Readers shall be surface or flushed mounted and all appropriate hardware shall be provided to ensure the unit is installed in an enclosed conduit system.

L. Portal Control Devices:
1. Install all signal input and output cables as well as all power cables.
2. Devices shall be surface or flush mounted as per the design package.
3. Program all devices and ensure they are working.

M. Door Status Indicators:
1. Install all signal input and output cables as well as all power cables.
2. Door position sensors shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2” (5 cm).

N. Entry Control Devices:
1. Install all signal input and power cables.
2. Strikes and bolts shall be mounted within the door frame.
3. Mortise locks shall be mounted within the door and an electric transfer hinge shall be utilized to transfer the wire from within the door frame to the mortise lock inside the door.
4. Electromagnetic locks shall be installed with the mag-lock mounted to the door frame and the metal plate mounted to the door.

O. System Start-Up:
1. The Contractor shall not apply power to the PACS until the following items have been completed:
   a. PACS equipment items and have been set up in accordance with manufacturer's instructions.
   b. A visual inspection of the PACS has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
   c. System wiring has been tested and verified as correctly connected as indicated.
   d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
   e. Power supplies to be connected to the PACS have been verified as the correct voltage, phasing, and frequency as indicated.

2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.

P. Supplemental Contractor Quality Control:

1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed PACS; and are approved by the Contracting Officer.
2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

3.2 TESTING AND TRAINING

All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

-----END----

SECTION 28 13 16

ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT

PART 1 – GENERAL

1.1 DESCRIPTION

Provide and install a complete Access Control System and Database Management as specified in this section.

1.2 RELATED WORK

A. For firestopping application and use, Section 07 84 00, FIRESTOPPING.

B. For all signage and labeling applications and use, Section 10 14 00, SIGNAGE.

C. For power connections and cables, Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).

D. For grounding of equipment, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

E. For infrastructure, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

F. For infrastructure, Section 26 05 36, CABLE TRAYS FOR ELECTRICAL SYSTEMS.

G. For perimeter lighting, Section 26 56 00, EXTERIOR LIGHTING.

H. For access control, Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEM (PACS).

I. For Warranty of Construction, Section 00 72 00, GENERAL CONDITIONS.

J. For General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

1.3 QUALITY ASSURANCE

A. The Contractor shall be responsible for providing, installing, and the operation of the Access Control System and Database Management as shown. The Contractor shall also provide certification as required.

B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a Information Technology (IT) computer network.

C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

D. The Contractor for the access control system shall be Vick Thomas Electric, Inc., P.O. Box 1735, Dublin, GA 31040, 478-272-9347.

1.4 SUBMITTALS

A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Provide certificates of compliance with Section 1.3, Quality Assurance.

C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.

D. Pre-installation design and as-built packages shall include, but not be limited to:

1. Index Sheet that shall:
   a. Define each page of the design package to include facility name, building name, floor, and sheet number.
   b. Provide a list of all security abbreviations and symbols.
   c. Reference all general notes that are utilized within the design package.
   d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
      1) Outline all general and job specific work required within the design package.
      2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
   a. Include a title block as defined above.
   b. Define the drawings scale in both standard and metric measurements.
   c. Provide device identification and location.
   d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
   e. Identify all pull box and conduit locations, sizes, and fill capacities.
   f. Address all general and drawing specific notes for a particular drawing sheet.
3. A riser drawing for each applicable security subsystem shall:
   a. Indicate the sequence of operation.

b. Relationship of integrated components on one diagram.
c. Include the number, size, identification, and maximum lengths of interconnecting wires.
d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.

4. A system drawing for each applicable security system shall:
   a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
   b. Provide full detail of all system components wiring from point-to-point.
   c. Identify wire types utilized for connection, interconnection with associate security subsystems.
   d. Show device locations that correspond to the floor plans.
   e. All general and drawing specific notes shall be included with the system drawings.
5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
   a. Device ID.
   b. Device Location (e.g. site, building, floor, room number, location, and description).
   c. Mounting type (e.g. flush, wall, surface, etc.).
   d. Power supply or circuit breaker and power panel number.
6. Detail and elevation drawings for all devices that define how they were installed and mounted.

E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
   1. 35 percent
   2. 65 percent
   3. 90 percent
   4. 100 percent

F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a

Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.

G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) 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)/Electronic Industries Alliance (EIA):
310D.....Racks, Panels, and Associated Equipment

C. National Electrical Manufactures Association (NEMA):
250-03.....Enclosures for Electrical Equipment

D. National Fire Protection Association (NFPA):
70-05.....Article 780-National Electrical Code

E. Underwriters Laboratories, Inc. (UL):
752-05.....Ballistic Level Protection (Class III)
827-96.....Central Station Alarm Services
1981-03.....Central Station Automation System

F. Uniform Federal Accessibility Standards (UFAS) 1984

G. Americans with Disabilities Act (ADA) 1975
ADA Standards for Accessible Design 1994

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment associated within the Access Control System and Database Management shall be UL 827 and UL 1981 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.

B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 96

hours of run time in the event of a loss of primary power to the facility.

C. The system shall be designed, installed, and programmed in a manner that will allow for easy of operation, programming, servicing, maintenance, testing, and upgrading of the system.

D. All equipment and materials for the system will be compatible to ensure correct operation.

2.2 EQUIPMENT ITEMS

A. The Access Control System and Database Management shall be set up as a Security System Network (SSN).

B. A SSN shall provide full interface with all components of the security subsystem as follows:

1. Shall allow for communication between the Access Control System and Database Management and all subordinate work and monitoring stations, local annunciation centers, the electronic Security Management System (SMS), and all other VA redundant or backup command center or other workstations locations.
2. Shall provide automatic continuous communication with all systems that are monitored by the Access Control System and Database Management, and shall automatically annunciate any communication failures or system alarms to the Access Control System and Database Management operator providing identification of the system, nature of the alarm, and location of the alarm.
3. Controlling devices shall be utilized to interface the Access Control System and Database Management with all field devices.
4. The Access Control System and Database Management and security console will be supported by an uninterrupted power supply (UPS) or dedicated backup generator power circuit.
5. The Access Control System and Database Management shall house the following equipment i.e. refer to individual master specifications for each security subsystem’s specific requirements:
   a. Security Console Bays and Equipment Racks
   b. PACS Monitoring and Controlling Equipment
   c. Main Panels for all Security Systems
   d. Power Supply Units (PSU) for all field devices
   e. Life safety and power monitoring equipment

f. All other building systems deemed necessary by the VA to include, but not limited to, heating, ventilation and air conditioning (HVAC), fire alarm monitoring, and other potential systems.

C. Remote/Secondary Access Control System and Database Management's: For facilities that have a remote, secondary back-up control console or workstation shall apply the following requirements:

1. The secondary stations shall match the requirements outlined in Sections 2.2.A-B.
2. Installation of an intercom station or telephone line shall be installed and provide direct one touch call-up for communications between the primary Access Control System and Database Management and secondary Access Control System and Database Management.
3. Secondary stations shall not have priority over a primary Access Control System and Database Management.
4. The primary Access Control System and Database Management shall have the ability to shut off power and a signal to a secondary control station in the event the area has been compromised.

D. Wires and Cables:

1. Shall meet or exceed the manufactures recommendation for power and signals.
2. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
3. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
4. All conduit, pull boxes, and junction boxes shall be marked with colored permanent tape or paint that will allow it to be distinguished from all other infrastructure conduit.
5. Conduit fills shall not exceed 50 percent unless otherwise documented.
6. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
7. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area.

8. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security subsystems shall be any cable or sets of cables carrying 30 VDC/VAC or higher.
9. For all equipment that is carrying digital data between the Access Control System and Database Management or at a remote monitoring station, it shall not be less that 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.
10. All cables and conductors, except fiber optic cables, that act as a control, communication, or signal lines shall include surge protection. Surge protection shall be furnished at the equipment end and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within three (3) ft. (one (1) m.) of the building cable entrance. The inputs and outputs shall be tested in both normal and common mode using the following wave forms:
    a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 watts and peak current of 60 amperes.
    b. An 8 microsecond rise time by 20 microsecond pulse width wave form with a peak voltage of 1000 volts and peak current of 500 amperes.
11. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. Fuses and relays shall not be used as a means of surge protection.

2.3 INSTALLATION KIT

A. General:

1. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. All unused and

partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outline the minimum required installation sub-kits to be used:

2. System Grounding:
   a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
   b. This includes, but is not limited to:
      1) Control Cable Shields
      2) Data Cable Shields
      3) Equipment Racks
      4) Equipment Cabinets
      5) Conduits
      6) Cable Duct blocks
      7) Cable Trays
      8) Power Panels
      9) Grounding
      10) Connector Panels
3. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
4. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
5. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
6. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.

7. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to provide the system documentation as required by this document and explained herein.

PART 3

3.1 INSTALLATION

A. System installation shall be in accordance with manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.

B. All equipment shall be installed per the design package and the manufacturer's installation specifications.

C. The Access Control System and Database Management will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a network.

D. For integration purposes, the Access Control System and Database Management shall operate and control the following associated security subsystems:

1. The Access Control System and Database Management shall be the central point of monitoring, controlling, programming, and recording all security subsystems utilizing the Electronic Security Management System (SMS).
2. The SMS shall utilize a central computer station that is capable of being connected to the VA's Local Area Network (LAN) or Internet.

E. Integration with security subsystems shall be achieved by computer programming and the direct hardwiring of the systems. Determination of methodology should be addressed and outlined in advance with the Contracting Officer prior to the system(s) is/are being designed and engineered.

F. For programming purposes, the Contractor shall refer to the manufacturer's requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.

G. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the

security subsystems. The Contractor shall not take any corrective action without written permission from the Contracting Officer.

H. System Startup:

1. The Contractor shall not apply power to the Access Control System and Database Management or security console until the following items have been completed:
   a. Access Control System and Database Management equipment items and have been set up in accordance with manufacturer's instructions.
   b. A visual inspection of the Access Control System and Database Management has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
   c. System wiring has been tested and verified as correctly connected as indicated.
   d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
   e. Power to be connected to all systems has been verified as the correct voltage, phasing, and frequency as indicated.
2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment installation efforts.

I. Supplemental Contractor Quality Control:

1. The following requirements supplement the contractor quality control requirements specified elsewhere in the contract:
   a. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed Access Control System and Database Management and security console; and are approved by the Contracting Officer in advance.
   b. The Contractor representatives will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
   c. The Contractor representatives shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
   d. The Contractor technical representatives shall participate in the testing and validation of the system and shall provide

certification that their respective system portions meet its contractual requirements.

3.2 TESTING AND TRAINING

All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

-----END----

SECTION 28 31 00

FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified.

B. Fire alarm systems shall comply with requirements of NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the Contracting Officer or his authorized representative. Installers shall have a minimum of two years experience installing fire alarm systems.

C. Fire alarm signals:

1. The building shall have an automatic audible fire alarm signal to notify occupants to evacuate.

D. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit located in the boiler plant.

E. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using the existing campus digital alarm communicator transmitter in accordance with NFPA 72.

1.2 SCOPE

A. A new fire alarm system shall be designed and installed in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and

this specification. Alarm system and zone notifications shall be integrated into facility's Simplex Grinnell system.

B. Basic Performance:

1. Alarm and trouble signals from the building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed five (5) seconds.
3. The signaling line circuits (SLC) between building fire alarm control units shall be wired Style 7 in accordance with NFPA 72. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.
4. Initiating device circuits (IDC) shall be wired Style B in accordance with NFPA 72.
5. Signaling line circuits (SLC) within buildings shall be wired Style 4 in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet of floor space or 3 floors whichever is less.
6. Notification appliance circuits (NAC) shall be wired Style Y in accordance with NFPA 72.

1.3 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS: Restoration of existing surfaces.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES: Procedures for submittals.

C. Section 07 84 00, FIRESTOPPING: Fire proofing wall penetrations.

D. Section 08 71 00, DOOR HARDWARE: Combination Closer-Holders.

E. Section 09 91 00, PAINTING: Painting for equipment and existing surfaces.

F. Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS: Sprinkler systems.

G. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements for items which are common to other Division 26 sections.

H. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and boxes for cables/wiring.

I. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW: Cables/wiring.

1.4 SUBMITTALS

A. General: Submit 4 copies and 1 reproducible 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 latest release and include all contractors' information. Layering shall be by VA criteria as provided by the Contracting Officer’s Technical Representative (COTR). Bid drawing files on AutoCAD 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. 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 zone. Show door holder 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 one (1) set of reproducible, as-built drawings, two blueline copies and one (1) set of the as-built drawing computer files using AutoCAD latest release. As-built drawings (floor plans) shall show all new and 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 manufacturers' installation limitations including but not limited to circuit length limitations.
   e. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
   f. Include information indicating who will provide emergency service and perform post contract maintenance.
   g. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
   h. 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.

i. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.

j. 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 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 equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

1.5 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 five (5) years from the date of acceptance of the entire installation by the Contracting Officer.

1.6 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 as well as all reused existing equipment connected to the fire alarm system. It shall include all interfaced equipment including but not limited to 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 site 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 VA. 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 VA. 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.

1.7 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.

B. National Fire Protection Association (NFPA):
70-2005.....National Electrical Code (NEC).
72-2002.....National Fire Alarm Code.
90A-2002.....Installation of Air Conditioning and Ventilating Systems.
101-2003.....Life Safety Code

C. Underwriters Laboratories, Inc. (UL):
2000-2000.....Fire Protection Equipment Directory

D. Factory Mutual Research Corp (FM): Approval Guide, 2005 Edition

E. American National Standards Institute (ANSI):
S3.41-1996.....Audible Emergency Evacuation Signal

F. International Code Council, International Building Code (IBC) 2003 Edition

1.8 MANUFACTURER

A. System shall be by Simplex Grinell to match existing campus system.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

A. All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers' requirements and that satisfactory total system operation has been achieved.

2.2 CONDUIT, BOXES, AND WIRE

A. Conduit shall be in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS and as follows:

1. All new 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. Wire:

1. All new wiring shall be installed in a conduit or raceway.
2. Wiring shall be in accordance with NEC article 760, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.
3. Addressable circuits and wiring used for the multiplex communication loop shall be twisted and shielded unless specifically accepted by the fire alarm equipment manufacturer in writing.
4. Any fire alarm system wiring that extends outside of the building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.
5. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.

C. Terminal Boxes, Junction Boxes, and Cabinets:

1. Shall be galvanized steel in accordance with UL requirements.
2. All boxes shall be sized and installed in accordance with NFPA 70.
3. 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 FIRE ALARM CONTROL UNIT

A. General:

1. The building shall be provided with a fire alarm control unit and shall operate as a supervised zoned fire alarm system. Fire alarm system shall be integrated with the facility’s master Simplex Grinnell fire alarm system.
2. Each power source shall be supervised from the other source for loss of power.
3. All circuits shall be monitored for integrity.
4. Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.
5. Transmit digital alarm information to the main fire alarm control unit.
6. Equipped with modular network communication card.
7. Unit shall include 80 character LCD display and shall include a keypad for use in entering and executing commands.
8. The unit shall have a strip printer mounted directly in the unit enclosure. The printer shall be U.L. listed.

B. Enclosure:

1. The control unit shall be housed in a cabinet suitable for both recessed and surface mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. Cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.

C. Power Supply:

1. The control unit shall derive its normal power from a 120 volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24 volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
2. The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door.
3. Power supply for smoke detectors shall be taken from the fire alarm control unit.

4. Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.
5. Provide new separate and direct ground lines to the outside to protect the equipment from unwanted grounds.

D. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.

E. Supervisory Devices: All sprinkler system valves, post indicator valves (PIV), and main gate valves shall be supervised for off-normal position. Closing a valve shall sound a supervisory signal at the control unit until silenced by an off switch. The specific location of all closed valves shall be identified at the control unit. Valve operation shall not cause an alarm signal. Low air pressure switches and duct detectors shall be monitored as supervisory signals.

F. Trouble signals:
1. Arrange the trouble signals for automatic reset (non-latching).
2. System trouble switch off and on lamps shall be visible through the control unit door.

G. Function Switches: Provide the following switches in addition to any other switches required for the system:
1. Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the main fire alarm control unit when in the "off" position. A system trouble signal shall be energized when switch is in the off position.
2. Alarm Off Switch: Shall disconnect power to alarm notification circuits on the local building alarm system. A system trouble signal shall be activated when switch is in the off position.
3. Trouble Silence Switch: Shall silence the trouble signal whenever the trouble silence switch is operated. This switch shall not reset the trouble signal.
4. Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in alarm until reset.
5. Lamp Test Switch: A test switch or other approved convenient means shall be provided to test the indicator lamps.

6. Drill Switch: Shall activate all notification devices without tripping the remote alarm transmitter. This switch is required only for general evacuation systems specified herein.
7. Door Holder By-Pass Switch: Shall prevent doors from releasing during fire alarm tests. A system trouble alarm shall be energized when switch is in the abnormal position.
8. HVAC/Smoke Damper By-Pass: Provide a means to disable HVAC fans from shutting down and/or smoke dampers from closing upon operation of an initiating device designed to interconnect with these devices.

H. Remote Transmissions:
1. Provide capability and equipment for transmission of alarm, supervisory and trouble signals to the main fire alarm control unit.
2. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

I. Remote Control Capability: The building fire alarm control unit shall be installed and programmed so that each must be reset locally after an alarm, before the main fire alarm control unit can be reset. After the local building fire alarm control unit has been reset, then the all system acknowledge, reset, silence or disabling functions can be operated by the main fire alarm control unit

J. System Expansion: Design the control units and enclosures so that the system can be expanded in the future (to include the addition of twenty percent more alarm initiating, alarm notification and door holder circuits) without disruption or replacement of the existing control unit and secondary power supply.

2.4 STANDBY POWER SUPPLY

A. Batteries:
1. Battery shall be of the sealed, maintenance free type, 24-volt nominal.
2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus five minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure.
3. Battery racks shall be steel with an alkali-resistant finish. Batteries shall be secured in seismic areas 2B, 3, or 4 as defined by the Uniform Building Code.

B. Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120-volt, 60 hertz emergency power source.
2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
3. Shall have protection to prevent discharge through the charger.
4. Shall have protection for overloads and short circuits on both AC and DC sides.
5. A trouble condition shall actuate the fire alarm trouble signal.
6. Charger shall have automatic AC line voltage regulation, automatic current-limiting features, and adjustable voltage controls.

2.5 ANNUNCIATION

A. Annunciator, Alphanumeric Type (System):

1. Shall be a supervised, LCD display containing a minimum of two lines of 40 characters for alarm annunciation in clear English text.
2. Message shall identify building number, floor, zone, etc on the first line and device description and status (pull station, smoke detector, waterflow alarm or trouble condition) on the second line.
3. The initial alarm received shall be indicated as such.
4. A selector switch shall be provided for viewing subsequent alarm messages.
5. The display shall be UL listed for fire alarm application.
6. Local building annunciators, for general evacuation system buildings, shall be permitted when shown on the drawings and approved by the COTR.

2.6 ALARM NOTIFICATION APPLIANCES

A. Strobes:

1. Xenon flash tube type minimum 15 candela in toilet rooms and 75 candela in all other areas with a flash rate of 1 HZ. Strobes shall be synchronized where required by the National Fire Alarm Code (NFPA 72).
2. Backplate shall be red with 13 mm (1/2 inch) permanent red letters. Lettering to read "Fire", be oriented on the wall or ceiling properly, and be visible from all viewing directions.
3. Each strobe circuit shall have a minimum of twenty (20) percent spare capacity.

4. Strobes may be combined with the audible notification appliances specified herein.

B. Fire Alarm Horns:

1. Shall be electric, utilizing solid state electronic technology operating on a nominal 24 VDC.
2. Shall be a minimum nominal rating of 80 dBA at ten feet.
3. Mount on removable adapter plates on conduit boxes.
4. Horns located outdoors shall be of weatherproof type with metal housing and protective grille.
5. Each horn circuit shall have a minimum of twenty (20) percent spare capacity.

C. Notification Appliance Circuit:

1. Notification Appliance Circuit provides synchronization of strobes at a rate of 1 Hz and operates horns with a March Time cadence operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash. The capability to synchronize multiple notification appliance circuits shall be provided.

2.7 ALARM INITIATING DEVICES

A. Manual Fire Alarm Stations:

1. Shall be non-breakglass, address reporting type.
2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
3. Stations shall be double action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE".
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.

B. Smoke Detectors:

1. Smoke detectors shall be UL listed for use with the fire alarm control unit being furnished.
2. Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be

installed in accordance with the manufacturer's recommendations and NFPA 72.

3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.
4. All spot type and duct type detectors installed shall be of the photoelectric type.
5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.
7. Detectors do not require resetting or readjustment after actuation to restore normal operation.
8. Each sensor base shall contain a magnetically actuated test switch for easy alarm testing at the sensor location.
9. Patient room smoke detectors shall have a sounder base, and shall annunciate through the nurse call corridor light.

C. Heat Detectors:

1. Heat detectors shall be of the addressable restorable rate compensated fixed-temperature spot type.
2. Detectors shall have a minimum smooth ceiling rating of 2500 square feet.
3. Intermediate temperature rated (200 degrees F) heat detectors shall be utilized in all areas.

D. Water Flow and Pressure Switches:

1. Wet pipe water flow switches and dry pipe alarm pressure switches for sprinkler systems shall be connected to the fire alarm system by way of an address reporting interface device.
2. All water flow switches shall be of a single manufacturer and series and non-accumulative retard type. See Section 21 12 00, FIRE-SUPPRESSION STANDPIPES and Section 21 13 13, WET-PIPE SPRINKLER

SYSTEMS for new switches added. Connect all switches shown on the approved shop drawings.

3. All switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Timing shall be recorded and documented during testing.

2.8 SUPERVISORY DEVICES

A. Duct Smoke Detectors:

1. Duct smoke detectors shall be provided and connected by way of an address reporting interface device. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Detector placement shall be such that there is uniform airflow in the cross section of the duct.
2. Interlocking with fans shall be provided in accordance with NFPA 90A and as specified hereinafter under Part 3.2, "TYPICAL OPERATION".
3. Provide remote indicator lamps, key test stations and identification nameplates (e.g. "DUCT SMOKE DETECTOR AHU-X") for all duct detectors. Locate key test stations in plain view on walls or ceilings so that they can be observed and operated from a normal standing position.

B. Sprinkler and Standpipe System Supervisory Switches:

1. Each sprinkler system water supply control valve, riser valve or zone control valve, and each standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valve shall be equipped with a supervisory switch.
3. Valve supervisory switches shall be connected to the fire alarm system by way of address reporting interface device. See Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches to be added. Connect tamper switches for all control valves shown on the approved shop drawings.

4. The mechanism shall be contained in a weatherproof die-cast aluminum housing that shall provide a 19 mm (3/4 inch) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The entire installed assembly shall be tamper-proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting.
6. Where dry-pipe sprinkler systems are installed, high and low air pressure switches shall be provided and monitored by way of an address reporting interface devices.

2.9 ADDRESS REPORTING INTERFACE DEVICE

A. Shall have unique addresses that reports directly to the building fire alarm panel.
B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.
C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.
D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.
E. Shall be mounted in weatherproof housings if mounted exterior to a building.

2.10 SMOKE BARRIER DOOR CONTROL

A. Electromagnetic Door Holders:
   1. New Door Holders shall be standard wall mounted electromagnetic type. In locations where doors do not come in contact with the wall when in the full open position, an extension post shall be added to the door bracket.
   2. Operation shall be by 24 volt DC supplied from a battery located at the fire alarm control unit. Door holders shall be coordinated as to voltage, ampere drain, and voltage drop with the battery, battery charger, wiring and fire alarm system for operation as specified.
B. A maximum of twelve door holders shall be provided for each circuit. Door holders shall be wired to allow releasing doors by smoke zone.
C. Door holder control circuits shall be electrically supervised.
D. Smoke detectors shall not be incorporated as an integral part of door holders.

E. Where combination holder-closer units are required to match existing, these devices are furnished and installed as per Section 08 71 00, DOOR HARDWARE. Connection and wiring shall be as herein specified.

2.11 UTILITY LOCKS AND KEYS:

A. All key operated test switches, control units, annunciator panels and lockable cabinets shall be provided with a single standardized utility lock and key.

B. Key-operated manual fire alarm stations shall have a single standardized lock and key separate from the control equipment.

C. All keys shall be delivered to the COTR.

2.12 SPARE AND REPLACEMENT PARTS

A. Provide spare and replacement parts as follows:

1. Manual pull stations - 2
2. Heat detectors - 2 of each type
3. Fire alarm strobes - 3
4. Smoke detectors - 3
5. Duct smoke detectors with all appurtenances - 1
6. Sprinkler system water flow switch - 1 of each size
7. Sprinkler system water pressure switch - 1 of each type
8. Sprinkler valve tamper switch - 1 of each type
9. Control equipment utility locksets - 5
10. Control equipment keys - 10
11. Fire alarm SLC cable (same as installed) – 152 m (200 feet)

B. Spare and replacement parts shall be in original packaging and submitted to the COTR.

C. Furnish and install a storage cabinet of sufficient size and suitable for storing spare equipment. Doors shall include a pad locking device. Padlock to be provided by the VA. Location of cabinet to be determined by the COTR.

D. Provide to the VA, all hardware, software, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

2.13 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 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 new conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.

C. All 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 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.

3.2 TYPICAL OPERATION

A. Activation of any manual pull station, water flow or pressure switch, heat detector, 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. Operation of a smoke detector at a corridor door used for automatic closing shall also release only the magnetic door holders in that smoke zone.

C. 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.

D. 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.

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 trouble shooting 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.

PART 4 - SCHEDULES

4.1 SMOKE ZONE DESCRIPTIONS:

A. There are three fire alarm zones in this building. Fire Alarm Zone 1: South part of building; Fire Alarm Zone 2: West part of building; Fire Alarm Zone 3: North part of building. Refer to fire alarm drawing (Sheet T101) for boundaries of each zone.

- - - END - - -

SECTION 31 20 00
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.

B. Site underground survey investigation and location is the responsibility of the general contractor. The VA will not provide any underground utility location, with the exception of what is included in the bid documents.

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 698 D 1557 AASHTO T 99 T 180.
   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 the **Geotechnical Report and** –

design requirements, excavate to acceptable strata subject to COTR'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 COTR. 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 COTR 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 COTR 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 and blasting operations: 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. Foundation system requirements: Section 31 23 23.33, FLOWABLE FILL.

H. Paving sub-grade requirements: Section 32 12 16, ASPHALT PAVING.

1.4 CLASSIFICATION OF EXCAVATION:

A. Unclassified Excavation: OMMITTED.

B. Classified Excavation: Removal and disposal of all material except that material not defined as Rock.

C. 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 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION:

A. Measurement: Cross section and measure uncovered and separated materials, and compute quantities by Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. Do not measure quantities beyond the following limits:
   1. 600 mm (24 inches) from outside face of concrete work for which forms are required, except for footings.
   2. 300 mm (12 inches) from outside of perimeter of formed footings.
   3. 150 mm (6 inches) below bottom of pipe and not more than pipe diameter plus 600 mm (24 inches) in width for pipe trenches.
   4. From outside dimensions of concrete work for which no forms are required (trenches, conduits, and similar items not requiring forms).

B. Payment for Differing Site Conditions: When rock excavation, as classified, is encountered, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable.

1.6 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 COTR:
   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 698 D 1557 AASHTO T 99 T 180 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.

1.7 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 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 Medical Center.

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 COTR. Remove materials from Medical 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 COTR. 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 Medical Center.

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 from a site survey that measured spot elevations and subsequently generated existing contours and spot elevations. Grades and spot elevations in the vicinity of the Wellness Center were taken from construction plans as provided during the design of this project by the client and had not been constructed at the time of preparation of these plans. 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 COTR of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify COTR 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 COTR, 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 COTR.
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. under disturbed foundations, as directed by COTR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by COTR.

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 COTR. Approval by the COTR 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 COTR.

D. Blasting: OMMITTED

E. 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.

F. 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.

G. 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 COTR.
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.

H. 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 COTR 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 COTR, 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 (1/2 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 COTR. 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 COTR 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 COTR 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 COTR.

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 COTR. 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 AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 95 percent.
   b. Curbs, curbs and gutters, AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A 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 AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 95 percent.
   d. Landscaped areas, top 400 mm (16 inches), AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 85 percent.
   e. Landscaped areas, below 400 mm (16 inches) of finished grade, AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A 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), AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 95 percent.
   b. Curbs, curbs and gutters, top 150 mm (6 inches), AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 95 percent.
   c. Under sidewalks, top 150 mm (6 inches), AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A 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 COTR 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 property.

B. Disposal: Transport surplus satisfactory soil to designated storage areas on Medical Center property. Stockpile or spread soil as directed by COTR.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.

C. Place excess excavated materials suitable for fill and/or backfill on site where directed.

D. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.

E. Segregate all excavated contaminated soil designated by the COTR from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

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 Medical Center Property .

----- E N D -----

SECTION 31 23 19
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 COTR. Obtain written approval from COTR before discontinuing operation of dewatering system.

----- E N D -----

SECTION 32 05 23
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, and combination curb and gutter wheel stop.

C. Pedestrian Pavement: Walks grade slabs wheelchair curb ramps terraces steps.

D. Vehicular Pavement: Service courts driveways.

E. Equipment Pads: Oxygen storage transformers propane tanks.

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 53, CAST-IN-PLACE-CONCRETE.

D. Metal Components of Steps (Nosing and Railing): Section 05 50 00, METAL FABRICATIONS.

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 53, 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 COTR, 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):

M31.....Deformed and Plain Billet Steel Bars for Concrete Reinforcement (ASTM A615/A615M-96A)

M55M/55M.....Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A185)

M147.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 1996)

M148.....Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309A)

M171.....Sheet Materials for Curing Concrete (ASTM C171

M182.....Burlap Cloth Made from Jute or Kenaf

M213.....Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)

T99.....Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop

T180.....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.....Ready-Mixed Concrete

C143/C143M.....Slump of Hydraulic Cement Concrete

PART 2 - PRODUCTS

2.1 GENERAL

Concrete shall be Type C, air-entrained as specified in Section 03 30 53, 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 or M42. Tie bars shall be deformed steel bars conforming to AASHTO M31 or M42.

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.

3.3 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 COTR 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 COTR 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 COTR before placing concrete.
B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the COTR 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 PLACING CONCRETE FOR VEHICULAR PAVEMENT

A. Deposit concrete into the forms as close as possible to its final position.
B. Place concrete rapidly and continuously between construction joints.
C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
D. Finish the surface to the elevation and crown as shown.
E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the COTR.

3.9 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.

3.10 CONCRETE FINISHING CURB AND GUTTER

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, gutter, and combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.11 CONCRETE FINISHING PEDESTRIAN PAVEMENT

A. Walks, Grade Slabs, Wheelchair Curb Ramps, Terraces, :

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.

B. Steps: The method of finishing the steps and the sidewalls is similar to above except as herein noted.

1. Remove the riser forms one at a time, starting with the top riser.
2. After removing the riser form, rub the face of the riser with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Use an outside edger to round the corner of the tread; use an inside edger to finish the corner at the bottom of the riser.
3. Give the risers and sidewall a final brush finish. The treads shall have a final finish with a stiff brush to provide a non-slip surface.
4. The texture of the completed steps shall present a neat and uniform appearance and shall not deviate from a straightedge test more than 5 mm (3/16 inch).

3.12 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

A. Accomplish longitudinal floating with a longitudinal float not less than 3000 mm (10 feet) long and 150 mm (6 inches) wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a sawing motion parallel to the direction in which the pavement is being laid from one side of the pavement to the other, and advancing not more than half the length of the float.

B. After the longitudinal floating is completed, but while the concrete is still plastic, eliminate minor irregularities in the pavement surfaces by means of metal floats, 1500 mm (5 feet) in length, and straightedges, 3000 mm (10 feet) in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.

C. Test the surface for trueness with a 3000 mm (10 foot) straightedge held in successive positions parallel and at right angles to the direction in which the pavement is being laid and the entire area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one half the length of the straightedge. Correct all irregularities and refinish the surface.

D. The finished surface of the pavement shall not vary more than 6 mm (1/4 inch) in both longitudinal and transverse directions when tested with a 3000 mm (10 foot) straightedge.

E. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).

F. When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a broomed finish with an approved fiber broom not less than 450 mm (18 inches) wide. Pull the broom gently over the surface of the pavement from edge to edge. Brooming shall be transverse to the line of traffic and so executed that the corrugations thus produced will be uniform in character and width, and not more than 3 mm (1/8 inch) in depth. Carefully finish the edge of the pavement along forms and at the joints with an edging tool. The brooming shall eliminate the flat surface left by the surface face of the edger.

G. The finish surfaces of new and existing abutting pavements shall coincide at their juncture.

3.13 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.

3.14 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.

3.15 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 and gutters by inserting 3 mm (1/8 inch) steel plates conforming to the cross sections of the curb and gutter .
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.

3.16 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.

3.17 CONSTRUCTION JOINTS

A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown.

B. Place transverse construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.

C. Use a butt-type joint with dowels in curb and gutter if the joint occurs at the location of a planned joint.

D. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb and gutter joint interval.

3.18 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.

3.20 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 COTR.

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.

3.21 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.

3.22 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 COTR, 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 COTR.

3.23 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

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SECTION 32 12 16
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 COTR 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 Georgia Department of Transportation State Highway Department.

2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by Georgia Department of Transportation State Highway Department.
3. Job-mix formula.

C. Certifications:
1. Asphalt prime and tack coat material certificate of conformance to Georgia Department of Transportation State Highway Department requirements.
2. Asphalt cement certificate of conformance to Georgia Department of Transportation State Highway Department requirements.
3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the Georgia Department of Transportation State Highway Specification.

D. One copy of Georgia Department of Transportation 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 and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the Georgia Department of Transportation 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 COTR 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 Georgia Department of Transportation 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 Georgia Department of Transportation State Highway Specifications, the Georgia Department of Transportation 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 Georgia Department of Transportation 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 COTR 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 32 17 23
PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall consist of furnishing and applying 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 COTR. 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-B-1325C.....Beads (Glass Spheres); Retro-Reflective

TT-P-1952D.....Paint, Traffic Black, and Airfield Marking, Waterborne

C. Master Painters Institute (MPI):

No. 97-2007.....Latex Traffic Marking Paint

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-1952D. 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 REFLECTIVE GLASS BEADS

Beads shall conform to Fed. Spec. TT-B-1325C, Type I, Gradation A. When used in regions of high humidity, coat beads with silicone or other suitable waterproofing material to assure free flow. Furnish the glass beads in containers suitable for handling and strong enough to prevent loss during shipment. A certificate shall accompany each batch of beads stating compliance with this section.

2.3 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.

2.4 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 COTR. The application of paint conforming to Fed. Spec. TT-P-1952 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 COTR 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 inchApply paint in one coat. At the direction of the COTR, 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 spotssmears, 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 COTR, 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 COTR, 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 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 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 DESCRIPTION

This work consists of all labor, materials, and equipment necessary for furnishing and installing chain link fence, gates and accessories in conformance with the lines, grades, and details as shown.

1.2 RELATED WORK

A. Grounding of fencing for enclosures of electrical equipment and for lightning protection as shown: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

B. Temporary Construction Fence: Section 01 00 00, GENERAL REQUIREMENTS.

C. Finish Grading: Section 31 20 00, EARTH MOVING , and Section 32 90 00, PLANTING .

D. Guard Booths: Section 13 34 19, METAL BUILDING SYSTEMS

E. Card readers and biometric devices: Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEMS

F. Intrusion alarm: Section 28 16 11, INTRUSION DETECTION SYSTEM

G. Security fences: Section 32 31 53, PERIMETER SECURITY FENCES AND GATES.

1.3 MANUFACTURER'S QUALIFICATIONS

Fence, gates, and accessories shall be products of manufacturers' regularly engaged in manufacturing items of type specified.

1.4 SUBMITTALS

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

1. Manufacturer's Literature and Data: Chain link fencing, gates and all accessories.
2. Manufacturer's Certificates: Zinc-coating complies with complies with specifications.

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):

A121-07.....Metallic Coated Carbon Steel Barbed Wire

A392-07.....Zinc-Coated Steel Chain-Link Fence Fabric

A817-07.....Metal-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire

C94/C94M-07.....Ready-Mixed Concrete

F567-07.....Installation of Chain-Link Fence

F626-(R2003).....Fence Fittings

F900-05.....Industrial and Commercial Swing Gates

F1043-06.....Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework

F1083-08.....Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

C. Federal Specifications (Fed. Spec.):

FF-P-110J.....Padlock, Changeable Combination

PART 2 - PRODUCTS

2.1 GENERAL

Materials shall conform to ASTM F1083 and ASTM A392 ferrous metals, zinc-coated; and detailed specifications forming the various parts thereto; and other requirements specified herein. Zinc-coat metal members (including fabric, gates, posts, rails, hardware and other ferrous metal items) after fabrication shall be reasonably free of excessive roughness, blisters and sal-ammoniac spots.

2.2 CHAIN-LINK FABRIC

ASTM A392 9 gauge wire woven in a 50 mm (2 inch) mesh. Top and bottom selvage shall have twisted and barbed finish. Zinc-coating weight shall be —340 grams/m^2 (1.2 ounces per square foot).

2.3 POST, FOR GATES AND FENCING

ASTM F1083, Grade SK-40A, round, zinc-coated steel. Dimensions and weights of posts shall conform to the tables in the ASTM Specification. Provide post braces and truss rods for each gate, corner, pull or end post. Provide truss rods with turnbuckles or other equivalent provisions for adjustment.

2.4 TOP RAIL AND BOTTOM RAIL

ASTM F1083, Grade SK-40A, round, zinc-coated steel. Dimensions and weights of posts shall conform to the tables in the ASTM Specification; fitted with suitable expansion sleeves and means for securing rail to each gate, corner, and end posts.

2.5 TOP AND BOTTOM TENSION WIRE

ASTM A817 and ASTM F626, zinc-coated, having minimum coating the same as the fence fabric.

2.6 ACCESSORIES

Accessories as necessary caps, rail and brace ends, wire ties or clips, braces and tension bands, tension bars, truss rods, and miscellaneous accessories conforming to ASTM F626

2.9 GATES

ASTM F900, type as shown. Gate framing, bracing, latches, and other hardware zinc-coating weight shall be the same as the FABRIC. Gate leaves more than 2400 mm (8 feet) wide shall have either intermediate members and diagonal truss rods, or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gates less than 2400 mm (8 feet) wide shall have truss rods or intermediate braces . Attach gate fabric to the gate frame by method standard with the manufacturer, except that welding will not be permitted. Arrange latches for padlocking so that padlock will be accessible from both sides of the gate regardless of the latching arrangement. When required, extend each end member of gate frame sufficiently above the top member or provide three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

2.10 GATE HARDWARE

A. Manufacturer's standard products, installed complete. The type of hinges shall allow gates to swing through 180 degrees, from closed to open position. Hang and secure gates in such a manner that, when locked, they cannot be lifted off hinges.

B. Provide stops and keepers for all double gates. Latches shall have a plunger-bar arranged to engage the center stop. Arrange latches for locking. Center stops shall consist of a device arranged to be set in

concrete and to engage a plunger bar. Keepers shall consist of a mechanical device for securing the free end of the gate when in full open position.

C. Padlocks for gates are specified under Section 08 71 00, DOOR HARDWARE. Padlocks shall have chains that are securely attached to the gate or gate post.

D. Equip gate openings with padlock conforming to Fed Spec FF-P-110H, Type EPC, size 50 mm (2 inch). Padlocks shall have chains that are securely attached to the gate or gate post. Before padlocks are delivered to project, submit sample to COTR for approval. Approved sample may be incorporated in work. Key padlock as directed by the COTR.

2.11 CONCRETE

ASTM C94/C94M, using 19 mm (3/4 inch) maximum-size aggregate, and having minimum compressive strength of 25 mPa (3000 psig) at 28 days. Non-shrinking grout shall consist of one part Portland cement to three parts clean, well-graded sand, non-shrinking grout additive and the minimum amount of water to produce a workable mix.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fence by properly trained crew, on previously prepared surfaces, to line and grade as shown. Install fence in accordance with ASTM F567 and with the manufacturer's printed installation instructions, except as modified herein or as shown. Maintain all equipment, tools, and machinery while on the project in sufficient quantities and capacities for proper installation of posts, chain links and accessories.

B. A Registered Professional Land Surveyor or Registered Civil Engineer specified in Section 01 00 00, GENERAL REQUIREMENTS, shall stake out and certify the fence alignment to meet the requirements as shown.

3.2 EXCAVATION

A. Excavation for concrete-embedded items shall be of the dimensions shown, except in bedrock. If bedrock is encountered before reaching the required depth, continue the excavation to the depth shown or 450 mm (18 inches) into the bedrock, whichever is less, and provide a minimum of 50 mm (2 inches) larger diameter than the outside diameter of the post. Clear loose material from post holes. Grade area around finished

concrete footings as shown and dispose of excess earth as directed by the COTR.

3.3 POST SETTING

A. Install posts plumb and in alignment. Set post in concrete footings of dimensions as shown, except in bedrock. Thoroughly compact concrete so as it to be free of voids and finished in a slope or dome to divert water running down the post away from the footing. Straight runs between braced posts shall not exceed 150 m (500 feet) . Install posts in bedrock with a minimum of 25 mm (one inch) of non-shrinking grout around each post. Thoroughly work non-shrinking grout into the hole so as to be free of voids and finished in a slope or dome. Cure concrete and grout a minimum of 72 hours before any further work is done on the posts.

3.4 POST SETTING IN STRUCTURES

Install post in retaining walls, curbs, concrete slabs, or similar construction in proper size galvanized pipe sleeves set into the concrete or built into the masonry as shown. Set sleeves plumb and 13 mm (1/2 inch) above the finished structure. Fill space solidly between sleeve and post with non-shrinking grout, molten lead, or sulphur, and finish to divert water running down the post away from the post base.

3.5 POST CAPS

Fit all exposed ends of post with caps. Provide caps that fit snugly and are weathertight. Where top rail is used, provide caps to accommodate the top rail. Install post caps as recommended by the manufacturer and as shown.

3.6 SUPPORTING ARMS

Design supporting arms, when required, to be weathertight. Where top rail is used, provide arms to accommodate the top rail. Install supporting arms as recommended by the manufacturer and as shown.

3.7 TOP RAILS AND BOTTOM RAILS

Install rails before installing chain link fabric. Provide suitable means for securing rail ends to terminal and intermediate post. Top rails shall pass through intermediate post supporting arms or caps as shown. The rails shall have expansion couplings (rail sleeves) spaced

as recommended by the manufacturer. Where fence is located on top of a wall, install expansion couplings over expansion joints in wall.

3.8 TOP AND BOTTOM TENSION WIRE

Install and pull taut tension wire before installing the chain-link fabric.

3.9 ACCESSORIES

Supply accessories (posts braces, tension bands, tension bars, truss rods, and miscellaneous accessories), as required and recommended by the manufacturer, to accommodate the installation of a complete fence, with fabric that is taut and attached properly to posts, rails, and tension wire.

3.10 FABRIC

Pull fabric taut and secured with wire ties or clips to the top rail bottom rail and tension wire close to both sides of each post and at intervals of not more than 600 mm (24 inches) on centers. Secure fabric to posts using stretcher bars and ties or clips.

3.11 BARBED WIRE

Install barbed wire, when required, on supporting arms above the fence posts. Extend each end member of gate frames sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Pull each strand taut and securely fasten to each supporting arm and extended member.

3.12 GATES

Install gates plumb, level, and secure for full opening without interference. Set keepers, stops and other accessories into concrete as required by the manufacturer and as shown. Adjust hardware for smooth operation and lubricate where necessary.

3.13 REPAIR OF GALVANIZED SURFACES

Use galvanized repair compound, stick form, or other method, where galvanized surfaces need field or shop repair. Repair surfaces in accordance with the manufacturer's printed directions.

3.14 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the station.

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SECTION 32 84 00
PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

An automatically-controlled—irrigation system, complete, including piping, backflow preventer, sprinkler heads, valves, controls, control wiring, fittings, electrical connections and necessary accessories.

1.2 RELATED WORK

A. Concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.
B. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
C. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
D. Protection of Materials and Equipment: 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.
E. Division 26, ELECTRICAL.
F. Section 32 90 00, PLANTING

1.3 QUALITY ASSURANCE

A. Criteria:
   1. Manufacturer regularly and presently manufactures the item submitted as one of their principal products.
   2. There is a permanent service organization, maintained or trained by the manufacturer, which will render satisfactory service within eight hours of receipt of notification that service is requested.
   3. Installer, or supplier of a service, has technical qualifications, experience, and trained personnel and facilities to perform the specified work.
B. Products Criteria:
   1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units are products of one manufacturer.
   2. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.

a. All components of an assembled unit need not be products of the same manufacturer but component parts which are alike are the product of a single manufacturer.
b. Components are compatible with each other and with the total assembly for the intended service.

3. Nameplates: Nameplate bearing manufacturer's name or identification 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.

C. System Requirements:

1. Full and complete coverage is required. Contractor shall, at no additional cost to the Government, make necessary adjustments to layout required to achieve full coverage of irrigated areas without overthrow on roadways, sidewalks, window wells, or buildings and to protect trees from close high spray velocity.
2. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown. Lines are to be common trenched wherever possible.
3. Locations of remote control valves is schematic. Remote control valves shall be grouped wherever possible and aligned at a set dimension back of curb along roads.
4. Irrigation lines and control wire shall run through designated utility lanes, beside walks or beside roadways where possible.

D. Maintenance and Operating Instructions: Prior to final acceptance, verbal instructions, for a period of not less than four (4) hours, shall be provided to the operating personnel. Provide manuals as specified in Section 01 00 00, GENERAL REQUIREMENTS.

E. Completely program controller according to approved irrigation schedule.

F. Follow manufacturer's instructions for installation.

G. Manufacturer of Control Systems to certify Control System is complete, including all related components, and totally operational. Submit certificate to COTR.

H. As-Built Record Drawings: Maintain a complete set of as-built drawings which shall be corrected daily to show changes in locations of all pipe, valves, pumps and related irrigation equipment. Valves shall be shown with dimensions to reference points.

I. Controller Chart:

1. Prepare a map diagram showing location of all valves, lateral lines, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. "As-built" drawings must be approved before charts are prepared.
2. Provide one controller chart showing the area covered by controller for each automatic controller supplied at the maximum size controller door will allow. Chart shall be a reduced drawing of the actual "as-built" system. If controller sequence is not legible when the drawing is reduced to door size, the drawing shall be enlarged to a size that is readable and placed folded, in a sealed plastic container, inside the controller door.
3. Chart shall be a blackline print with a different color used to show area of coverage for each station. Charts must be completed and approved prior to final inspection of the irrigation system.

1.4 SUBMITTALS

A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturers' Literature and Data:

1. Piping.
2. Jointing materials.
3. Valves.
4. Backflow preventer.
5. Pressure gages.
6. Automatic control equipment.
7. Sprinkler heads.
8. Quick couplers.
9. Valve boxes.

C. Complete detailed layout shop drawings covering design of system showing pipe sizes and lengths; fittings, locations, types and sizes of sprinkler heads; controls; backflow preventers; valves; location and mounting details of electrical control equipment; complete wiring diagram showing routes and wire sizes; wiring details and source of current. Do not start work before final shop drawing approval.

D. Name and address of a permanent service organization maintained or trained by the manufacturers that will render satisfactory service within eight hours of receipt of notification that service is requested.

E. Reproducible "as-built" drawings.

F. After "as-built" drawings have been approved, submit print of controller chart.

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.):

AA-60005.....Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole

C. American National Standard Institute (ANSI):

B40.1-98.....Gauges-Pressure Indicating Dial Type-Elastic Element

D. American Society of Sanitary Engineers (ASSE):

1013-2005.....Reduced Pressure Principle Backflow Preventers

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

B61-02.....Steam or Valve Bronze Castings

B62-02.....Composition Bronze or Ounce Metal Castings

D1785-04a.....Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120

D2241-04b.....Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

D2287-96(2001).....Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

D2464-99e1.....Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D2466-05.....Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

D2564-04.....Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems

D2855-96(2002).....Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F. American Water Works Association (AWWA):

C110/A21.10-03.....Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch for Water

C111/A21.11-00.....Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

C115/A21.15-99.....Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

C151/A21.51-02.....Ductile-Iron Pipe, Centrifugally Cast, for Water C153/A21.53-00 Ductile-Iron Compact Fittings for Water Service

C500-02.....Metal-seated Gate Valves for Water Supply Service C504-00 Rubber Seated Butterfly Valves

C600-99.....Installation of Ductile-Iron Water Mains and Their Appurtenances

G. Manufacturers Standardization Society (MSS):

SP70-1998.....Cast Iron gate Valves, Flanged and Thread Ends

H. National Electrical Manufacturers Association (NEMA):

250-2003.....Enclosures for Electrical Equipment (1000 Volts Maximum);

PART 2 - PRODUCTS

2.1 PIPING

A. Irrigation Mains: Polyvinyl Chloride (PVC) Pressure Pipe, AWWA C900, PVC 1120, working pressure 1025 kPa (150 psi). Pipe shall conform to outside diameters of AWWA 151 cast iron pressure pipe to accommodate cast iron fittings.

B. Irrigation Laterals: Polyvinyl Chloride, ASTM D2241, PVC 1120, SDR 21, solvent welded.

C. Threaded Pipe: Polyvinyl Chloride, ASTM D1785, PVC 1120, Schedule 80, for threaded connections, risers and swing joints.

D. Fittings:

1. Irrigation Mains (PVC Pipe): AWWA 110.
2. Irrigation Laterals: PVC, schedule 40, solvent welded socket type, ASTM D2466.
3. Threaded Pipe: PVC, schedule 80, ASTM D2464.
4. Swing Joints: Threaded fittings with elastomeric seals that allow 360 degree rotation, and designed for minimum 1375 kPa (200 psig) working pressure, may be used in lieu of standard threaded fittings.

E. Jointing Materials:

1. Irrigation Mains: Rubber gaskets, AWWA C111.

2. Irrigation Laterals: Solvent cement, ASTM D2564.

2.2 VALVES (EXCEPT REMOTE CONTROL VALVES)

A. Underground Shut-Off Valves: Provide One of the Following:
   1. Gate valves 50 mm (2 inches) and larger: Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 1025 kPa (150 psi) minimum working pressure. AWWA C504.
   2. Butterfly valves 80 mm (3 inches) and larger: cast iron body with stainless steel shaft, ductile iron valve disc and resilient rubber coated, 1025 kPa (150 psi) minimum pressure. AWWA C504.
   3. Ball valves (for isolation valves 1-1/2” and smaller): Full-port ball valves with bronze body, PTFE seats, and 90 degree on/off handle. Ball valves to have NPT female end connections.

B. Operations:
   1. Underground: furnish valves with 50 mm (2 inch) nut for T-Handle socket wrench operation.
   2. Above ground and in pits: MSS SP70, with handwheels.
   3. All butterfly valves 150 mm (6 inches) and above shall have enclosed gear drive operators.
   4. Ends of valves shall accommodate the type of pipe installed.

C. Check: Swing.
   1. Smaller than 100 mm (4 inches): Bronze body and bonnet, ASTM B61 or B62, 850 kPa (125 pound) WSP.
   2. One hundred mm (4 inches) and larger: Iron body, bronze trim, vertical or horizontal installation, flange connection, 1375 kPa (200 pound) WOG.

D. Pressure Reducing Valve: Cast steel body with renewable seats, with stainless steel trim. Flow passages and all parts designed to withstand high velocity applications, flange connected.

2.3 VALVE BOX

A. Gate and Butterfly Valve: Valve boxes shall be precast concrete (from Rigid Cast Iron Forms) with compressive strength of the concrete in excess of 30 Mpa (4000 psi). Box shall be of such length to be adapted to depth of cover required over pipe at valve location. Mark box cover to differentiate between lawn irrigation system and domestic water supply system and set flush with finished grade. Provide two (2) "T"

handle socket wrenches of 15 mm (5/8 inch) round stock with sufficient length to extend 600 mm (2 feet) above top of deepest valve box cover.

B. Remote Control Valves: In planter areas, valve boxes shall be HDPE structural foam Type A, Class III, green in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with key-lockable hinged cast iron cover.
   1. After installation, label boxes with two 80 mm (3 inch) size stencils designated controller and circuit numbers with permanent white epoxy paint. Numbers shall be placed at center of valve cover and shall face nearest main road or service road.
   2. Furnish two (2) 750 mm (30 inch) long valve adjustment keys.

2.4 BACKFLOW PREVENTER

Provide reduced pressure principle backflow preventer in each new connection to existing water distribution system, ASSE 1013, except pressure drop at design flow shall not exceed 70 kPa (10 psi).

2.5 FRAMES AND COVERS

A. When not in roadway:
   1. Fed. Spec. RR-F-621. Cast Iron. Provide covers with cast-in identification symbol "WATER".
   2. Frame: Figure 1, Type I, Style A, Size 30A.
   3. Cover: Figure 8, Type A, Size 30A
B. When in roadway use traffic rated frame and cover.

2.6 AUTOMATIC CONTROL EQUIPMENT—INDEPENDENT ELECTRIC CONTROLLER WITH NO FLOW SENSING (FOR SMALLER INSTALLATIONS)

A. Overall control concept: The electric automatic control system shall consist of one controller which operates individual remote control valves in accordance with timing schedules programmed into the independent unit. The location of the controller is shown on the drawings. Rainbird Controller, or equal.
B. 4 independent programs.
C. Seven (7) day calendar, odd/even day or day interval options of one (1) to thirty (30) days.
D. Exclude a day option to allow for the selection of specific day(s) not to water.
E. Three hundred sixty-five (365) day clock/calendar.
F. Station run times of one (1) minute to ten (10) hours in one (1) minute increments.

G. 16 total start times.
H. Start time stacking within each program.
I. Season adjust setting from ten (10) to two hundred (200) percent in ten (10) percent increments.
J. Rain delay setting from one (1) to seven (7) days
K. Automatic, semi-automatic, and manual and timed-manual operation.
L. 10 position programming dial and LCD display.
M. Lightning surge protection.
N. Self-diagnostic circuit breakers that identify and override electrical malfunction of valves.
O. Non-volatile memory to retain power during power failures of any duration.
P. Battery backup to maintain accurate time for up to ninety (90) days.
Q. Weather-resistant, locking metal cabinet with heavy duty internal transformer.

2.7 REMOTE CONTROL VALVES:

A. Each sprinkler section shall be automatically operated by a remote control valve installed underground and operated by a 24-volt AC electric solenoid. Valves shall be globe type of heavy duty construction and shall have manual shut-off and flow control adjustment and provide for manual operation. Install valves with unions on each side to allow for easy removal. Valves shall have a minimum of 1025 kPa (150 psi) working pressure.
B. Valves shall be of all brass construction furnished as straight or angle pattern type, or valve body shall be cast-iron with brass bonnet, trim and renewable seat and have two inlet tappings (furnished with one plugged) to allow installation as either a straight or angle pattern valve.
C. Valves shall be completely serviceable from the top without removing valve body from the system. Furnish two (2) 750 mm (30 inch) long adjustment keys. Valves to operate at no more than 50 kPa (7 psi) pressure loss at manufacturers maximum recommended flow rate.

2.8 SPRINKLER HEADS

A. Shall be of make, type and performance as indicated on drawings. The entire internal assembly including filter screen, to be capable of removal from the top without removing the sprinkler case from the riser.

B. Rotary Pop-up Sprinklers: To be gear-driven.

1. Full Circle Sprinklers: To be a dual or tri-nozzle combination type with positive drive by means of a water-driven gear assembly. Sprinkler head to rotate uniformly and to be driven by means of a train of gears. Sprinklers to be equipped with an integral anti-drain valve to be self-closing at pressures of 3.0m (10 feet) of head or less. Gears and pinions shall be assembled on stainless steel spindles in a water-lubricated sandproof gear case. An inlet screen shall prevent debris from entering the sprinkler and shall be removable with the internal assembly. Sprinklers outer case shall be constructed of corrosion resistant, impact resistant, heavy-duty ABS.
2. Part circle sprinklers to be variable arc type as required with same type drive used for full circle heads.

C. Shrub Spray Heads: Nozzle shall be pop-up or fixed spray type of standard, undersize or oversize configuration as noted on plans. The sprinkler body, stem, nozzle and screen shall be constructed of heavy-duty, ultraviolet resistant plastic. It shall have a heavy duty stainless steel retract spring and a ratcheting system for alignment of the pattern. The sprinkler shall have a soft elastomer pressure-activated comolded wiper seal for cleaning debris from the pop-up stem. The sprinkler shall have a plastic or brass nozzle with an adjusting screw capable of regulating the radius and flow. The sprinkler shall be capable of housing protective, nonclogging filter screens or pressure compensating screens (PCS) under the nozzle.

2.9 QUICK COUPLERS

A. Shall have all parts contained in a two-piece unit and shall consist of a coupler water seal valve assembly and a removable upper body to allow the spring and key track to be serviced without shut down of the main.

B. Metal parts shall be brass.

C. Lids shall be lockable vinyl covered and have springs for positive closure on key removal.

D. Furnish two (2) hose swivels and operating keys for each size coupler to the COTR.

2.10 LOW VOLTAGE CONTROL VALVE WIRE

Wire: Solid copper wire, Underwriters Laboratories Inc. approved for direct burial in ground. Size of wire shall be in accordance with manufacturer's recommendations, but in no case less than No. 14.

2.11 SPLICING MATERIALS: EPOXY WATERPROOF SEALING PACKET. LOW VOLTAGE CONTROLLER CABLE

Multi-strand cable, Underwriters Laboratories Inc. approved for direct burial in ground. Size and type of wire shall be in accordance with manufacturer’s recommendations.

2.12 SLEEVE MATERIAL

PVC-1120-5DR 17, Schedule 40.

2.13 WARNING TAPE

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, detectable type blue with black letters (if potable water), or purple with black letters (if reclaimed or untreated well water), and imprinted with “CAUTION BURIED IRRIGATION WATER LINE BELOW”.”

A. TRACER WIRES

No. 14, Green, Type TW plastic-coated copper tracer wire shall be installed with non-metallic irrigation main lines.

PART 3 - EXECUTION

3.1 PIPE LAYING - GENERAL

A. Do not lay pipe on unstable material, in wet trench or when, in the opinion of COTR, trench or weather conditions are unsuitable for the work.

B. Concrete thrust block shall be installed where the irrigation main changes direction as at ells and tees and where the irrigation main terminates. Pressure tests shall not be made for a period of 36 hours following the completion of pouring of the thrust blocks. Concrete thrust blocks for supply mains shall be sized and placed in strict accordance with the pipe manufacturer's specifications and shall be of an adequate size and so placed as to take all thrust created by the maximum internal water pressure.

C. Allow a minimum of 80 mm (3 inches) between parallel pipes in the same trench.

D. Hold pipe securely in place while joint is being made.

E. Do not work over, or walk on, pipe in trenches until covered by layers of earth well tamped in place to a depth of 300 mm (12 inches) over pipe.

F. Full length of each section of pipe shall rest upon the pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipe on wood blocking.

G. Install sprinkler lines to avoid heating trenches, electric ducts, storm and sanitary sewer lines, and existing water and gas mains, all of which have right of way.

H. Clean interior of pipe of foreign matter before installation. Keep pipe clean during laying operations by means of plugs or other methods. When work is not in progress, securely close open ends of pipe and fittings to prevent water, earth, or other substances from entering.

I. Each sprinkler section shall drain to waste valves placed at lowest points in the system. Waste valves shall discharge to drainage pits composed of 3 foot long vertical sections of 600 mm (24 inch) diameter sewer pipe placed under the lawn areas. Fill pipe with gravel and cover with 50 mm (2 inch) precast concrete cover before backfilling. Waste valves may also discharge to storm sewers, where available.

J. Minimum cover over water mains shall be 750 mm (30 inches). Control valves shall never be less than 80 mm (3 inches) below finished grade. Cover laterals to minimum depth of 600mm (24 inches).

K. Existing sidewalks and curbs shall not be cut during trenching and installation of pipe. Install pipe under sidewalks and curbs by jacking, auger boring, or by tunneling. Repair or replace any concrete that cracks, due to settling, during the warranty period.

L. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

M. Warning tape shall be continuously placed 300 mm (12 inches) above sprinkler system water mains and laterals.

3.2 LAYING PLASTIC PIPE

A. Shall be snaked in trench at least 1 meter to 100 meters (1 foot per 100 feet) to allow for thermal construction and expansion and to reduce strain on connections.

B. Joints

1. Solvent Welded Socket Type: ASTM D2855.

2. Threaded Type: Apply liquid teflon thread lubricant of teflon thread type. After joint is made hand tight (hard), a strap wrench should be used to make up to two additional full turns.
3. Elastomeric Gasket: ASTM F477.
   a. Immediately before joining two lengths of PVC pipe, the inside of the bell or coupling, the outside of the spigot and the elastomeric gasket shall be thoroughly cleaned to remove all foreign material.
   b. Lubrication of the joint and rubber gasket shall be done in accordance with the pipe manufacturer's specifications.
   c. Care shall be taken that only the correct elastomeric gasket, compatible with the annular groove of the bell, is used. Insertion of the elastomeric gasket in the annular groove of the bell or coupling shall be in accordance with the manufacturer's recommendations. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint.
   d. The spigot and bell or coupling shall be aligned and pushed until the reference line on the spigot is flush with the end of the bell or coupling. Pushing shall be done in a smooth, steady motion.

3.3 INSTALLATION OF SPRINKLERS AND QUICK COUPLERS

A. Sprinkler heads and quick couplers shall be placed on temporary nipples extending at least 80 mm (3 inches) above finished grade. After turf is established, remove temporary nipples, ensuring that no dirt or foreign matter enters outlet, and install sprinkler heads and quick couplers at ground surface as detailed.
B. Place part-circle rotary sprinkler heads no more than 150 mm (6 inches) from edge, of and flush with top of adjacent walks, header boards, curbs, and mowing aprons, or paved areas at time of installation.
C. Install all shrub sprays, sprinklers and quick couplers on swing joints as detailed on plans.
D. Set shrub heads 200 mm (8 inches) above grade and 300 mm (1 foot) from edge of curb or pavement. Place adjacent to walls. Stake heads prior to backfilling trenches. Stakes to be parallel to riser.
E. Install sprinklers and quick coupling valves on a swing joint assembly.

3.4 INSTALLATION OF CONTROL WIRING

A. Wiring from master controllers to satellites and stub-cuts for future extension shall be located in trench with new mains or in separate trench at back of curb, unless cross-country route is shown. Locate in trench with mains when possible on cross-country routes.

B. Wiring bundles located with piping shall be set with top of the bundle below top of the pipe. No two wires in any bundle shall be of the same color. Wires shall be bundled, and tied or taped at 4.5 m (15 foot) intervals. A numbered tag shall be provided at each end of a wire, i.e., at valve, at field located controllers and at master controller. The number at each end of wire to be the same.

C. Splicing shall be held to a minimum. A pullbox shall be provided at each splice. No splices will be allowed between field located controllers and remote control valves.

D. Provide 300 mm (12 inch) expansion loops in wiring at each wire connection or change in wire direction. Provide 600 mm (24 inch) loop at remote control valves.

E. Power wiring for the operation of irrigation system shall not be run in same conduit as control wiring.

3.5 Tracer Wire installation

A. Tracer wire shall be installed on bottom of trench, adjacent to vertical pipe projections, carefully installed to avoid stress from backfilling, and shall be continuous throughout length of pipe with spliced joints soldered and covered with insulation type tape.

B. Tracer wire shall follow main line pipe and branch lines and terminate in yard box with gate valve controlling these main irrigation lines. Provide sufficient length of wire to reach finish grade, bend back end of wire to make a loop and attach a Dymo-Tape type plastic label with designation "Tracer Wire."

C. Record locations of tracer wires and their terminations on project record documents.

3.6 SETTING OF VALVES

A. No valves shall be set under roads, pavement or walks.

B. Clean interior of valves of foreign matter before installation.

C. Where pressure control valves are installed adjacent to remote control valve, they shall be housed in the same valve box.

D. Set valve box cover flush with finished grade.

3.7 SLEEVING

A. Furnish and install where pipe and control wires pass under walks, paving, walls, and other similar areas.

B. Sleeving to be twice line size or greater to accommodate retrieval for repair of wiring or piping and shall extend 300 mm (12 inches) beyond edges of paving or construction.

C. Bed sleeves with a minimum of 100 mm (4 inches) of sand backfill above top of pipe.

3.8 TEST AND FLUSHING

A. Pressure Test: Pressure test lines before joint areas are backfilled. Backfill a minimum of 300 mm (12 inches) over the pipe to maintain pipe stability during test period. Test piping at hydraulic pressure of 1025 kPa (150 psi) for two hours. Maximum loss shall be 3 L/25 mm pipe diameter/300 m (0.8 gallons/inch pipe diameter/1000-feet). Locate pump at low point in line and apply pressure gradually. Install pressure gage shut-off valve and safety blow-off valve between pressure source and piping. Inspect each joint and repair leaks. Line shall be retested until satisfactory.

B. Flushing: After testing, flush system with a minimum of 150 percent of operating flow passing through each pipe beginning with larger mains and continuing through smaller mains in sequence. Flush lines before installing sprinkler heads and quick couplers.

C. Operation Test: Upon completion of the final adjustment of the sprinkler heads to permanent level at ground surface, test each sprinkler section by the pan test and visual test to indicate a uniform distribution within any one sprinkler head area and over the entire area. Operate the entire installation to demonstrate the complete and successful operation of all equipment.

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SECTION 32 90 00

PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

This work consists of furnishing and installing all planting materials required for landscaping hereinafter specified in locations as shown.

1.2 EQUIPMENT

Maintain all equipment, tools and machinery while on the project in sufficient quantities and capacity for proper execution of the work.

1.3 RELATED WORK

A. Section 31 20 00, EARTH MOVING, Stripping Topsoil and Stock Piling.
B. Section 01 45 29, TESTING LABORATORY SERVICES, Topsoil Testing.
C. Section 31 20 00, EARTH MOVING, Topsoil Materials.
D. Section 32 84 00, PLANTING IRRIGATION.
E. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.4 SUBMITTALS

A. Samples: Submit the following samples for approval before work is started:

Organic Mulch	2.3 kg (5 pounds) of each type to be used.
Pre-Emergent Herbicide	2.3 kg (5 pounds) of each type to be used.

B. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the COTR for approval:
   1. Plant Materials (Department of Agriculture certification by State Nursery Inspector declaring material to be free from insects and disease).
   2. Fertilizers.
   3. Lime
   4. Peat
   5. Membranes
C. Manufacturer's Literature and Data:

1. Metal edging
2. Antidesiccant
3. Pre-emergent herbicide

1.5 DELIVERY AND STORAGE

A. Delivery:
1. Notify the COTR of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant material from the job site immediately.
2. Protect plants during delivery to prevent damage to root balls or desiccation of leaves. Protect trees during transport by tying in the branches and covering all exposed branches.
3. 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.
4. Deliver fertilizer to the site in the original, unopened containers bearing the manufacturer's warranteed chemical analysis, name, trade name or trademark, and in conformance to state and federal law. In lieu of containers,fertilizer may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.

B. Storage:
1. Store plants not installed on the day of arrival at the site as follows:
   a. Shade and protect plants from the wind when stored outside.
   b. Heel in bare root plants.
   c. Protect plants stored on the project from drying out at all times by covering the balls or roots with moist sawdust, wood chips, shredded bark, peat moss, or other similar mulching material.
   d. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.

1.6 PLANTING AND TURF INSTALLATION SEASONS AND CONDITIONS

A. Perform operations within the following dates: From March 15—to June 15 for spring and from September 15 to November 15 for fall—but not before irrigation system installed, tested, and approved.

B. No work shall be done when the ground is frozen, snow covered, too wet or in an otherwise unsuitable condition for planting. Special conditions may exist that warrants a variance in the specified planting

dates or conditions. Submit a written request to the COTR stating the special conditions and proposal variance.

1.7 PLANT ESTABLISHMENT PERIOD

A. The Establishment Period for plants shall begin immediately after installation, with the approval of the COTR, and continue for a minimum of ninety (90) days. During the Plant Establishment Period the Contractor shall:

1. Water all plants to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is the equivalent of 25 mm (1 inch) of absorbed water per week either through natural rainfall or augmented by periodic watering. Apply water at a moderate rate so as not to displace the mulch or flood the plants.
2. Prune plants and replace mulch as required.
3. Replace and restore stakes, guy wires, and eroded plant saucers as required.
4. In plant beds and saucers, remove grass, weeds, and other undesired vegetation, including the root growth, before they reach a height of 75 mm (3 inches).
5. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the COTR.
6. Remove plants that die during this period and replace each plant with one of the same size and species.

1.8 PLANT WARRANTY

A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of FAR clause 52.246-21, including the following supplements:

1. A One Year Plant Warranty will begin on the date that the Government accepts the project or phase for beneficial use and occupancy. The Contractor shall have completed, located, and installed all plants according to the plans and specifications. All plants are expected to be living and in a healthy condition at the time of final inspection.
2. The Contractor will replace any dead plant material immediately. A one year warranty for the plants that was replaced, will begin on the day the work is completed.

3. Replacement of relocated plants, that the Contractor did not supply, is not required unless they die from improper handling and care during transplanting. Loss through Contractor negligence requires replacement in kind and size.
4. The Government will reinspect all plants at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material immediately. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification. The Contractor shall also comply with the following requirements:
   a. Replace dead, missing or defective plant material prior to final inspection.
   b. Mulch and weed plant beds and saucers. Just prior to this inspection, treat these areas to a second application of approved pre-emergent herbicide.
   c. From plants having been installed for one year, remove stakes, guy wires and any required tree wrappings.
   d. Complete remedial measures directed by the COTR to ensure plant survival.
   e. Repair damage caused while making plant replacements.

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 basic designation only.

B. American National Standards Institute (ANSI) Publications:

ANSI Z60.1-04.....Nursery Stock

ANSI Z133.1-06.....Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush- Safety Requirements

C. Hortus Third, A Concise Dictionary of Plants Cultivated in the U.S. and Canada.

D. American Society for Testing and Materials (ASTM) Publications:

C136-06.....Sieve Analysis of Fine and Coarse Aggregates

C516-02.....Vermiculite Loose Fill Thermal Insulation

C549-06.....Perlite Loose Fill Insulation

D977-05.....Emulsified Asphalt (AASTHO M140)

D2028-97 (Rev. 2004)....Cutback Asphalt (Rapid-curing Type)

D2103-05.....Polyethylene Film and Sheeting

PART 2 - PRODUCTS

2.1 GENERAL

All plant material will conform to the varieties specified or shown in the plant list and be true to botanical name as listed in Hortus Third.

2.2 PLANTS

A. Plants shall be in accordance with ANSI Z60.1, except as otherwise stated in the specifications or shown on the plans. Where the drawings or specifications are in conflict with ANSI Z60.1, the drawings and specification shall prevail.

B. Provide well-branched and formed planting stock, sound, vigorous, and free from disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems. Provide trees, deciduous and evergreen, that are single trunked with a single leader, unless otherwise indicated, display no weak crotches. Provide symmetrically developed deciduous trees and shrubs of uniform habit of growth, with straight boles or stems and free from objectionable disfigurements, and evergreen trees and shrubs with well developed symmetrical tops with typical spread of branches for each particular species or variety. Provide ground cover and vine plants with the number and length of runners for the size specified, and 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.

C. 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 COTR, 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.

D. 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.

E. 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.
F. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
G. NO substitutions will be permitted.

2.3 LABELS

Each plant, or group and bundles or containers of the same species, variety, and size of plant, shall be legibly tagged with a durable, waterproof and weather-resistant label indicating the correct plant name and size specified in the plant list. Labels shall be securely attached and not be removed.

2.4 TOPSOIL

A. Topsoil shall be a well-graded soil of good uniform quality. It shall be a natural, friable soil representative of productive soils in the vicinity. Topsoil shall be free of admixture of subsoil, foreign matter, objects larger than 25 mm (one inch) in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and shall have a pH value of not less than 5.0 nor more than 7.5.
B. Obtain material from stockpiles established under Section 31 20 00, EARTH MOVING, subparagraph, Stripping Topsoil, that meet the general requirements as stated above. Amend topsoil not meeting the pH range specified by the addition of pH Adjusters.
C. If sufficient topsoil is not available on the site to meet the depth as specified herein, the Contractor shall furnish additional topsoil. At least 10 days prior to topsoil delivery, notify the COTR of the source(s) from which topsoil is to be furnished. Obtain topsoil from well drained areas. Additional topsoil shall meet the general requirements as stated above and comply with the requirements specified in Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting the pH range specified by the addition of pH adjusters.

2.5 LIME

Lime shall be agricultural limestone containing not less than 90 percent calcium and magnesium carbonates. Lime must be ground to such a fineness that not less than 90% must pass No. 8 mesh and not less than 25% must pass No. 100 mesh. Moisture is not to exceed 10%.

2.6 SOIL CONDITIONERS

A. Peat shall be a natural product of sphagnum moss peat derived from a fresh-water site conforming to Fed. Spec. Q-P-166, except as otherwise specified.

B. Coarse Sand
Coarse concrete sand, ASTM C-33 Fine Aggregate, shall be clean, sharp, free of limestone, shale and slate particles and of toxic materials.

C. Perlite shall conform to ASTM C549.

D. Vermiculite shall be horticultural grade and free of any toxic materials and conform to ASTM C516.

E. Organic Matter shall be commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

F. Fertilizer: Agricultural fertilizer of a formula indicated by the soil test. Fertilizers shall be organic, slow-release compositions whenever applicable

2.7 PLANTING SOIL MIXTURE

The planting soil mixture shall be composed of two (2) parts topsoil, and one (1) part sphagnum moss peat.

2.8 PLANT FERTILIZER

A. Provide plant fertilizer that is commercial grade and uniform in composition and conforms to applicable state and federal regulations.

B. For new plant material, provide packet, table, or pellet forms of slow release fertilizers, bearing the manufacturer's warranteed statement of analysis. Slow release fertilizers shall contain a minimum percentage by weight of 16% nitrogen, 8% available phosphoric acid, and 16%potash.

2.9 MEMBRANES

A. Landscape Fabric shall be a woven needle-punched polypropylene weighing 113 grams per square meter (4.8 oz. per sq. yd.) And a 950 liter per minute flow rate per sq. meter. (90 gal. per minute flow rate per sq. ft.)

2.10 MULCH

A. Mulch shall be free from deleterious materials and shall be stored as to prevent inclusion of foreign material.

B. Organic mulch materials shall be shredded hardwood.

2.11 TREE WRAP

A. Crinkle Paper Tree wrap shall be two thicknesses of crinkled paper cemented together with a layer of bituminous material. Wrapping material shall be a minimum of 100 mm (4 inches) in width and have a stretch factor of 33-1/3 percent. Twine for tying shall be lightly tarred medium or coarse sisal yarn.

B. Tree wrap shall be secured to the trunk using bio-degradable tape suitable for nursery use and which is expected to degrade in sunlight in less than two years after installation

2.12 STAKES AND GUYING WIRES

A. Provide stakes for tree support of rough sawn wood, free from knots, rot, cross grain, or other defects that would impair the strength. Stakes shall be a minimum of 50 mm by 50 mm (2 inches by 2 inches), or 65 mm (2-1/2 inches) in diameter, by 2400 mm (8 feet) long and pointed at one end.

B. Guying wire shall be 2.7 mm (12 gage) annealed galvanized steel.

C. Hose chafing guards shall be new or used 2-ply reinforced rubber or plastic hose of all the same color on the project.

D. Flags to be fastened to guys shall be surveyor's plastic tape, white in color and 150 mm (6 inches) in length.

E. Eye bolts shall be galvanized or cadmium plated having a 50 mm (one inch) diameter eye with a minimum screw length of 40 mm (1-1/2 inches).

2.13 EDGING

Metal edging shall be galvanized steel or aluminum with slots provided for stakes and shall be 5 mm (3/16 inch) thick by 100 mm (4 inches) deep in standard lengths. Steel edging shall be treated with a rust preventative coating and factory finished in color green. Anchoring stakes shall be of similar material and 400 to 450 mm (16 to 18 inches) long and tapered.

2.14 WATER

Water shall not contain elements toxic to plant life. It shall be obtained from on site sources as specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph, Temporary Services at no cost to the Contractor.

2.15 ANTIDESICCANT

Antidesiccant shall be an emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

PART 3 - EXECUTION

3.1 LAYOUT

Stake plant material locations and bed outlines on project site for approval by the COTR before any plant pits or beds are dug. The COTR may approve adjustments to plant material locations to meet field conditions.

3.2 EXCAVATION FOR PLANTING

A. Prior to excavating for plant pits and bed, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turf before excavations are made in a manner that will protect turf areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.

B. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. Where underground utilities, construction, or solid rock ledges are encountered, the COTR may select other locations for plant material.

C. Dig plant pits by any approved method so that they have vertical sides and flat bottoms. When pits are dug with an auger and the sides of the pits become glazed, scarify the glazed surface. Size the plant pits as shown, otherwise, the minimum allowable dimensions of plant pits shall be regardless of width, 150 mm (6 inches) deeper for shrubs and 225 mm (9 inches) deeper for trees than the depth of ball or root spread; for ball or root spread up to 600 mm (2 feet), pit diameters shall be twice the ball or root spread; for ball or root spread from 600 to 1200 mm (2 to 4 feet), pit diameters shall be 600 mm (2 feet) greater; for ball or root spread over 1200 mm (4 feet), pit diameters shall be 1-1/2 times the ball or root spread.

D. Where ground cover and planting beds occur in existing turf areas, remove turf to a depth that will ensure the removal of the entire root system, with additional bed preparation as specified in the next paragraph.

E. Where existing soil is to be used in place, till new ground cover and plant beds to a depth of 100 mm (4 inches). Spread soil amendment uniformly over the bed to depth of 50 mm (2 inches) and thoroughly incorporate it into the existing soil to a depth of 100 mm (4 inches) using a roto-tiller or similar type of equipment to obtain a uniform and well pulverized soil mix. Where existing soil is compacted (former roadways, parking lots, etc.) till the soil down to a depth necessary to support the growth of new planting. During tillage operations, remove all sticks, stones, roots, and other objectionable materials. Bring plant beds to a smooth and even surface conforming to established grades.

F. In areas of new grading where existing soil is being replaced for the construction of new ground cover and plant beds, remove 100 mm (4 inches) of existing soil and replace with topsoil. Plant beds shall be brought to a smooth and even surface conforming to established grades.

G. Using topsoil, form earth saucers or water basins for watering around plants. Basins to be 2” high for shrubs and 4” high for trees.

H. Treat plant saucers, shrub, and ground cover bed areas, prior to mulching, with an approved pre-emergent herbicide. Plant ground cover in areas to receive erosion control material through the material after material is in place.

3.3 SETTING PLANTS

A. Handle balled and burlapped and container-grown plants only by the ball or container. Remove container-grown plants in such a way to prevent damage to plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around the roots or ball. Set plants so that the root crown is 1” higher than the surrounding grade. Plant ground cover plants after the mulch is in place. Avoid contaminating the mulch with the planting soil. Add slow release packet, tablet or pellet fertilizer as each plant is installed as per manufacturer's recommendation for method of installation and quantity.

B. Backfill balled and burlapped and container-grown plants with planting soil mixture as specified to approximately half the depth of the ball and then tamp and water. For balled and burlapped plants, carefully remove excess burlap and tying materials and fold back. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of

backfill Planting Soil Mixture; then form earth saucers or water basins around isolated plants with topsoil.

3.4 TRUNK WRAPPING

Wrap the trunks of deciduous trees immediately after planting. Wrap the trunks of deciduous trees, 40 mm (1-1/2 inches) or greater in caliber with the specified material beginning at the base and extending to the first branches. Remove wrapping after one year. When using Crinkled Paper Wrap, securely tie wrapping at the top and bottom and at 450 mm (18 inch) maximum intervals with twine.

3.5 STAKING AND GUYING

A. Stake and guy plants as shown on the drawings and as specified.
B. Fasten flags securely on each guy approximately 2/3 of the distance up from ground level.
C. Remove stakes and guy wires after one year.

3.6 EDGING PLANT BEDS

A. Uniformly edge beds using a sharp tool to provide a clear cut division line between the planted area and the adjacent lawn.
B. Install metal edging materials in accordance with manufacturer's recommendations and as shown on the plans.

3.7 MULCHING PLANTS

A. Mulch within 48 hours after planting and applying a pre-emergent herbicide. Do not mulch in ground cover areas that shall have organic material placed before planting.
B. Placing Inert Material: Place Landscape fabric with edges lapped 150 mm to 300 mm (6 inches to 12 inches) to receive inert mulch material.
C. Placing Organic Material: Spread a mulch to a uniform minimum thickness of 50 mm (2 inches).
D. Keep mulch out of the crowns of shrubs and off buildings, sidewalks, light standards, and other structures.

3.8 PRUNING

A. Prune new plant material in the following manner: Remove dead, broken and crossing branches. Prune deciduous trees and shrubs to reduce total amount of anticipated foliage by 1/4 to 1/3 while retaining typical growth habit of individual plants with as much height and spread as is practicable. Make cuts with sharp instruments as close as possible to the branch collar. Do not make flush cuts. Do not make "Headback" cuts

at right angles to line of growth. Do not pole trees or remove the leader. Remove trimmings from the site. Paint cuts 13 mm (1/2 inch) in diameter and larger with the specified tree wound dressing.

3.9 RESTORATION AND CLEAN-UP

Where existing or new turf areas have been damaged or scarred during planting and construction operations, restore disturbed area to their original condition. Keep at least one paved pedestrian access route and one paved vehicular access route to each building clean at all times. In areas where planting and turf work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas is completed. Remove all landscape contractor related debris, rubbish and excess material from the station.

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SECTION 33 10 00
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.
F. Fire protection system connection, Section 21 10 00, WATER-BASED FIRE-SUPPRESSION SYSTEMS.

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 Health Department 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 and Polyvinyl Chloride (PVC) shall be in accordance with AWWA C600 and C605 respectively; and shall be provided to COTR 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
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
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 POLYVINYL CHLORIDE PIPE AND FITTINGS:

A. Class-Rated Polyvinyl Chloride (PVC) Pipe:

1. PVC pipe and accessories 100 mm to 356 mm (4 inches–14 inches) in diameter, AWWA C900 “Polyvinyl Chloride (PVC) Pressure Pipe”, Class 200, DR 14, cast iron outside diameters, unless otherwise shown or specified.
2. PVC pipe and accessories 400 mm (16 inches) or larger, AWWA C905, “Polyvinyl Chloride Water Transmission Pipe”, Class 235, DR 18, cast iron outside diameters unless otherwise shown or specified. Pipe and accessories shall bear the NSF mark indicating pipe size,

manufacturer's name, AWWA and/or ASTM Specification number, working pressure and production code. Pipe and couplings shall be made in accordance with ASTM D1784.

3. PVC Pipe and Accessories Smaller than 100 mm (4 inches): Schedule 80, meeting the requirements of ASTM D-1785, Type 1, Grade 1. All exposed piping shall be CPVC meeting requirements of ASTM F441.

B. Joints:

1. Pipe 75 mm (3 inches) and Greater in Diameter: Push-on type with factory installed solid cross section elastomeric ring meeting the requirements of ASTM F-477.
2. Pipe Less Than 75 mm (3 inches) in Diameter: Threaded (ASTM D-2464) or solvent welded (ASTM 2467). Use Teflon tape or liquid Teflon thread lubricant approved for use on plastic on all threaded joints.

C. Fittings:

1. Class-Rated Pipe 75 mm (3 inches) in Diameter and Greater: Ductile iron with mechanical joints conforming to the requirements of AWWA C153.
2. For Schedule 80 Pipe less than 75 mm (3 inches) in Diameter: Threaded or solvent weld. Threaded PVC fittings shall conform to ASTM D2464. CPVC fittings shall conform to ASTM F437 for threaded fittings and ASTM F439 for solvent weld fittings.

2.2 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.

2.3 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.

2.4 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.

2.5 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.

2.6 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 those in use at station.

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 _0__ wrenches with handles not less than 350 mm (14 inches) long. (note – no new fire hydrants are proposed)

2.7 PIPE SLEEVES:

Ductile iron or zinc coated steel.

2.8 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.

2.9 WATER METER:

Furnish and install meter approved by Water Service Utility. Forward approval. Integrate meter into facility's wireless meter network.

2.10 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).

2.11 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".

2.12 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.

2.13 POTABLE WATER:

Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.14 DISINFECTION CHLORINE:

A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.
C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5.g tablets, and shall contain 65 percent chlorine by weight.

2.15 WARNING TAPE

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, 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 COTR.
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.

3.5 PVC PIPE:

A. PVC piping shall be installed in strict accordance with the manufacturer’s instructions and AWWA 605. Place selected material and thoroughly compacted to one foot above the top of the pipe and thereafter back filled as specified in Section 31 20 00, EARTH MOVING.
B. Copper Tracer Wire: Copper tracer wire consisting of No. 14 AWG solid, single conductor, insulated copper wire shall be installed in the trench with all piping to permit location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation from the wire and soldering with rosin core solder. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 300 m (1000 feet), provide a 2.3 kg (5 pound) magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall be attached at the end of each line.
C. Magnetic markers may be used in lieu of copper tracer wire to aid in future pipe locating. Generally, install markers on 6 m (20 foot) centers. If pipe is in a congested piping area, install on 3 m (10 foot) centers. Prepare as-built drawing indicating exact location of magnetic markers.

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 or PVC pipe equivalent to water main standards of construction 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).

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 Health Department of the State. 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 COTR office.
3. Polyvinyl Chloride (PVC) AWWA C605.Provide to COTR 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 COTR.

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SECTION 33 30 00
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. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.

E. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

F. Sanitary Sewer Pumping Facilities, Division 22, 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 and Ladders.

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
A625/A625M-03.....Tin Mill Products, Black Plate, Single Reduced
A746-03.....Ductile Iron Gravity Sewer Pipe
C12-06.....Installing Vitrified Clay Pipe Lines
C76-05b/C76M-05b.....Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
C139-05.....Concrete Masonry Units for Construction of Catch Basins and Manholes
C150-05.....Portland Cement
C425-04.....Compression Joints for Vitrified Clay Pipe and Fittings
C478-06a/C478M-06a.....Precast Reinforced Concrete Manhole Sections
C700-05.....Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
C828-03.....Low-Pressure Air Test of Vitrified Clay Pipe Lines

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

D2992-01.....Practice for Obtaining Hydrostatic or Pressure Design Basis for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings

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

D3261-03.....Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

D3350-05.....Polyethylene Plastics Pipe and Fittings Materials

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

F714-05.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

F794-03.....Poly (Vinyl Chloride)(PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

F894-05.....Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

F949-03.....Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings

C. American Water Works Association (AWWA):

C105/A21.5-05.....Polyethylene Encasement for Ductile Iron Pipe Systems

C110/A21.10-03.....Ductile-Iron and Gray-Iron Fittings for Water

C111/A21.11-00.....Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings

C115-99.....Flanged Ductile-Iron Pipe with Threaded Flanges

C116-03.....Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron Pipe and Gray Iron Fittings for Water Supply Service

C151-/A21.51-02 Ductile-Iron Pipe, Centrifugally Cast for Water

C153-00 Ductile-Iron Compact Fittings for Water Services

C508-01.....Swing Check Valves for Waterworks, 2 inches (50 mm) Through 24 inches (600 mm) NPS

C509-01.....Resilient Seated Gate Valves for Water-Supply Service

C515-01.....Reduced-Wall, Resilient-Seated Gate Valves For Water Supply Service

C512-04.....Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

C550-05.....Protective Epoxy Interior Coatings for Valves and Hydrants

C600-05.....Installation for Ductile-Iron Water Mains and Their Appurtenances

C605-94.....Underground Installation of Polyvinyl (PVC) Pressure Pipe and Fittings for Water

C900-97 .....Polyvinyl Chloride (PVC) Pressure Pipe, 100 mm (4 inches) Through 300 mm (12 inches) for Water Distribution

C905-97.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 350 mm through 1,200 mm (14 Inches through 48 Inches), for Water Transmission and Distribution

C906-99.....Polyethylene (PE) Pressure Pipes and Fittings, 100 mm through 1575 mm (4 Inches through 63 Inches), for Water Distribution

D. 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

E. 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 26 . 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.

b. Pipe and fittings, 450 to 900 mm (18 to 36 inches) in diameter, shall be solid wall or have a corrugated or ribbed exterior profile and a smooth interior. Pipe shall conform to the following:

1) Pipe and fittings shall conform to ASTM F949 corrugated sewer pipe with a smooth interior. The corrugated outer wall shall be fused to the smooth interwall at the corrugation valley. Pipe and fitting shall have a smooth bell, elastomeric joints conforming to ASTM D3212, and shall have a minimum pipe stiffness of 350 kPa (50 psi) at 5 percent deflection, when tested in accordance with ASTM D2412. Corrugation shall be perpendicular to the axis of the pipe to allow gaskets to be installed on field cut sections of pipe without the requirement for special fittings.

2) Ribbed wall PVC pipe and fittings shall conform to ASTM F794 ribbed sewer pipe with smooth interior pipe and fittings shall have a smooth bell, elastomeric joints conforming to ASTM D3212, and shall have a minimum pipe stiffness of 320 kPa (46 psi) when tested in accordance with ASTM D 2412, at 5 percent

vertical deflection. Joints shall not leak at 7.6 m (25 feet) of head under 5 percent deflection.

3) Solid wall pipe and fittings shall conform to ASTM F679, SDR 26 pipe and fittings shall gaskets conforming to ASTM F477, and shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi).

2.2 JOINTING MATERIAL:

A. Gravity Flow Lines:

3. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.

2.3 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 COTR. 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 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.

3.3 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 COTR.

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.

3.4 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).

3.5 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. Ductile Iron Piping: NOT USED.
   2. Vitrified Clay Piping: NOT USED.
   3. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
   4. High Density Polyethylene (HDPE) Piping: NOT USED

3.6 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 1/8 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.

3.7 INSPECTION OF SEWERS:

Inspect and obtain the COTR'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.

3.8 TESTING OF SANITARY SEWERS:

A. Gravity Sewers and Manholes (Select one of the following):

1. Air Test: 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 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies construction of outside, underground storm sewer systems. The storm sewer systems shall be complete and ready for operation, including all drainage structures, frames, grate and covers, connections to new buildings, structure service lines, existing storm sewer lines and existing drainage structures and all required 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.
C. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 53, CAST-IN-PLACE CONCRETE.
D. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.
E. 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, 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 storm 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. Piping.
   2. Jointing material.
   3. Manhole, inlet and catch basin material.
   4. Frames and covers.
   5. Steps.
   6. Resilient connectors and downspout boots.
C. One copy of State Department of Transportation standard details of MANHOLES, INLETS and catch basins.
D. One copy of State Department of Transportation specification.

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):

A48-03/A48M-03.....Gray Iron Castings
A536-84(2004).....Ductile Iron Castings
A615-05/A615M-05.....Deformed and Plain-Billet Steel Bars for Concrete Reinforcement
A655-04e1/A655M-04e1... Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
A742-03/A742M-03.....Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
A760-01a/A760M-01a.....Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
A762-00/A762M-00.....Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
A798-01/M798M-01.....Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
A849-00.....Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
A929-01/A929M-01.....Steel Sheet, Metallic Coated by the Hot Dip Process for Corrugated Steel Pipe
C76-05a/C76M-05a.....Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
C139-03.....Concrete Masonry Units for Construction of Catch Basins and Manholes

C150-04ae1.....Portland Cement

C443-05/C443M-05.....Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

C478-03a/C478M-03a.....Precast Reinforced Concrete Manhole Sections

C506-05/C506M-05.....Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe

C507-05a/C507M-05a.....Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe

C655-04e1/C655M-04e1....Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe

C1433-04e1/C1433M-04e1..Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers

C828-03.....Low-Pressure Air Test of Vitrified Clay Pipe Lines

C857-95(2001).....Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

C923-02/C923M-02.....Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Materials

C924-02/C924M-02.....Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method

C1103-03/C1103M-03.....Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

D698-00ae1.....Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

D1056-00.....Flexible Cellular Materials-Sponge or Expanded Rubber

D2412-02.....Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading

D2321-04e1.....Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications .

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

D3350-04.....Polyethylene Plastics Pipe and Fittings Materials
D4101-05a.....Polypropylene Injection and Extrusion Materials
F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F679-03.....Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
F714-05.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
F794-03.....Poly (Vinyl Chloride)(PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
F894-98a.....Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
F949-03.....Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior
F1417-92(2005).....Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

NOTE: ASTM test methods shall be the current version as of the date of advertisement of the project.

C. American Association of State Highway and Transportation Officials (AASHTO):

HB17.....Standard Specifications for Highway Bridges
M190-04.....Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
M198-05.....Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
M294-04.....Corrugated Polyethylene Pipe, 300-1500 mm (12 to 60 inches) Diameter

PART 2 - PRODUCTS

2.1 PIPING:

A. Gravity Lines (Pipe and Appurtenances):

1. Polyvinyl Chloride (PVC):

a. Pipe and Fittings, Type PSM PVC Pipe, 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 D 3212. Gaskets shall conform to ASTM F 477. Solvent welded joints shall not be permitted.

b. Pipe and fittings, smooth wall, corrugated or ribbed PVC, shall conform to the following:

1) Pipe and fittings shall conform to ASTM F949 corrugated sewer pipe with a smooth interior. The corrugated outer wall shall be fused to the smooth interwall at the corrugation valley. Pipe and fitting shall have a smooth bell, elastomeric joints conforming to ASTM D 3212, and shall have a minimum pipe stiffness of 345 kPa (50 psi) at 5 percent deflection, when tested in accordance with ASTM D 2412. Corrugation shall be perpendicular to the axis of the pipe to allow gaskets to be installed on field cut sections of pipe without the requirement for special fittings.

2) Ribbed wall PVC pipe and fittings shall conform to ASTM F794, Series 46. Ribbed sewer pipe with smooth interior pipe and fittings shall have a smooth bell, elastomeric joints conforming to ASTM D 3212, and shall have a minimum pipe stiffness of 320 kPa (46 psi) when tested in accordance with ASTM D 2412, at 5 percent vertical deflection. Joints shall not leak at 7.6 m (25 feet) of head under 5 percent deflection.

3) Solid wall pipe and fittings shall conform to ASTM F 679, SDR 35 SDR 26 pipe and fittings shall gaskets conforming to ASTM F 477, and shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi).

2. High Density Polyethylene (HDPE):

a. Smooth Wall PE Pipe: Shall comply with ASTM F714, DR 21 for pipes 75 to 600 mm (3 to 24 inches), and SDR 26 for pipes 650 to 1200 mm (26 to 48 inches). Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

b. Corrugated PE Pipe: Shall comply with AASHTO M294, for pipes 300 to 1500 mm (12 to 60 inches). Pipe walls shall have following minimum properties:

Nominal Size	Minimum Wall Area	Min. Moment of Inertia mm^4/mm (in^4/in)
300 mm (12 in)	3200 mm^2/m (1.50 in^2/ft)	390 (.024)
375 mm (15 in)	4000 mm^2/m (1.91 in^2/ft)	870 (.053)
450 mm (18 in)	4900 mm^2/m (2.34 in^2/ft)	1020 (.062)
600 mm (24 in)	6600 mm^2/m (3.14 in^2/ft)	1900 (.116)
750 mm (30 in)	8300 mm^2/m (3.92 in^2/ft)	2670 (.163)
900 mm (36 in)	9500 mm^2/m (4.50 in^2/ft)	3640 (.222)
1050 mm (42 in)	9900 mm^2/m (4.69 in^2/ft)	8900 (.543)
1200 mm (48 in)	10900 mm^2/m (5.15 in^2/ft)	8900 (.543)
1350 mm (54 in)	12000 mm^2/m (5.67 in^2/ft)	13110 (.800)
1500 mm (60 in)	13650 mm^2/m (6.45 in^2/ft)	13110 (.800)

c. Profile Wall PE Pipe: Shall comply with ASTM F894, Class 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, Minimum cell class 334433C. Pipe walls shall have following minimum properties:

Nominal Size	Minimum Wall Area	Min. Moment of Inertia mm^4/mm (in^4/in)
450 mm (18 in)	6300 mm^2/m (2.96 in^2/ft)	850 (.052)
525 mm (21 in)	8800 mm^2/m (4.15 in^2/ft)	1150 (.070)
600 mm (24 in)	9900 mm^2/m (4.66 in^2/ft)	1330 (.081)
675 mm (27 in)	12500 mm^2/m (5.91 in^2/ft)	2050 (.125)
750 mm (30 in)	12500 mm^2/m (5.91 in^2/ft)	2050 (.125)

825 mm (33 in)	14800 mm²/m (6.99 in²/ft)	2640 (.161)
900 mm (36 in)	17100 mm²/m (8.08 in²/ft)	3310 (.202)
1050 mm (42 in)	16500 mm²/m (7.81 in²/ft)	4540 (.277)
1200 mm (48 in)	18700 mm²/m (8.82 in²/ft)	5540 (.338)

2.2 JOINTING MATERIAL:

A. Polyvinyl Chloride (PVC) Pipe:

1. PVC Plastic Pipe: Joints shall comply with ASTM D3212, Elastomeric Gaskets shall comply with ASTM F477 and as recommended by the manufacturer.

B. PE Plastic Pipe:

1. Smooth Wall PE Plastic Pipe: Pipe shall be joined using butt fusion as recommended by the manufacturer.
2. Corrugated PE Plastic Pipe: Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.
3. Profile Wall PE Plastic Pipe: Joints shall be gasket or thermal weld type with integral bell in accordance with ASTM F894.

2.3 MANHOLES, INLETS AND CATCH BASINS:

A. Manholes, inlets and catch basins shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. Manholes, inlets and catch basins shall be in accordance with State Department of Transportation standard details, and the following VA requirements, in case of variance, VA requirements supersede:

1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6 m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6 m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that joints seal and bond effectively with cement mortar. Parge structure interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.

2. 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.
3. 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.
4. Flat top manhole tops shall be reinforced concrete as detailed on the drawings.
5. Precast Catch Basins: Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C-857.
6. Mortar:
   a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 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 21L (5-1/2 gallons) per sack of cement.
7. 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 M-198B.
8. 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 “storm 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.

9. 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 250 mm (10 inches) wide and project a minimum of 125 mm (5 inches) away from the mall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.
10. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 9 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 400 mm (16 inches) apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall offset the ladder 180 mm (7 inches) from the wall. The ladder assembly shall be rated for a minimum of 2200 N (500 pounds).

B. Prefabricated Plastic Manholes and Drain Basins: Plastic manholes and drain basins shall be as indicated on the drawings.

C. Frame and Cover for Gratings: Frame and cover for gratings shall be cast gray iron conforming to ASTM A48; cast ductile iron conforming to ASTM A536 in accordance with State Department of Transportation standard details . Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the drawings.

2.4 HEADWALLS:

A. Headwalls shall be cast-in-place concrete and in accordance with State Department of Transportation standard details. 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 CONCRETE:

Concrete shall be in accordance with State Department of Transportation standard specification. For concrete not specified in above standards, 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 to the provisions of Division 03 of these specifications.

2.6 REINFORCING STEEL:

Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.7 FLARED END SECTIONS:

Flared End Sections: Sections shall be of standard design fabricated from zinc-coated steel sheets conforming to requirements of ASTM A929.

2.8 PRECAST REINFORCED CONCRETE BOX.

Precast Reinforced Concrete Box: For highway loadings with 600 mm (2 feet) of cover or more subjected to dead load only, conform to ASTM C1433; For less than 600 mm (2 feet) of cover subjected to highway loading, conform to ASTM C1433.

2.9 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS:

A. Resilient Connectors: Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.
B. Downspout Boots: Boots used to connect exterior downspouts to the storm drainage system shall be of gray cast iron conforming to ASTM A48, Class 30B or 35B.

2.10 WARNING TAPE:

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable non-detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.1 EXCAVATION FOR STORM DRAINS AND DRAINAGE STRUCTURES:

Excavation of trenches and for appurtenances and backfilling for storm drains, shall be in accordance with the applicable portions of Section 31 20 00, EARTH MOVING.

3.2 PIPE BEDDING:

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.

3.3 GENERAL PIPING INSTALLATION:

A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.

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.

H. Do not walk on pipe in trenches until covered by layers of shading to a depth of 300 mm (12 inches) over the crown of the pipe.

I. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:

1. Reinforced Concrete Pipe: Comply with manufacturer’s recommendations with gasketed joints .
2. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
3. High Density Polyethylene (HDPE) Piping: Comply with manufacturer’s recommendations with gasketed joints gaskets with fused joints
4. Corrugated Metal Pipe: ASTM A798.

J. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.

3.4 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.

C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES:

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.

3.6 MANHOLES, INLETS AND CATCH BASINS:

A. General:

1. Circular Structures:

a. 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 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.

b. 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.

c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

2. Rectangular Structures:

a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE of these specifications.

b. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be

set on a 200 mm (8 inches) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D 698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.

3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
4. 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.
5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (25mm per 300mm, 1-inch per foot) nor more than 1:6 (50mm per 300mm, 2 inches per foot). Bottom slab and benches shall be concrete.
6. The wall that supports access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
7. 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.
8. 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.

3.7 CURB INLETS, CATCH BASINS, AND AREA DRAINS:

Reinforced concrete as shown or precast concrete.

3.8 INSPECTION OF SEWERS:

Inspect and obtain the COTR's approval. Thoroughly flush out before inspection. Lamp between structures and show full bore indicating sewer is true to line and grade. Lip at joints on inside of sewer is prohibited.

3.9 TESTING OF STORM SEWERS:

A. Gravity Sewers (Select one of the following):

1. Air Test: 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.
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 1 hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11L (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.

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