



U.S. Department
of Veterans Affairs

FT. BAYARD NATIONAL CEMETERY

FT. BAYARD, NEW MEXICO

CEMETERY IMPROVEMENTS

PROJECT 885CM3007B

PROJECT MANUAL
BID SET
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PREPARED BY:

LEAD DESIGN CONSULTANT/ LANDSCAPE ARCHITECT:

MTR LANDSCAPE ARCHITECTS, LLC
101 BELLEVUE RD., PITTSBURGH, PA 15229

ENGINEER:

KCI TECHNOLOGIES
936 RIDGEBROOK RD., SPARKS, MD 21152

LANDSCAPE ARCHITECT:

MORROW REARDON WILKINSON MILLER, LTD.
210 LA VETA NE, ALBUQUERQUE, NM 87108

ARCHITECT:

CHERRY SEE REAMES ARCHITECTS, LLP.
220 GOLD AVENUE SW, ALBUQUERQUE, NM 87102

ELECTRICAL ENGINEERS:

THE RESPONSE GROUP
11930 MENAUL NE SUITE 214, ALBUQUERQUE, NM 87112

MECHANICAL AND PLUMBING ENGINEERS:

ARSED ENGINEERING GROUP LLC
4700 LINCOLN ROAD NE SUITE 101, ALBUQUERQUE, NM 87109

**DEPARTMENT OF VETERANS AFFAIRS
 NCA MASTER SPECIFICATIONS**

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SECTION 01 00 00
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SECTION 01 00 00
GENERAL REQUIREMENTS (MINOR NCA PROJECTS)

1.1 GENERAL INTENTION

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor, materials, equipment and services and perform and complete all work for Cemetery Improvements, Fort Bayard National Cemetery, as required by drawings and specifications.
- B. Visit to the site by Bidders, see solicitation for the date and time.
- C. Architect-Engineers (A/E) may 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 Contracting Officer/Contracting Officer's Representative (CO/COR) or his duly authorized representative.
- D. All Testing Laboratory services will be retained and paid for by the Contractor (see Spec Section 01 45 29, Testing Laboratory Services).
- E. All employees of general contractor and subcontractors shall comply with security requirements as established by the CO/COR, and shall be identified by name and employer. They shall be restricted from unauthorized access.
- F. Prior to commencing work, general contractor shall provide proof that a OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.

Training:

- 1. Contractor's Superintendent shall have the 30-hour OSHA certified Construction Safety course.
 - 2. All employees of general contractor or subcontractors shall, at the minimum, have successfully completed the 10-hour OSHA certified Construction Safety course.
 - 3. Submit OSHA training records of all employees for approval before the start of work.
- G. Working Hours: Working Hours: Contractor shall be permitted to work between the hours of 8:00 am and 4:30pm unless otherwise approved by CO/COR and Cemetery Director. Coordinate with Cemetery staff on the schedule of services each week and any required adjustments to working

hours. No noisy work and no deliveries shall occur between the hours of 9am and 3pm when services are scheduled.

1.2 STATEMENT OF BID ITEM(S)

- A. BID ITEM I, GENERAL CONSTRUCTION: Installation of all work shown on the plans and described in the specifications including but not limited to: miscellaneous improvements to existing buildings, site utilities, storm drainage, grading, landscaping, and irrigation. Work items excluded from Bid Item I are Bid Item II and all add alternates. Item II and all add alternates shall be priced separately and shall not be included in the Bid Item I price.
- B. BID ITEM II, ROCK EXCAVATION, TRENCHES AND PITS: Refer to section 31 20 11 Earth Moving (Short Form). Bid item shall include rock removal and replacement with suitable bedding and backfill as indicated in the Contract Documents. Provide unit cost and extension for quantities indicated:
1500 CUBIC YARDS (CY) AT _____ PER CY. Any cubic yard quantity greater than 1,500 CY will be priced at the current stated per CY price in a modification action.
- C. ADD ALTERNATE NO.1: Provide concrete mowcurb and gravel mulch at a portion of the eastern edge of Section A; Bermuda grass hydroseeding at Sections A, B, D and E burial areas; spray irrigation at Sections A, B, D and E burial areas; and root-watering bubbler irrigation to all existing trees outside of spray-irrigated burial areas as indicated in the Contract Documents. See drawings L-101, L-102, L-501, L-502, I-201 and I-202 for additional information.
- D. ADD ALTERNATE NO. 2: Demolish a portion of the existing colored concrete paving at the Rostrum area and provide new colored concrete paving as indicated in the Contract Documents. Mockup required. See drawings D-102 and L-105 for additional information
- E. ADD ALTERNATE NO. 3: Provide spray irrigation to turf at the Section F burial area. See drawing I-101 for additional information
- F. ADD ALTERNATE NO. 4: Provide Bermuda grass hydroseeding at Section F burial area. See drawing L-501 for additional information
- G. ADD ALTERNATE NO. 5: Provide concrete mow curb and gravel mulch at northern and eastern edges of Section D as indicated in the Contract Documents. See drawings L-102 and L-501 for additional information

H. ADD ALTERNATE NO. 6: Provide concrete mow curb and gravel mulch in the following locations as indicated in the Contract Documents: at north and south edges of Section F; at north and south edges of Section B; at north edge of Section A. See drawings L-101, L-102, L-501 and L-502 for additional information.

A Single award will be made on BID Item I AND BID Item II. In the event additional funds are available, ADD ALTERNATE NO. 1 will be added to the award. If additional funds are still available, ADD ALTERNATE NO. 2 will be added to the award. If additional funds are still available, ADD ALTERNATE NO. 3 will be added to the award. If additional funds are still available, ADD ALTERNATE NO. 4 will be added to the award. If additional funds are still available, ADD ALTERNATE NO. 5 will be added to the award. If additional funds are still available, ADD ALTERNATE NO. 6 will be added to the award.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

A. AFTER AWARD OF CONTRACT, Additional sets of drawings may be made by the Contractor, at Contractor's expense, from digital files furnished by the 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 site without following the procedures approved by the CO/COR. 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 CO/COR so that appropriate arrangements can be provided for the Cemetery 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 CO/COR.
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 CO/COR.

C. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the CO/COR for the purpose of security inspections of every area of project including tool boxes and parked machines, and to take any necessary emergency action.

1.5 FIRE SAFETY

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

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

E84-2009a Surface Burning Characteristics of Building
Materials

2. National Fire Protection Association (NFPA):

10-2010 Standard for Portable Fire Extinguishers
30-2008 Flammable and Combustible Liquids Code
51B-2009 Standard for Fire Prevention During Welding,
Cutting and Other Hot Work
70-2008 National Electrical Code
241-2009 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 CO/COR/Cemetery Director 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 subcontractor's 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, safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of NCA equipment, etc.

Documentation shall be provided to the CO/COR that individuals have undergone the Contractor's safety briefing.

- C. Site and Building Access: Maintain free and unobstructed access to emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with CO/COR/Cemetery Director.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to CO/COR.
- H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- J. 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. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with CO/COR. All existing or temporary fire protection systems (fire alarms) located in construction areas shall be tested as coordinated with the Cemetery. Parameters for the testing and results of any tests performed shall be recorded by the Cemetery and copies provided to the CO/COR.
- K. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with CO/COR.
- L. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with CO/COR.

- M. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to CO/COR.
- N. 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.
- O. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily and site weekly.
- P. 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 CO/COR. 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 trailers, office trailers) and utilities may be erected by the Contractor only with the approval of the CO/COR 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.
- C. The Contractor shall, under regulations prescribed by the CO/COR, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the CO/COR. 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.

(FAR 52.236-10)

- D. Working space and space available for storing materials shall be as shown on the drawings. Contractor parking will be only in areas and on roadways designated and agreed to by the CO/COR in agreement of the Cemetery.

- E. Workmen are subject to rules of the Cemetery applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Cemetery as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.
 - 1. Do not store materials and equipment in other than assigned areas.
 - 2. Provide unobstructed access to the Cemetery areas required to remain in operation.
- G. Phasing: The Contractor shall furnish the CO/COR with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, the Contractor shall notify the CO/COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such phasing dates to insure accomplishment of this work in successive phases mutually agreeable to the Cemetery Director, CO/COR and Contractor, as follows:

Phase I: Columbarium completed including all site improvements, irrigation and landscaping.

Phase II: All buildings complete and ready for occupancy, including but not limited to utilities connected and tested (including septic system), mechanical, electrical, security, and plumbing systems completed, tested and operational, building finishes and repair work completed.

Phase III: Remainder of project complete including but not limited to all site demolition, concrete, hardscape, storm drainage, site furnishings, landscaping, irrigation, and project closeout documentation.

- H. The PIC Building will be occupied during performance of work. The 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 Cemetery's operations will not be hindered. The Contractor shall permit access to Cemetery personnel through other construction areas which serve as routes of access to such affected areas and equipment. Coordinate alteration work in areas occupied by

Cemetery Staff so that Cemetery operations will continue during the construction period.

- I. Construction Fence: Before construction operations begin, the Contractor shall provide a chain link construction fence, eight feet minimum height, around the construction area indicated on the drawings. Construction fence shall be temporary, free-standing type, 2" mesh opening with posts driven into the ground or, in paved areas, panel stands ("feet"), secured by sandbags. 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. The temporary fencing shall encompass the construction work area(s) to serve as a pedestrian barrier to alert cemetery patrons of the construction site. Where indicated on plans, construction fence shall have opaque woven polypropylene screen fabric securely attached for the full height and length of the fence. Repair and reattach fabric as needed during the construction period whenever it becomes detached or frayed. Provide durable temporary signage on the outside of the fence indicating that it is a construction zone. Remove the fence when directed by CO/COR.
- J. When a building is turned over to Contractor, Contractor shall accept entire responsibility therefore.
1. The Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.
 2. The Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, the Contractor shall make arrangements for pre-inspection of the site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from the Contractor's employee.
- K. Utilities Services: Maintain existing utility services for the Cemetery at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, 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 CO/COR. All such actions shall be coordinated with the Utility Company involved.

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 CO/COR. 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 CO/COR, and Cemetery 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. The Contractor shall submit a request to interrupt any such services to both CO/COR and the Cemetery Director in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
 3. The 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 the Cemetery. Interruption time approved by the Cemetery and CO/COR 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 CO/COR.
 5. In case of a contract construction emergency, service will be interrupted on approval of CO/COR. 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.
- L. 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.

- M. To minimize interference of construction activities with flow of Cemetery 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 CO/COR.
- N. Coordinate the work for this contract with other construction operations as directed by CO/COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.
- O. Coordination of Construction with Cemetery Director: **The burial activities at a National Cemetery shall take precedence over construction activities.** The Contractor must cooperate and coordinate with the Cemetery Director, through the CO/COR, in arranging construction schedule to cause the least possible interference with Cemetery activities in actual burial areas. Construction noise during the committal services shall not disturb the service. Trucks and workmen shall not pass through the service area during this period.
1. The Contractor is required to discontinue his work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal holidays, to permit him to clean up all areas of operation adjacent to existing burial plots before these dates.
 2. Cleaning up shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

1.7 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the CO/COR of building, site, and areas which are

anticipated routes of access, and furnish a signed report, to the Contracting Officer. This report shall list:

1. Existing condition and types of flooring, doors, windows, walls, curbs, pavements, trees, and other items not required to be altered throughout affected areas.
 2. Shall note any discrepancies between drawings and existing conditions at site.
 3. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and CO/COR.
- 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 CO/COR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by the Contractor with new items in accordance with specifications which will be furnished by the 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 CO/COR together shall make a thorough re-survey of the areas of buildings and site work involved. They shall furnish a report on conditions then existing as compared with conditions of same as noted in first condition survey report.
1. Re-survey report shall also list any damage caused by the Contractor to such items, despite protection measures; and, will form the basis for determining extent of repair work required of the Contractor to restore damage caused by the 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. Protect the interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, surfaces and items 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 ENVIRONMENTAL CONTROLS

- A. 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 CO/COR. Block off ducts and diffusers to prevent circulation of dust into occupied areas during construction.
- B. Vacuum and wet mop all transition areas from construction to the occupied Cemetery buildings at the end of each workday.
- C. Final Cleanup:
 1. Upon completion of the 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. 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 CO/COR.
 2. Items not reserved shall become property of the Contractor and be removed by Contractor from the Cemetery.
 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 a licensed Arborist.
- 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 CO/COR 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. Coverage under the 2012 Construction General Permit must be maintained by submitting a notice of intent (NOI) certifying that the permit's eligibility conditions have been met and that compliance with the permit's effluent limits and other responsibilities will be upheld. The

Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. The Contractor shall apply for a new NOI through the EPA's online eNOI system. The Contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:

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

1.11 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, water/irrigation or electric work without approval of the CO/COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the CO/COR 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, landscape stone, 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 the Contractor's own expense, the Contractor shall immediately restore to service and repair any damage caused by the Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services, fire protection systems, communications systems (including telephone), irrigation system control and power, 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 shown on the existing conditions plans are the result of site investigations by KCI Technologies, Inc.

(FAR 52.236-4)

- C. A copy of the soil boring logs will be made available for inspection by bidders upon request to the Contracting Officer.
- D. The 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 the site of work and logs of borings and, after investigation, decide for themselves the character of materials and make their bids accordingly. Upon proper application to the Department of Veterans Affairs, including approved scheduling 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 the 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 CO/COR. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the CO/COR until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the CO/COR 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 lines for each gravesite control monument, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, roads, parking lots, gravesite control monuments, 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. The 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 CO/COR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.
- D. During progress of work, the Contractor shall have lines, grades, locations and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the CO/COR before any major items of concrete work are placed. In addition, furnish to the CO/COR 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 and elevations of storm drains constructed by the Contractor.
 2. Lines and elevations and location of top of pre-placed crypts at each corner of the existing pre-placed crypt section.
 3. Lines and elevations of grade over pre-placed crypts.
 4. Northing/Easting coordinate locations and elevation of all water, sanitary, storm, gas and irrigation structures, directional fittings, control wire and lines installed by the Contractor or uncovered during construction.
 5. Northing/Easting coordinate locations for each gravesite grid monument.
- E. Upon completion of the work, the Contractor shall furnish the CO/COR with reproducible drawings, in AutoCAD form, at the scale of the contract drawings, showing the surveyed information described above. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.
- 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, which will include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the CO/COR's review, as often as requested.

- C. The Contractor shall deliver two approved completed sets of as-built drawings to the CO/COR within 15 calendar days after acceptance of the project by the CO/COR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.16 USE OF ROADWAYS

- A. For hauling, use only established public roads and designated permanent roads on Cemetery property and, when indicated or authorized by the CO/COR, such existing or Contractor constructed and/or modified temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed or modified by the Contractor at the Contractor's expense following approved plans that include: construction, operation, maintenance and restoration. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

1.18 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 CO/COR. If the equipment is not installed and maintained in accordance with the following provisions, the CO/COR 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, 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.

1.19 TEMPORARY TOILETS

- A. Provide where directed, (for use of all Contractor's workers) ample temporary sanitary toilet accommodations with suitable sewer and water connections, or when approved by CO/COR 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.

1.20 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the CO/COR, 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. The Contractor shall install meters at the Contractor's expense and furnish the Cemetery 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:
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. Obtain electricity by connecting to the Cemetery 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. Where not available or not convenient to connect to the Cemetery distribution system, the contractor shall supply power via portable generators at own expense. Generators shall be acoustically screened so as not to disturb committal services and/or visitation to the adjacent columbarium.
- F. Water (for Construction and Testing): Furnish temporary water service.
 - 1. Obtain water by connecting to the Cemetery potable water distribution system. The contractor shall install reduced pressure backflow preventer at each connection at own expense.
 - 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 CO/COR's discretion) of use of water from the Cemetery's system.
 - 3. Where not available or not convenient to connect to the Cemetery distribution system, the Contractor shall supply water via portable/temporary means at his own expense.
- G. Fuel: Fuel required for prolonged burner setup, adjustments, or modifications due to improper design or operation of burner, or control devices shall be furnished by the Contractor at Contractor's expense.

1.21 NEW TELEPHONE EQUIPMENT

- A. The contractor shall coordinate with the work of installation of telephone equipment by others.

1.22 TESTS

- A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.
- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the CO/COR. 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, hot water, controls and electricity, etc. Another example of a complex which involves several components of different disciplines is a burner installation. Efficient and acceptable burner operation depends upon the coordination and proper operation of fuel, combustion air, controls, and other related components.
- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.
- E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.23 INSTRUCTIONS

- A. The 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 CO/COR 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: the 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 CO/COR and shall be considered concluded only when the CO/COR 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 CO/COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.24 GOVERNMENT-FURNISHED PROPERTY

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on drawings.
- B. Materials furnished by the Government to be installed by the Contractor will be furnished to the Contractor at the Cemetery.

- C. Storage space for materials will be provided by the Contractor and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Cemetery.
- D. Notify CO/COR in writing, 60 days in advance, of date on which Contractor will be prepared to receive materials furnished by Government. Arrangements will then be made by the Government for delivery of materials.
 - 1. Immediately upon delivery of materials, the Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of materials described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 - 2. The Contractor thereafter is responsible for such material 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.

1.25 RELOCATED ITEMS

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated to be relocated by the Contractor.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the CO/COR.

- C. Suitably cap existing service lines, such as water, drain, gas, air, and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.
- E. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

1.26 CONSTRUCTION SIGN

- A. Provide a Construction Sign where directed by the CO/COR. 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. Signface shall be 4 feet x 5 feet and 6 inches. Provide two 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 900 mm (three 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 50mm x 100 mm (two by four inch) material as directed.
- B. Paint all surfaces of sign and posts two coats of white semi-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 CO/COR.

1.27 SAFETY SIGN

- A. Provide a Safety Sign where directed by CO/COR. Signboard shall be shall be three feet x four feet, 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 CO/COR.
- D. Post the number of accident free days on a daily basis.

1.28 CONSTRUCTION DIGITAL IMAGES

- A. During construction period through completion, furnish Department of Veterans Affairs weekly color digital photographs of construction progress (8 to 10 images per week.) Photographs of the reinforcing steel shall be taken after all reinforcing steel, sleeves, inserts, etc. are in place but prior to setting of runways. Photographs must show distinctly, at as large a scale as possible, all parts of work embraced in picture.
- B. Photographs are to be taken with a high-resolution digital camera, minimum 6 megapixels, with good wide-angle capability. The images shall be recorded in JPEG format with a minimum of 24-bit color and no reduction in actual picture size.
 - 1. Compressed size of the file shall be no less than 80% of the original with no loss of information.
 - 2. File names shall contain the Project number, the date the image was taken, and a unique sequential identifier, for example:
101CM3202_10-01-2013_0001. Use underscore, not spaces in digital file names.
- C. The digital photo files shall become property of Government and will be both e-mailed and submitted on CD-ROM.
 - 1. The images shall be forwarded electronically to the CO/COR Manager via email to NAME@va.gov within 2 days of when the photo was taken. Identify the content of each picture by a caption incorporated in the photo.
 - 2. The digital photo files shall also be submitted on CD-ROM to the CO/COR at the conclusion of the project. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.

1.29 FINAL ELEVATION PHOTOGRAPHS

- A. Final photographs shall be taken by a commercial/professional photographer. They shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day at as large a scale as possible to obtain sufficient detail to show depth and to provide clear, sharp pictures. All images shall become property of the Government.
- B. Photographs shall be artistically composed showing full front elevations of PIC building, committal shelter, columbarium court,

- site features and surrounding landscapes. A minimum of thirty six (36) images shall be taken as per these specifications.
- C. Minimum digital photo file size for final photos is 20 mb un-interpolated, preferably 52 mb. Submit proofs, via e-mail or web photo gallery, from which the CO/COR will select the final images for printing.
 - D. Pictures selected by the CO/COR for printing shall be 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. Photographs shall have full picture print with no margin.
 - E. Submit two (2) 400 mm x 500 mm (16 x 20) framed prints and three (3) 8 x 10 prints of the final selected photos. Deliver to the CO/COR, in boxes suitable for shipping,
 - F. Submit a CD-ROM to the CO/COR containing all (minimum 36) final digital photo files.
 - 1. 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% of the original with no loss of information.
 - 2. File names shall contain the date the image was taken, the Project number and a unique sequential identifier.
 - 3. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.
 - G. Each of the selected 16 x 20 prints shall be placed in a frame with a minimum 2 inches, maximum 3 inches, of appropriate matting as a border. Provide a selection of 3 different mats and 3 different frames from which the COR will select one mat and one frame style to frame both prints. Preferred frame style is wood molding, matte black finish, box frame, 1-1/8" wide x 7/8-inch deep.
 - H. Place a typewritten self-adhesive identity label on the back of each final print without damage to photograph. PHOTO NUMBER shall be included in both the digital file name on the CD and on the photo print label.
 - I. The following information shall be on the identity-label for photographs:

1. PHOTO NUMBER;
2. CEMETERY NAME
3. LOCATION;
4. PROJECT TITLE;
5. PROJECT NUMBER;
6. DATE TAKEN;
7. CONSTRUCTION COMPANY;
8. CONTRACT NUMBER.

1.30 HISTORIC PRESERVATION

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

1.31 PROJECT HEALTH AND SAFETY PLAN

- A. Prior to commencing any construction, the Contractor shall submit a site specific Project Health and Safety Plan (PHSP). At a minimum, the PHSP shall cover the following topics:
1. Organizational structure (including Responsible Persons)
 2. Site Characterization and Job Hazard Identification
 3. Site Control and Security
 4. Training
 5. PPE
 6. Heat Stress
 7. Spill Containment
 8. Decontamination
 9. Emergency Response
 10. Trench Safety

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SECTION 01 32 17
NETWORK ANALYSIS SCHEDULES
(MICROSOFT PROJECT GANTT CHART)

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The Contractor shall develop a Microsoft Project 2003 (or later) Gantt Chart (bar chart) schedule demonstrating fulfillment of the contract requirements. The Contractor shall keep the network up-to-date in accordance with the requirements of this section. The Contractor shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). The Gantt Chart will be utilized to satisfy time applications.

1.2 CONTRACTOR'S REPRESENTATIVE:

- A. The Contractor shall designate an in-house representative who will be responsible to prepare the schedule, review the schedule and report progress of the project to the Contracting Officer's Representative.
- B. The Contractor's in-house representative shall be given authority to act on behalf of the Contractor in fulfilling the requirements of this specification section. Such authority shall not be interrupted throughout the duration of the project.

1.3 COMPUTER PRODUCED SCHEDULES:

- A. The contractor shall provide to VA monthly computer processing of all computer produced schedules generated from monthly project updates. The Contractor shall provide to VA two (2) copies of the updated Microsoft Project Gantt Chart and an electronic copy of this data. This must be submitted with and substantively support the contractor's monthly payment request.
- B. The Contractor is responsible for the correctness and timeliness of the computer-produced reports. The Contractor is also responsible for the accurate and timely submittal of the updated project schedule.
- C. VA shall report errors in computer-produced reports to the Contractor's representative within ten (10) calendar days from receipt of reports. The Contractor shall reprocess the Gantt Chart and associated CDs, when requested by the Contracting Officers Representative, to correct errors that affect the schedule for the project.

1.4 THE COMPLETE PROJECT GANTT CHART SUBMITTAL:

- A. The Complete Project Microsoft Project Gantt Chart will contain at least 50 work activities/events as necessary to fully detail the project schedule.
- B. Within ten (10) calendar days after receipt of the Notice to Proceed, the Contractor shall submit for the Contracting Officer's review, a Microsoft Project Gantt Chart and a CD. Each activity/event on the Gantt Chart schedule shall contain as a minimum, but not limited to, activity/event description, duration, start dates and finish dates. Activity constraints, not required by the contract, will not be accepted. Logic events (non-work) will be permitted where necessary to reflect proper sequence among work events, but must have zero duration.
- C. The complete working Gantt Chart shall reflect the Contractor's approach to scheduling the complete project. The final Gantt Chart in its original form shall contain no contract changes or delays that may have been incurred during the final Gantt Chart development period. It shall reflect the Contractors "AS BID" or "DAY 1" schedule. Changes and /or delays shall be entered at the first monthly update after the final Gantt Chart has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.
- D. Within ten (10) calendar days after receipt of the complete project Gantt Chart, the Contracting Officer or his representative, will do one or both of the following:
 - 1. Notify the Contractor concerning his actions, opinions, and objections.
 - 2. Schedule a meeting with the Contractor at, or near the job site, for joint review, correction or adjustment of the proposed plan. Within ten (10) calendar days after the joint review, the Contractor shall revise and shall submit two (2) copies of the revised Gantt Chart and a revised CD as specified to the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.

1.5 WORK ACTIVITY/EVENT AND COST DATA INFORMATION:

- A. The Contractor shall not be required to "cost load" the computerized Microsoft Project Gantt Chart. As part of this submission, the

Contractor shall provide a separate **Schedule of Costs** on AIA document G703. This Schedule of Costs shall reflect and contain all the same activities/events identified on the Gantt Chart.

- B. The Contractor and the Contracting Officer shall use this Schedule of Costs for monthly payment purposes as referenced in the General Conditions of this agreement.
- C. The Contractor and Contracting Officer shall agree on percentages for monthly work accomplished. The cumulative total amount of all cost loaded activities/events (including alternates) shall equal the total contract price.
- D. Prorate overhead, profit and general conditions on all work activities/events for the entire project. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

1.6 GANTT CHART REQUIREMENTS:

- A. Show on the Gantt Chart the sequence and interdependence of work activities/events required for complete performance of all items of work. In preparing the Gantt Chart, the Contractor shall:
 - 1. Show the following on each work activity/event:
 - a. Concise description of the work represented by the activity/event.
 - b. Duration (in work days.)
 - 2. Show activities/events as:
 - a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
 - b. Contracting Officer Representative's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
 - c. Interruption of VA Cemetery utilities, delivery of Government furnished equipment, project phasing and any other specification requirements.
 - d. Test, balance and adjust various systems and pieces of equipment.
 - e. VA inspection and acceptance activity/event with a minimum duration of five (5) work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.
 - 3. Break up the work into activities/events of durations no longer than thirty (30) work days each, except as to non-construction

- activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the Contracting Officer may approve the showing of a longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals shall not be less than ten (10) workdays. The construction time as determined by the Gantt Chart schedule from start to finish for any sub-phase, phase or the entire project shall not exceed the total contract duration. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.
4. Exterior Label Information: Provide the following information on an external label attached to each diskette(s):
- a. VA project number and project location.
 - b. Name and telephone number of a point of contact, preferably the person who created the CD
 - c. The CD number and total number of CDs in the set
 - d. The project data status date.

1.7 PAYMENT TO THE CONTRACTOR:

- A. Monthly, the contractor shall submit the Gantt Chart updated for remaining activity durations and a Schedule of Costs updated for costs. AIA application and certification for payment documents G702 and G703 will be used. The payment request should reflect and be in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS of Section GENERAL CONDITIONS. The Contractor is entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated Schedule of Costs unless, in special situations, the Contracting Officer permits an exception to this requirement. Monthly payment requests shall include: two (2) copies of the updated Microsoft Project Gantt Chart, a listing of all project schedule changes, and associated data, made at the update. These must be submitted with and substantively support the contractor's monthly application and certificate for payment request documents.

- B. When the Contractor fails or refuses to furnish to the Contracting Officer the information and the associated updated Gantt Chart data, which, in the sole judgment of the Contracting Officer, are necessary for validating the monthly progress payment, the Contractor shall not be deemed to have provided supporting schedule data upon which progress payment may be reasonably determined.

1.8 PAYMENT AND PROGRESS REPORTING:

- A. Monthly job site progress meetings shall be held on dates mutually agreed to by the Contracting Officer (or Contracting Officer's Representative) and the Contractor. Presence of subcontractors during the progress meeting is optional unless required by the Contracting Officer (or Contracting Officer's Representative). Job progress will be reviewed to verify:
1. Actual start and/or finish dates for updated/completed activities/events.
 2. Remaining duration, required to complete each activity/event started, or scheduled to start, but not completed.
 3. Time and cost data for change orders, and supplemental agreements that are to be incorporated into the Gantt Chart.
 4. Percentage for completed and partially completed activities/events.
 5. Logic and duration revisions required by this section of the specifications.
 6. Activity/event duration and percent complete shall be updated independently.
- B. The Contractor shall submit a narrative report as a part of his monthly review and update, in a form agreed upon by the Contracting Officer. The narrative report shall include a description of problem areas; current and anticipated delaying factors and their estimated impact on performance of other activities/events and completion dates; and an explanation of corrective action taken or proposed. This report is in addition to the daily reports pursuant to the provisions of Article, DAILY REPORT OF WORKERS AND MATERIALS in the GENERAL CONDITIONS.
- C. As part of the monthly jobsite progress meeting, the General Contractor, specifically requested subcontractors and the Contracting Officers Representative shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary

actions required to maintain project schedule during the reporting period.

1.9 RESPONSIBILITY FOR COMPLETION:

A. Whenever it becomes apparent from the monthly progress review meeting or the monthly computer-produced Gantt Chart schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:

1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
3. Reschedule the work in conformance with the specification requirements.

B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the Contracting Officer for the proposed schedule changes. If such actions are approved, the revisions shall be incorporated by the Contractor into the Gantt Chart before the next update, at no additional cost to the Government.

1.10 CHANGES TO GANTT CHART SCHEDULE:

A. Within ten (10) calendar days after VA acceptance and approval of any updated computer-produced schedule, the Contractor shall submit a revised Gantt Chart, the associated CDs, and a list of any activity/event changes including predecessors and successors for any of the following reasons:

1. Delay in completion of any activity/event or group of activities/events, which indicate an extension of the project completion by twenty (20) working days or 10 percent of the remaining project duration, whichever is less. Such delays which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the Gantt Chart as the direct cause for delaying the project beyond the acceptable limits.
2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
3. The schedule does not represent the actual prosecution and progress of the project.

4. When there is, or has been, a substantial revision to the activity/event costs of the network diagram regardless of the cause for these revisions.
- B. Revisions made under this paragraph, which affect the previously approved computer-produced schedules for Government furnished equipment, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, must be furnished in writing to the Contracting Officer for approval.
- C. Contracting Officer's approval for the revised Gantt Chart and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the Contracting Officer's Representative.
- D. The cost of revisions to the Gantt Chart resulting from contract changes will be included in the cost of the change.
- E. The cost of revisions to the Gantt Chart not resulting from contract changes is the responsibility of the Contractor.

1.11 ADJUSTMENT OF CONTRACT COMPLETION:

- A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, Gantt Chart data and supporting evidence as the Contracting Officer may deem *necessary for determination as to whether or not the Contractor is* entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals.
- B. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced Gantt Chart schedule for the time period when the change took place and all other relevant information. The Contracting Officer will, within thirty (30) calendar days after receipt of such justification and supporting evidence, advise the Contractor in writing of his decision on the matter.
- C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under Article, CHANGES, in the Section, GENERAL CONDITIONS. The Contractor shall include, as a part of each change order proposal, a sketch showing all revisions, duration (in work days)

changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.

- D. All delays due to non-work activities/events such as RFI's, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.

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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, 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 Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
 - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
 - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion. Submit all submittals for a particular specification section in one package for review. Providing submittals in piecemeal fashion will result in longer review times.
- 1-5. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Contracting Officer's Representative (COR) on behalf of the Contracting Officer (CO).

- 1-6. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.
- 1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.
- 1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect-Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1-9. 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.
 - A. 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 Cemetery, 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 Cemetery, 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 shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
 2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
 3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
 4. Contractor shall send a copy of transmittal letter to both CO/COR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
 5. Laboratory test reports shall be sent directly to CO/COR 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 CO/COR 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 Cemetery 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, shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

(Architect-Engineer)

(A/E P.O. Address)

(City, State and Zip Code)

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 CO/COR.

1-12. Samples for approval shall be sent to Architect-Engineer, in care of Cemetery Director, Jacksonville National Cemetery, 4083 Lannie Road Jacksonville, FL 32218.

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**SECTION 01 42 19
REFERENCE STANDARDS**

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

- A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to - GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.
- B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

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

- A. The specifications and standards cited in this solicitation can be examined at the following location:
United States Department of Veteran Affairs
Technical Information Library
<http://www.cfm.va.gov/til/>

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

- A. The specifications cited in this solicitation may be obtained from the associations or organizations listed below.
- AA Aluminum Association, Inc.
<http://www.aluminum.org>

AABC	Associated Air Balance Council http://www.aabchg.com
AADM	American Association of Automatic Door Manufacturers http://www.aaadm.com
AATC	American Association of Textile Chemists and Colorist http://www.aatcc.org
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.transportation.org/Pages/default.aspx
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
ADA	American with Disabilities Act http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag
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
AHA	American Hardboard Association http://www.domensino.com/AHA/
AIHA	American National Standards Institute/American Industrial Hygiene Association http://www.aiha.org/Pages/default.aspx
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
ALI	Automotive Lift Institute http://www.autolift.org/
AMCA	Air Movement and Control Association http://www.amca.org/
ANLA	American Nursery & Landscape Association http://www.anla.org
ANSI	American National Standards Institute, Inc. http://www.ansi.org
APA	Architectural Precast Association http://www.archprecast.org/
APA	The Engineered Wood Association http://www.apawood.org
ARI	Air-Conditioning and Refrigeration Institute http://www.lightindustries.com/ARI/
ARMA	Asphalt Roofing Manufacturers Association http://www.asphaltroofing.org/
ASAE	American Society of Agricultural Engineers http://www.asabe.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

AWPA	American Wood Protection Association http://www.awpa.com
AWWA	American Water Works Association http://www.awwa.org
BHMA	Builders Hardware Manufacturers Association http://www.buildershardware.com
BIA	The Brick Industry Association http://www.bia.org
CAGI	Compressed Air and Gas Institute http://www.cagi.org
CARB	California Environmental Protection Agency Air Resources Board http://arb.ca.gov/hompage.html/
CFR	Code of Federal Regulations http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR
CGA	Compressed Gas Association, Inc. http://www.cganet.com
CID	Commercial Item Description http://www.gsa.gov/portal/content/100847
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
CPA	Composite Panel Association http://www.compositepanel.org/
CRA	California Redwood Association http://www.calredwood.org
CRI	Carpet and Rug Institute http://www.carpet-rug.com
CRRC	Cool Roof Rating System http://coolroofs.org/
CRSI	Concrete Reinforcing Steel Institute http://www.crsi.org
CSI	Cast Stone Institute http://www.caststone.org

DASMA Door and Access Systems Manufacturers Association
<http://www.dasma.com/>

DHI Door and Hardware Institute
<http://www.dhi.org>

DOE U.S. Department of Energy
<http://www.energy.gov/>

EEI Edison Electric Institute
<http://www.eei.org>

EGSA Electrical Generating Systems Association
<http://www.egsa.org>

EIMA Exterior Insulation Manufacturers Association
<http://www.eima.com/>

EPA Environmental Protection Agency
<http://www.epa.gov>

ETL ETL Testing Laboratories, Inc.
<http://www.envirotestinglabs.com/>

FCC Federal Communications Commission
<http://www.fcc.gov>

FHA Federal Highway Administration
<http://www.fhwa.dot.gov/>

FM FM Global
<http://www.fmglobal.com>

FPS The Forest Products Society
<http://www.forestprod.org>

FSC Forest Stewardship Council
<http://www.fscus.org>

GA Gypsum Association
<http://www.gypsum.org>

GANA Glass Association of North America
<http://www.glasswebsite.com>

GBI Green Building Initiative
<http://www.thegbi.org/>

GS Green Seal
<http://www.greenseal.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>

ICC The International Code Council
<http://www.iccsafe.org/Pages/default.aspx>

ICEA Insulated Cable Engineers Association Inc.
<http://www.icea.net>

IEEE Institute of Electrical and Electronics Engineers
<http://www.ieee.org/>

IGMA Insulating Glass Manufacturers Alliance
<http://www.igmaonline.org>

ITS Intertek Training Services
<http://www.intertek.com/>

MBMA Metal Buildings Manufacturers Association
<http://www.mbma.com>

MHI Material Handling Industry of America
<http://www.mhi.org/>

MIA Marble Institute of America
<http://www.marble-institute.com/>

MIC Masonry Industry Council

MPI Master Painters Institute
<http://www.mpi.net/>

MSJC Masonry Standards Joint Committee
<http://www.masonrysociety.org/msjc/>

NAAMM National Association of Architectural Metal Manufacturers
<http://www.naamm.org>

NAPHCC Plumbing-Heating-Cooling Contractors Association
<http://www.phccweb.org/>

NBS National Bureau of Standards
See - NIST

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>

NFRC National Fenestration Rating Council
<http://www.nfrc.org/>

NHLA National Hardwood Lumber Association
<http://www.natlhardwood.org>

NIH National Institute of Health
<http://www.nih.gov>

NIOSH The National Institute for Occupational Safety and Health
<http://www.cdc.gov/niosh/>

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

NPCA National Precast Concrete Association
<http://www.precast.org>

NRCA National Roofing Contractors Association
<http://www.nrca.net>

NSF National Sanitation Foundation
<http://www.nsf.org>

NSF NSF International
<http://www.nsf.org/>

NTMA National Terrazzo and Mosaic Association
<http://ntma.com/>

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.cement.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>

RCSC Research Council of Structural Connections
<http://www.boltcouncil.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>

SCAQMD South Coast Air Quality Management District
<http://www.aqmd.gov>

SCMA Southern Cypress Manufacturers Association
<http://www.cypressinfo.org>

SDI Steel Deck Institute
<http://www.sdi.org>

SDI Steel Door Institute
<http://www.steeldoor.org>

SEI Structural Engineering Institute
<http://www.asce.org/SEI/>

SJI Steel Joist Institute
<http://www.steeljoist.org>

SMACNA Sheet Metal and Air-Conditioning Contractors
National Association, Inc.
<http://www.smacna.org>

SPRI Single Ply Roofing Industry
<http://www.spri.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>

SWRI Sealant Waterproofing and Restoration Institute
<http://www.swrionline.org/>

TCNA Tile Council of North America, Inc.
<http://www.tileusa.com>

TPI Truss Plate Institute, Inc.
<http://www.tpinst.org/>

UL Underwriters' Laboratories Incorporated
<http://www.ul.com>

ULC Underwriters' Laboratories of Canada
<http://www.ulc.ca>

USDA U.S. Department of Agriculture
<http://www.usda.gov>

USGBC U.S. Green Building Council
<http://www.usgbc.org>

WCLIB West Coast Lumber Inspection Bureau
<http://www.wclib.org/>

WDMA Window and Door Manufacturers Association
<https://www.wdma.com/>

WH Warnock Hersey
<http://www.intertek.com/marks/wh/>

WRCLA Western Red Cedar Lumber Association
<http://www.wrcla.org/>

WWPA Western Wood Products Association
<http://www2.wwpa.org/>

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor. Refer to Section 01 00 00, GENERAL REQUIREMENTS, for additional information.

1.2 RELATED DOCUMENTS

- A. Section 01 00 00, GENERAL REQUIREMENTS.

1.3 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. American Association of State Highway and Transportation Officials (AASHTO):
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| T27-11 | 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 |
| T99-10 | The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop |
| T104-99 (R2007) | Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate |
| T180-10 | 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 Society for Testing and Materials (ASTM):
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| A325-10 | Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength |
| A370-12a | Definitions for Mechanical Testing of Steel Products |

A490-12	Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
C31/C31M-12	Making and Curing Concrete Test Specimens in the Field
C33/C33M-13	Concrete Aggregates
C39/C39M-12	Compressive Strength of Cylindrical Concrete Specimens
C109/C109M-12	Compressive Strength of Hydraulic Cement Mortars
C138/C138M-12a	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C140-13	Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-12	Slump of Hydraulic Cement Concrete
C172/C172M-10	Sampling Freshly Mixed Concrete
C173/C173M-12	Air Content of freshly Mixed Concrete by the Volumetric Method
C330/C330M-09	Lightweight Aggregates for Structural Concrete
C567/C567M-11	Density Structural Lightweight Concrete
C780-12a	Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-11	Sampling and Testing Grout
C1064/C1064M-12	Freshly Mixed Hydraulic Cement Concrete
C1077-13	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1314-12	Compressive Strength of Masonry Prisms
C1364-10b	Architectural Cast Stone
D698-12	Laboratory Compaction Characteristics of Soil Using Standard Effort
D1143/D1143M-07	Deep Foundations 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

D1557-12	Laboratory Compaction Characteristics of Soil Using Modified Effort
D2166-06	Unconfined Compressive Strength of Cohesive Soil
D2167-08	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216-10	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2974-07	Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666-11	Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740-12a	Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock
E94-04 (2010)	Radiographic Examination
E164-08	Contact Ultrasonic Testing of Weldments
E329-11c	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
E543-13	Agencies Performing Nondestructive Testing
E709-08	Guide for Magnetic Particle Testing
E1155-96 (2008)	Determining FF Floor Flatness and FL Floor Levelness Numbers

D. American Welding Society (AWS):

D1.1-07	Structural Welding Code-Steel
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1.4 REQUIREMENTS

A. Accreditation Requirements: Testing Laboratory retained and paid for by Contractor must be accredited by one or more of the National Voluntary Laboratory Accreditation Program (NVLAP) programs acceptable in the geographic region for the project. Furnish to the CO/COR a copy of the Certificate of Accreditation and Scope of Accreditation. For testing laboratories that have not yet obtained accreditation by a NVLAP program, submit an acknowledgement letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the CO/COR for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

1. Laboratories engaged in testing of construction materials must meet the requirements of ASTM E329.
 2. Laboratories engaged in testing of concrete and concrete aggregates must meet the requirements of ASTM C1077.
 3. Laboratories engaged in testing of bituminous paving materials must meet the requirements of ASTM D3666.
 4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, must meet the requirements of ASTM D3740.
 5. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.
 6. Laboratories engaged in non-destructive testing (NDT) must meet the requirements of ASTM E543.
 7. Laboratories engaged in Hazardous Materials Testing must meet the requirements of OSHA and EPA.
- B. Inspection and Testing: Testing laboratory to inspect materials and workmanship and perform tests described herein and additional tests requested by CO/COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory must direct attention of CO/COR to such failure.
- C. Written Reports: Testing laboratory to submit test reports to CO/COR, AE, and Contractor within 24 hours after each test is completed unless other arrangements are agreed to in writing by the CO/COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to CO/COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK

- A. General: The Testing Laboratory is to 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 is as identified herein including, 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 CO/COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to CO/COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide part time 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.

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, AASHTO T191, or ASTM D2167 to 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 must provide satisfactory explanation to the CO/COR before the tests are conducted.
 - a. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - b. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - c. 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.

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 CO/COR.

3.2 LANDSCAPING

A. Test topsoil for organic materials, pH, salinity, free lime, available calcium, magnesium, sodium, potassium, nitrate, and phosphate.

1. Test for organic material by using ASTM D2974.

2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.
- B. Submit laboratory test report of topsoil to CO/COR.
- C. Submit recommendations for soil amendments from an independent certified agricultural soil testing laboratory or regional soil conservation service or cooperative extension, to make the fertility of the imported soil appropriate for each type of plant material being grown in it.
- D. One (1) topsoil test shall be completed for each unique source of imported material.

3.4 SITE WORK CONCRETE

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

3.5 CONCRETE

- A. Batch Plant Inspection and Materials Testing:
 1. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.
- B. Field Inspection and Materials Testing:
 1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
 2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
 3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m³ (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. Label each cylinder

- with an identification number. CO/COR may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
 5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
 6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
 7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
 8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
 9. Verify that specified mixing has been accomplished.
 10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
 - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
 11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.

12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
 13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
 14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
 15. Observe preparations for placement of concrete:
 - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
 16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
 17. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
- 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 CO/COR. Compile laboratory test reports as follows: Compressive strength test to be the result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it must be discarded and strength of spare cylinder to be used.
 2. Furnish certified compression test reports (duplicate) to CO/COR. 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).
 - f. Weather conditions during placing.
 - g. Temperature of concrete in each test cylinder when test cylinder was molded.
 - h. Maximum and minimum ambient temperature during placing.
 - i. Ambient temperature when concrete sample in test cylinder was taken.

j. Date delivered to laboratory and date tested.

3.6 REINFORCEMENT

A. Review mill test reports furnished by Contractor.

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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, and solid waste, 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 affect human health or welfare.
 - 2. Unfavorably alter ecological balances of importance to human life.
 - 3. Affect other species of importance to humankind.
 - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

1.2 DEFINITIONS OF POLLUTANTS

- A. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
- B. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
- C. Sediment: Soil and other debris that has been eroded and transported by runoff water.
- D. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from project construction activities.
- E. 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 "waters of the United States" and require a permit to discharge water from the governing agency.
- F. Rubbish: Combustible and noncombustible wastes such as, but not limited to, paper, plastic, metal and plastic containers and cans, boxes, metal and lumber scrap.
- G. Sanitary Wastes: Domestic Sanitary Sewage.

1.3 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 and note any corrective action taken.

1.4 REFERENCES

- 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. U.S. National Archives and Records Administration (NARA):
33 CFR 328 Definitions, Waters of the United States.
- C. Federal Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:
 - 1. Storm water permits; refer to The Office of Wastewater Management, NPDES Storm Water Program: <http://www.epa.gov/npdes/stormwater>
 - 2. Dredge and fill (Section 404) permits; refer to U.S. EPA Office of Wetlands, Oceans, and Watersheds (OWOW): <http://www.epa.gov/owow/>
 - 3. RCRA hazardous and non-hazardous solid waste requirements; refer to EPA's Office of Solid Waste and Emergency Response:
<http://www.epa.gov/epaoswer/osw/laws-reg.htm>
 - 4. Oil spill requirements for construction activities; refer to EPA Oil Program web site: <http://www.epa.gov/oilspill/>
 - 5. Hazardous substances (Superfund Liability) requirements for construction activities; refer to EPA's Superfund website:
<http://www.epa.gov/superfund/index.htm>
 - 6. Polychlorinated Biphenyl (PCB) waste requirements; refer to EPA's Polychlorinated Biphenyl (PCB) Homepage: <http://www.epa.gov/pcb/>
 - 7. Air quality requirements for construction activities; refer to EPA'S Air Program Mobile Sources Page:
<http://www.epa.gov/ebtpages/airmobilesources.html>
 - 8. Asbestos requirements for construction activities; refer to EPA's Asbestos Management and Regulatory Requirements Website:
<http://www.epa.gov/fedsite/cd/asbestos.html>
 - 9. National Environmental Policy Act (NEPA) requirements for construction activities
 - 10. Endangered Species Act; refer to The US Fish and Wildlife Service Endangered Species Program: <http://endangered.fws.gov/>

11.National Historic Preservation Act

D. State and Local Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:

1. State Office/Department of Environmental Quality.
2. Local Office/Department of Environmental Quality.
3. The Construction Industry Compliance Assistance Center:
<http://www.cicacenter.org/index.cfm>
4. The National Environmental Compliance Assistance Clearinghouse:
<http://cfpub.epa.gov/clearinghouse/>

1.5 SUBMITTALS

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

1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, meet with the Contracting Officer/Contracting Officer's Representative (CO/COR) 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, prepare and submit to the CO/COR for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. Name(s) and qualifications of person(s) within the Contractor's organization who is (are) responsible for:
 - 1) Ensuring adherence to the Environmental Protection Plan.
 - 2) Manifesting hazardous waste to be removed from the site.
 - 3) Training the Contractor's environmental protection personnel.
 - b. Description of the Contractor's environmental protection personnel training program.
 - c. 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.
 - d. 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.

- e. Procedures to provide environmental protection that complies 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.
 - f. Permits, licenses, and the location of the solid waste disposal area.
 - g. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and/or mandated state agency, and the Department of Veterans Affairs.
 - h. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - i. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of construction limits or protected areas. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
- B. Within 20 days after the date of its submittal, the CO/COR shall approve the Contractor's Comprehensive Environmental Protection Plan, or respond with an explanation for its rejection and resubmittal.
- C. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.6 TREE PROTECTION

- A. Intent: All existing trees (except those explicitly indicated to be removed) are to be protected from damage to their above and below ground structures including branches, trunk, and roots.
- B. Tree Protection Zone: The area defined by the drip line of the outer extent of the canopy of a tree, or within ten (10) feet of the outside diameter of a tree's trunk, or within tree protection fence area as shown on plans, whichever is larger.
- C. Tree Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements.

1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 6 feet (2.4 m) apart. Safety orange color, nonfading. Fencing shall be 4 feet high with 3 foot wide access gates.
 2. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering. An 8 ½" x 11" sign indicating the area as a tree protection zone shall be prominently displayed on each fence panel.
 3. The Contractor shall be responsible for the installation and maintenance of all tree protection fencing. Protective fencing shall remain undisturbed until all construction activities have been completed. The Contractor shall remove fencing upon completion of construction.
 4. If protective fencing is damaged, the Contractor shall immediately execute the necessary repairs to re-establish the protective fencing to original configurations.
- D. No construction activity, including storage of materials, staging, or installation of erosion control measures, shall start until all tree protection measures and procedures as indicated are completed.
- E. The following construction activities are prohibited within Tree Protection Zones:
1. Storage of any construction materials, equipment, stockpiling, excavation or fill, soil, gravel, etc.
 2. Equipment or vehicle parking.
 3. Masonry set up, clean up or washout.
 4. Burning within or in proximity to protected areas
 5. Felling trees into protected areas.
 6. Trenching or grading within the Protection Zone of protected trees for any purpose. This includes but is not limited to the following: silt fence, sediment erosion control, utilities, site lighting, irrigation, drainage, curbs, and footings. **If unavoidable, excavation, digging, trenching, and/or soil fill activities within the Tree Protection Zones shall be conducted using special methods per the requirements of this section, with the approval of the CO/COR.**

7. Contractor shall prevent any contamination of the soil within the Protection Zone by construction materials, debris, silt, fuel, oils, wash-out materials from cleaning equipment, concrete or mortar remainder, trash, garbage, or debris of any kind or any other chemical substance. Contractor shall notify the CO/COR of any such spills, compaction, or other disturbance within the Protection Zone and take immediate action using methods approved by the CO/COR.
 9. Excessive foot traffic that causes soil compaction.
- F. The following restrictions apply to the Tree Protection Zones:
1. Any grading, construction, demolition, or other work that is expected to encounter tree roots shall be made in consultation with the CO/COR.
 2. Any digging that must occur within Protection Zones must utilize alternative excavation methods including, but not limited to hand excavation or the use of a supersonic air tool (AirSpade). This includes storm drainage, planting and irrigation installation.
 3. Any roots 1 inch in diameter or less that sustain damage during construction shall be exposed to sound tissue and cleanly pruned close to the tree side of the excavation. Clean cuts shall be made at all times. The cutting of tree roots greater than 1 inch in diameter must be approved and supervised by a licensed arborist.
 4. Trees to be removed adjacent to the tree root protection zones shall be cut near ground level and the stump ground out completely to avoid damaging existing roots by pulling and breaking.
 5. Construction mat: In general, vehicle traffic is prohibited in Protection Zones. If equipment access is required through Protection Zones, provide the following: construction matting consisting of the following: geotextile fabric with 8-inch thickness of coarsely shredded wood chips on top. Respread or add mulch as needed to maintain the specified thickness. Completely remove all construction mat materials as soon as possible. Repair damaged turf with new sod to match existing turf. Repair landscaped areas with new landscape materials to match existing.
- G. Arborist Qualifications: All pruning, tree removals, root pruning, and fertilization required shall be performed by an ISA certified Arborist of five (5) years minimum experience in the field of urban forestry and remediation of construction damage.

- H. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of tree protection and trimming.
- I. Tree Pruning Standard: Comply with ANSI A300 (Part 1), "Tree, Shrub, and Other Woody Plant Maintenance--Standard Practices (Pruning)."
- J. Tree damage and repair:
1. Tree repair recommendations must be provided by a licensed Arborist.
 2. Provide COR reports of damage and recommended remediation on a daily basis if damage occurs.
 3. Damage includes: Soil compaction, broken root tissue, broken overstory tissue, actions and/or inactions by Contractor's forces resulting in signs of stress including, but not limited to, defoliation and chlorosis.
 4. Significant damage is damage that might reasonably be expected to endanger the long term health and/or form of the tree, as determined by the Landscape Architect, CO/COR or Arborist. Significantly damaged trees shall be replaced.
 5. Tree replacement:
 - a. Trees less than 4 inch caliper that are significantly damaged as a result of construction activities shall be replaced with a tree of the same species and equal or greater size at no additional cost to the government.
 - b. Trees greater than 4 inch caliper that are significantly damaged as a result of construction activities shall be replaced with one new 3 inch caliper tree of the same species per 4 inches of caliper of the existing tree (e.g. a damaged 24" caliper tree shall be replaced with 6 new trees).
 - c. Removal and replacement of significantly damaged trees shall be done at no additional cost to the government.
 6. Tree repair:
 - d. Remedial maintenance activities which may be required in lieu of or in addition to other penalties (at COR's discretion) shall include, but are not limited to, the following: Crown pruning, root pruning, fertilization, mulching, aeration, soil replacement, soil removal, watering, cabling, and bracing.

- e. Promptly provide remedial action to trees damaged by construction operations within 48 hours. Prune or otherwise treat damaged trunks, limbs, and roots according to Arborist's written instructions. Remedial actions shall be at Contractor's expense. Damage that is not addressed within 48 hours may be remediated by the VA at the Contractor's expense.

1.7 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 and after the project is complete and disturbed areas are permanently stabilized. Confine construction activities to areas defined by construction limits, 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, land forms, wetlands or wetland buffers without prior approval from the CO/COR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or dictated by special emergency use.
 - 1. Work Area Limits: Prior to any construction, mark/fence/protect the areas that require work to be performed under this contract. Prior to construction, mark/fence/protect monuments, works of art, and any other markers to remain. Convey to all personnel the purpose of marking and protecting all marked and protected objects.
 - 2. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas only as needed to use to work the area to be developed. Form earthwork to final grade as shown as quickly as possible to minimize potential erosion damage. Immediately protect side slopes and back slopes upon completion of rough grading or clearing with appropriate material as defined in the Sediment and Erosion Control Plan.
 - 3. Temporary Protection of Disturbed Areas: Install erosion and sedimentation control measures as shown in the Contract Drawings. Areas disturbed by construction operations that are not anticipated to be re-disturbed or brought to final grade within seven (7) days shall require temporary seeding.

4. Erosion and Sedimentation Control Devices: 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, straw waddles, fiber rolls, and/or silt fence, until permanent drainage and erosion control facilities are completed and operative and/or site is stabilized.
 5. Manage and control borrow and spoil areas on and off Government property to minimize erosion and to prevent soil and/or sediment from entering nearby water courses or lakes.
 6. Protect adjacent areas from despoilment by temporary excavations and embankments.
 7. 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.
 8. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 9. Handle discarded materials other than those included in the solid waste category as directed by the CO/COR.
- 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 sediment basins prior to entering retention/detention ponds, allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
 2. Monitor water areas, wetlands and wetland buffers 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 protected 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 New Mexico 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 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, or other methods are permitted to control particulates in the work area as approved in the Environmental Protection Plan.
 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. Noise Control: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the CO/COR. 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 5:00 p.m unless otherwise permitted by local ordinance or the CO/COR. Repetitive impact noise on the property shall not exceed the following Decibel A-scale (dBA) limitations:

Time Duration of Impact Noise	Sound Level in dBA
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 as measured with an A-scale decibel measuring device at 15 m (50 feet) (dBA):

CATEGORY OF EQUIPMENT			
EARTHMOVING		MATERIALS HANDLING	
EQUIPMENT STYLE	SOUND LEVEL dBA	EQUIPMENT STYLE	SOUND LEVEL dBA
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, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75	BLASTING	Not Allowed
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

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

c. Use efficient silencers on equipment air intakes.

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

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

f. 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 75 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 weighted sound level 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 CO/COR 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 as approved by the CO/COR. The site shall be left meeting the requirements of the EPA. Cleaning shall include off-cemetery 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, clearing, logging and general construction in accordance with state and local regulations and the contract.

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SECTION 02 41 16
STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies demolition and removal of existing buildings and associated utilities.

1.2 RELATED WORK:

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- 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. Waste Management: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

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 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. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 - 3. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- 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 Fort Bayard National Cemetery; any damaged items shall be repaired or replaced as approved by the Contracting Officer/Contracting Officer's Representative (CO/COR). 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 CO/COR'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 MATERIALS CO/CORSHIP:

- A. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques

and tablets, and other items of interest or value to the CO/COR that may be uncovered during demolition remain the property of CO/COR.

1. Carefully salvage in a manner to prevent damage and promptly return to the CO/COR.

B. Unless otherwise indicated, demolition waste becomes property of Contractor.

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 Fort Bayard National Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the CO/COR. 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 the Cemetery Property unless otherwise indicated on Contract Documents.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by CO/COR before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and CO/COR. Hazardous materials will be removed by the CO/COR under a separate contract.

3. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
 1. CO/COR will arrange to shut off indicated utilities when requested by Contractor.
 2. Arrange to shut off indicated utilities with utility companies.
 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 4. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.

3.2 CLEAN-UP:

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to CO/COR. Clean-up shall include the Fort Bayard National Cemetery Property, disposal of all items and materials not required to remain property of the Government, as well as all debris and rubbish resulting from demolition operations.

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SECTION 03 30 53
(SHORT-FORM) CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies cast-in-place structural concrete and material and mixes for other concrete.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- C. Joint sealants: 07 92 00 JOINT SEALANTS

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.

1.5 QUALITY CONTROL

- A. Mockups: Mockup is required for concrete retaining wall. Contractor's bid shall include two mockups.
- B. Coordinate the location for the mockup wall(s) with the CO/COR; mockup wall(s) cannot become part of the final project work.
- C. Mockup size - 18" height x 24" long x 8" wide.
- D. The approved mockup shall demonstrate the quality of exposed concrete work with regard to all requirements of the Contract Documents, including construction tolerances, forming, curing, finishes, joints, edges, weep holes, and sealants. Mockup shall include an expansion joint complete with backer rod and sealant.
- E. Approved mockup shall serve as the basis for determining the acceptance or rejection of the finished work.

1.6 SUBMITTALS

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

- B. Submit concrete mix design and product data for all admixtures and accessories.
- C. Shop Drawings:
 - 1. Submit Steel Reinforcement Shop Drawings and Product Data to include all information necessary for fabrication and placement of reinforcement.
 - 2. Indicate grades of reinforcing steel.
 - 3. Clearly indicate the splice length for every size and type of bar used.
 - 4. Indicate the type, size and location of all accessories required for the proper assembly, placement and support of the reinforcement.
 - 5. Provide layout drawings of all floor slabs and formed concrete indicating control and expansion joints.
- D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.7 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. American Concrete Institute (ACI):
 - 117-10 Tolerances for Concrete Construction and Materials and Commentary
 - 211.1-91 (R2009) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - 211.2-98 (R2004) Selecting Proportions for Structural Lightweight Concrete
 - 301-10 Structural Concrete
 - 305R-10 Guide to Hot Weather Concreting
 - 306R-10 Guide to Cold Weather Concreting
 - SP-66-04 ACI Detailing Manual
 - 318/318M-11 Building Code Requirements for Structural Concrete and Commentary
 - 347R-04 Guide to Formwork for Concrete
- C. American Society for Testing and Materials (ASTM):
 - A185/A185M-07 Steel Welded Wire Reinforcement, Plain, for Concrete

A615/A615M-12	Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
A996/A996M-09b	Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement
C31/C31M-12	Making and Curing Concrete Test Specimens in the Field
C33/C33M-13	Concrete Aggregates
C39/C39M-12a	Compressive Strength of Cylindrical Concrete Specimens
C94/C94M-13	Ready Mixed Concrete
C143/C143M-12	Slump of Hydraulic Cement Concrete
C150/C150M-12	Portland Cement
C171-07	Sheet Materials for Curing Concrete
C172/C172M-10	Sampling Freshly Mixed Concrete
C173/C173M-12	Air Content of Freshly Mixed Concrete by the Volumetric Method
C192/C192M-12a	Making and Curing Concrete Test Specimens in the Laboratory
C231/C231M-10	Air Content of Freshly Mixed Concrete by the Pressure Method
C260/C260M-10a	Air-Entraining Admixtures for Concrete
C330/C330M-09	Lightweight Aggregates for Structural Concrete
C494/C494M-13	Chemical Admixtures for Concrete
C618-12a	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
D1751-04 (R2008)	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
E1155-96 (2008)	Determining FF Floor Flatness and FL Floor Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS

- A. Wood, plywood, metal, or other materials, approved by CO/COR, of grade or type suitable to obtain type of finish specified.
- B. Form releasing agents to be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents must not impair subsequent treatment of concrete surfaces depending upon bond or

adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, follow the recommendation of the form coating manufacturer. Submit manufacturer's recommendation on method and rate of application of form releasing agents.

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. Provide Size 7 coarse aggregate for applied topping and metal pan stair fill.
- D. Fine Aggregate: ASTM C33.
- E. Lightweight Aggregate for Structural Concrete: ASTM C330, Table 1
- F. Mixing Water: Fresh, clean, and potable.
- G. Air-Entraining Admixture: ASTM C260.
- H. Chemical Admixtures: ASTM C494.
- I. Vapor Barrier: ASTM E1745, 0.38 mm (15 mil).
- J. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.
- K. Welded Wire Fabric: ASTM A185.
- L. Expansion Joint Filler: ASTM D1751.
- M. Sheet Materials for Curing Concrete: ASTM C171.
- N. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- O. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout cannot show settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement. Grout must produce a compressive strength of minimum 18 MPa (2500 psi) at 3 days and minimum 35 MPa (5000 psi) at 28 days.

2.3 CONCRETE MIXES

- A. Design of concrete mixes using materials specified as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days: Minimum 4000 psi.

- 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 Min. 28 Day Comp. Str. MPa (psi)	Non-Air-Entrained		Air-Entrained	
	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio
35 (5000) ^{1,3}	375 (630)	0.45	385 (650)	0.40
30 (4000) ^{1,3}	325 (550)	0.55	340 (570)	0.50
25 (3000) ^{1,3}	280 (470)	0.65	290 (490)	0.55
25 (3000) ^{1,2}	300 (500)	*	310 (520)	*

- 1. If trial mixes are used, the proposed mix design must achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design must achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
- 2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
- 3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
- * Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

- 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 must conform with ACI 318 Table 4.4.1.

2.4 BATCHING AND MIXING

- A. Store, batch, and mix materials as specified in ASTM C94.
 - 1. Job-Mixed: Mix in a batch mixer in manner specified for stationary mixers in ASTM C94.
 - 2. Ready-Mixed: 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 must furnish, in duplicate, certification as required by ASTM C94.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Installation conforms to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection while remaining within allowable construction tolerances, 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, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications are required to be in their final position at time concrete is placed - properly located, accurately positioned, built into construction, and maintained securely in place.
- D. Construction Tolerances:
 - 1. Set and maintain concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials.
 - 2. Cast-in-place concrete installed as part of exposed retaining walls or structures with greater than 12" showing above finished grade shall be constructed to dimensions indicated on Drawings within 1/4 inch) of location and elevation.
 - 3. Properly brace the forms so the set concrete is correct within the allowable construction tolerances when the forms are removed.
 - 4. Upon removal of the forms, the professional surveyor must survey the placed concrete and provide information to the CO/COR where the work is not in conformance with the design drawings, within the allowable

construction tolerances. The work cannot progress until the exposed concrete for the foundations are brought into compliance.

5. Remedial work necessary for correcting installations that is in excess of allowable tolerances are the responsibility of the Contractor.
6. Erected work that exceeds specified tolerance limits must be remedied or removed and replaced, at no additional cost to the Government.
7. Any remediation work is subject to approval of the CO/COR in advance of the work.
8. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 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.

3.3 PLACING CONCRETE

- A. Remove water from excavations 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 CO/COR before placing concrete. Provide screeds at required elevations for concrete slabs.
- B. Roughen and clean set concrete free from laitance, foreign matter, and loose particles, before placing new concrete on or against concrete which has set.
- 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. Provide vibration 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 cannot be used without written approval from CO/COR.

3.4 PROTECTION AND CURING

- A. 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 is subject to approval by CO/COR. Curing method shall be compatible with the finish specified and shall not cause mottling or staining of concrete exposed to view.

3.5 FORM REMOVAL

- A. 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.

3.6 SURFACE PREPARATION

- A. For exposed surfaces of concrete site walls, follow the procedures identified in Paragraph FINISHES for Exterior Exposed Areas (finished).
- B. For site walls, immediately after forms are removed, take steps to prepare and smooth the exposed portions of the concrete. Remove the form marks, including joint marks, fins, burrs and similar projections to produce a smooth surface. Complete the surface finish to result in a uniform textured surface with homogeneous color, unless surface is to be otherwise treated. Work must be as approved during the review of the mock-up.

3.7 FINISHES

- A. Vertical and Overhead Surface Finishes:
 - 1. Unfinished Areas: Vertical and overhead concrete surfaces exposed in unfinished areas, above suspended ceilings, in manholes, and other unfinished areas exposed or concealed will not require additional finishing.

2. Interior and Exterior Exposed Areas (to be painted): Fins, burrs and similar projections on surface must be knocked off flush by mechanical means approved by CO/COR and rubbed lightly with a fine abrasive stone or hone. Use an ample amount of water during rubbing without working up a lather of mortar or changing texture of concrete.
3. Interior and Exterior Exposed Areas (finished): Provide smooth, as cast finish of uniform color and smooth finish treated as follows:
 - a. The finish surfaces of the walls shall be free of honeycomb patterns and sharp or rough edges. Exposed, uniformly-spaced, snap tie indentions are acceptable. Rubbing or patching of exposed wall surfaces is not acceptable.
 - b. Provide Surface Finish-3.0 (SF-3.0) per ACI-301-10 as summarized below:
 - 1) Patch voids larger than 3/4 inch wide or 1/2 inch deep
 - 2) Remove projections larger than 1/8 inch
 - 3) Patch tie holes
 - 4) Surface tolerance Class A as specified in ACI 117
 - 5) Provide mockup of concrete surface appearance and texture

3.8 RETAINING WALLS

- A. Provide concrete for retaining walls as shown and air-entrained.
- B. Install and construct expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves as shown.
- C. Place porous backfill as shown.
- D. Provide surface finish as specified under "FINISHES" paragraph of this section and per approved mockup.

3.9 PRECAST CONCRETE ITEMS

- A. Precast concrete and cast stone items shall use 5,000 psi air-entrained concrete to shapes and dimensions shown. Finish surfaces to match corresponding adjacent concrete surfaces or as otherwise indicated on drawings. Reinforce with steel as necessary for safe handling and erection.

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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. Natural stone wall caps: 04 42 00 STONE MASONRY

1.3 TESTING LABORATORY-CONTRACTOR RETAINED

A. Engage a commercial testing laboratory approved by COR to perform tests specified below.

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

1.4 TESTS

A. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:

B. Mortar:

1. Test for compressive strength and water retention; ASTM C270.

2. Mortar compressive strengths 28 days as follows:

Type N: Minimum 5170 kPa (750 psi) at 28 days.

C. Cement:

1. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.

2. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.

D. Sand: Test for deleterious substances, organic impurities, soundness and grading.

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).

- f. 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
 - 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. Limit fine aggregate to stone less than 3/8" in diameter.

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

2.3 BLENDED HYDRAULIC CEMENT

ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT

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

2.5 MORTAR CEMENT

ASTM C1329, Type N, S or M.

2.6 PORTLAND CEMENT

A. ASTM C150, Type I.

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 MASONRY MORTAR

A. Conform to ASTM C270.

B. Admixtures:

1. Do not use mortar admixtures, except color admixtures if approved by COR.

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. Match mortar color in approved sample or mock-up.

D. Color Admixtures:

1. Proportion as specified by manufacturer.

2.10 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 mortar mixer.

1. Mix mortar for at least three minutes but not more than five minutes.

- B. Measure ingredients by volume. Measure by the use of a container of known capacity.
- C. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces of masonry units.
- D. Mortar that has stiffened because of loss of water through evaporations:
 - 1. Re-tempered by adding water to restore to proper consistency and workability.
 - 2. Discard mortar that has reached its initial set or has not been used within two hours.

3.2 MORTAR USE LOCATION

- A. Use Type N mortar for setting wall caps and other masonry work, except as otherwise specified.

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SECTION 04 42 00

STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies installation of cut limestone for wall caps and accessories.

1.2 RELATED WORK

- A. Cast-in-place concrete: Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.
- B. Mortar: Section 04 15 13 MASONRY MORTARING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product data: For mortar materials and mix design, all hardware and accessories related to limestone wall cap installation.
- C. Installer Qualifications: Provide documentation of requirements specified herein.
- D. Existing conditions report: photographically document condition of wall cap pieces prior to installation.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials to prevent damage.

1.5 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.

1. Indiana Limestone Handbook (current edition); Indiana Limestone Institute

STONE MASONRY

1.6 QUALITY ASSURANCE

A. Installer:

1. Must provide documentation demonstrating that they have a minimum of five years' experience setting natural stone.
2. Provide written handling and installation procedures that will be followed for the installation of the work for stones lifted, moved, adjusted in any way, other than by hand. Describe procedure starting at the inspection of the products once delivered to the site, and continue through the final setting of the stone units with them being secured into place in the work. Include procedures with description of the equipment that will be used, as well as all protection procedures to be followed, to ensure that no exposed surfaces or edges of the stone are damaged during handling or installation.
3. Provide written procedures for removal and replacement of stone units that have been damaged on any edges or faces that will be visible in the final installation, including drip slots.
4. Provide procedures for inspection and identification of any exposed damage, with procedures for immediate marking of the units to be removed and replaced prior to sealing of joints.

D. Pre-Installation Conference: Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include CO/COR and all parties whose work is effected or related to the work of this section.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual conditions to receive stone components by field measurements before production and installation.
- B. Dimensions on shop drawings to be based upon field measurements.

PART 2 - PRODUCTS

2.1 NATURAL STONE

- A. Rostrum wall cap: cut limestone cap pieces to be installed by the Contractor are stored at the Cemetery.

2.2 EMBEDDED ANCHORS AND OTHER INSERTS

- A. Fabricate from stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304.

2.3 SHIMS

- A. Shims or setting pads shall be resilient, nonferrous, non-rusting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Check stone materials for damage, coloration, finish, and fit prior to installation. Do not set unacceptable units.

3.2 SETTING TOLERANCES

- A. Set stones 3 mm (1/8 in.) or less, within the plane of adjacent units.
- B. Joints, plus - 1.5 mm (1/6 in.), minus - 3 mm (1/8 in.).

3.3 JOINTING

A. Joint Materials:

1. Mortar, Type N, ASTM C270. Limit fine aggregate size to less than 3/8" diameter.
2. Use a full bed of mortar at all bed joints.
3. Leave all joints with exposed tops or under relieving angles open for sealant.

B. Location of Joints:

1. As shown on shop drawings.

STONE MASONRY

2. At control and expansion joints unless otherwise shown.

3.4 SETTING

A. Preparation

1. When necessary, before setting in the wall, all stones shall be thoroughly cleaned on all exposed surfaces by washing with fiber brush and soap powder, followed by a thorough drenching with clear water.

B. Mortar Bed Setting:

1. Drench units with clean water prior to setting.
2. Fill dowel holes and anchor slots completely with silicone sealant.
3. Setting pads shall be placed under coping stones in same thickness as joint, and in sufficient quantity to avoid squeezing mortar out. Shims or setting pads shall not create point loads on the stones.
4. Set units in full bed of mortar containing water repellent.
5. Rake mortar joints to receive backer rod and sealant.
6. Remove excess mortar from unit faces immediately after setting.

3.5 PROTECTION, REPAIR AND CLEANING

- A. During construction, tops of walls shall be carefully covered at night, and especially during any precipitation or other inclement weather.
- B. At all times, walls shall be adequately protected from droppings.
- C. Whenever necessary, substantial wooden covering shall be placed to protect the stonework. Nonstaining building paper or membrane shall be used under the wood. Maintain all covering until removed to permit final cleaning of the stonework.
- D. The stone shall be washed with fiber brushes, mild soap powder or detergent and clean water or approved mechanical cleaning process. Cleaning shall not damage adjacent materials.

Ft. Bayard National Cemetery
Cemetery Improvements

Project 885CM3007B
Bid Set - April 14, 2016

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STONE MASONRY

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**SECTION 06 20 00
FINISH CARPENTRY**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies new interior millwork located at the Kiosk opening in the PIC Lobby.

1.2 RELATED WORK

- A. Wood doors: Section 08 14 00, INTERIOR WOOD DOORS.
- B. Finish: 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. Provide documentation of conformance with performance requirements of this section.
- C. Shop Drawings:
 - 1. Indicate materials and details of construction, methods of fastening, erection, and installation.
- D. Samples: 1" x 4" x 6" red oak trim piece. 6" x 6" x 3/4" plain sliced red oak plywood.

1.4 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 existing buildings.

PART 2 - PRODUCTS

2.1 LUMBER

- A. 1" x 4" select red oak; full length boards.

2.2 PLYWOOD

- A. 3/4" plain sliced red oak plywood.

2.3 MOISTURE CONTENT

- A. Moisture content of lumber and millwork at time of delivery to site.
 - 1. Moisture content of other materials to be in accordance with the standards under which the products are produced.

2.4 FABRICATION

- A. General:
 - 1. Provide interior woodwork complying with referenced quality standard.

2. Use AWI Custom Grade for architectural woodwork and interior millwork, except as otherwise indicated.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Maintain work areas and storage areas to a minimum temperature of 21⁰C (70⁰F) for not less than 10 days before and during installation of interior millwork.

3.2 INSTALLATION

- A. General:
 1. Install to comply with AWI 1700.
 2. Millwork receiving transparent finish to be primed and back-painted on concealed surfaces; do not set millwork until primed and back-painted.
 3. Secure trim with fine finishing nails, screws, or glue as required.
 4. Set nails for putty stopping. Use washers under bolt heads where no other bearing plate occurs.
 3. Plumb and level items unless shown otherwise.
- B. Install with miter at corners.

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SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK

- A. Expansion joint materials: Section 32 05 23 CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Sealing joints for painting: Section 09 91 00 PAINTING.

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.
 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
 5. Determine sealants will not stain joint substrates according to ASTM C1248.
- D. Meet VOC requirements of pertinent CARB and/or SCAQMD Rule for sealants VOC (4 percent by weight VOC or less in less than 16 ounce package or less than 250 g/L in larger package). All non-porous sealant primers must be below 250g/L and primers for porous substrates less than 775 g/L.

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. 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.
 - 4. Manufacturers color charts.

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: Do not proceed with installation of joint sealants where joint widths are less or more than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: 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 less than 5° C (40° F) or exceeding 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 to be extended to five (5) years.

- B. General Warranty: Special warranty specified in this Article will not deprive Government of other rights Government may have under other provisions of Contract Documents and are 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 the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

- B. American Society for Testing and Materials (ASTM):

C717-12b	Standard Terminology of Building Seals and Sealants
C734-06(2012)	Low Temperature Flexibility of Latex Sealants after Artificial Weathering
C834-10	Latex Sealants
C920-11	Elastomeric Joint Sealants
C1021-08	Laboratories Engaged in Testing of Building Sealants
C1193-13	Use of Joint Sealants
C1248-08(2012)	Staining of Porous Substrate by Joint Sealants
D217-10	Cone Penetration of Lubricating Grease
D1056-07	Flexible Cellular Materials—Sponge or Expanded Rubber

- C. Sealant, Waterproofing and Restoration Institute (SWRI):
The Professionals' Guide.

PART 2 - PRODUCTS

2.1 SEALANTS

- A. S-1:
1. ASTM C920, polyurethane or polysulfide.
Type M.
Class 25.
Grade NS.
Shore A hardness of 20-40.
- B. S-2:

1. ASTM C920, polyurethane.
Type M.
Class 25.
Grade P.
Shore A hardness of 25-40.

C. S-4:

1. ASTM C920 polyurethane.
Type S.
Class 25.
Grade NS.
Shore A hardness of 25-40.

D. S-6:

1. ASTM C920, silicone, neutral cure.
Type S.
Class: Joint movement range of plus 100 percent to minus 50 percent.
Grade NS.
Shore A hardness of 15-20.

E. S-9:

1. ASTM C920 silicone.
Type S
Class 25
Grade NS
Non-yellowing, mildew resistant.

F. S-11:

1. ASTM C920 polyurethane.
Type M/S.
Class 25.
Grade P/NS.
Shore A hardness of 35 to 50.

2.2 CAULKING COMPOUND

- A. C-1: ASTM C834, acrylic latex.

2.3 COLOR

- A. Match color of mortar joints at exposed masonry.
- B. Match color of adjacent concrete at unpainted concrete.
- C. Provide light gray or white, paintable caulking, unless specified otherwise.

2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

2.5 FILLER

- A. Mineral fiber board: ASTM C612, Type IVA.
- 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 as specified only when installers are ready to initiate sealant

application as soon as practicable after preparation and before subsequent surface deterioration.

- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
 - 1. Apply primer prior to installation of back-up rod or bond breaker tape.
 - 2. Use brush or other approved means that will reach all parts of joints.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.3 BACKING INSTALLATION

- A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.

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. Comply with manufacturer's written installation instructions for products and applications indicated.

3.6 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.

3.7 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.8 LOCATIONS

- A. Exterior Building Joints, Horizontal and Vertical:

1. Metal to Masonry or Stone: Type S-1.
 2. Masonry to Masonry or Stone: Type S-1.
 3. Stone to Stone: Type S-1.
 4. Cast Stone to Cast Stone: Type S-1.
 5. Masonry Expansion and Control Joints: Type S-6.
- B. Metal Reglets and Flashings:
1. Flashings to Wall: Type S-6.
 2. Metal to Metal: Type S-6.
- C. Sanitary Joints:
1. Walls to Plumbing Fixtures: Type S-9.
 2. Counter Tops to Walls: Type S-9.
 3. Pipe Penetrations: Type S-9.
- D. Horizontal Traffic Joints:
1. Concrete Paving, Unit Pavers: Type S-11.
- E. Interior Caulking:
1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Type C-1.
 2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Type C-1.

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SECTION 08 14 00
INTERIOR WOOD DOORS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section refers to the interior flush doors, and stile and rail doors that have been finished on site.
- B. Section includes fire rated doors, and nonrated doors.
- C. All wood doors are in place. Wood door manufacturer: Marshfield Door Systems (www.marshfielddoors.com, 1(800)869-3667).
- D. This section addresses the finishing of the doors, the door rehanging and adjusting.

1.2 RELATED WORK

- A. Door hardware including hardware Section 08 71 00, DOOR HARDWARE. Some new door hardware will be required.
- B. Finish: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

- A. All wood doors are in place; so, no door submittals are required.

1.4 WARRANTY

- A. All interior wood doors carry the existing manufacturer's warranty for lifetime of original installation.

PART 2 - PRODUCTS

2.1 FLUSH DOORS & STILE AND RAIL DOORS

- A. All doors are in place, and they meet requirements of their placement.
- B. All wood doors are red oak premium grade with a clear finish.

2.2 FINISHING DOORS

- A. All wood door tops and bottoms edges are rough and have not been sanded or finished. All wood doors shall be removed to sand and finish the tops and bottom edges. The doors must be rehung and adjusted after refinishing. All finishes shall match the existing clear coat finish.

PART 3 - EXECUTION

3.1 DOOR REMOVAL AND REINSTALLATION.

- A. 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.
- C. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch. If door faces are not smooth to touch, sand and apply an additional coat of clear finish.
- D. Maintain the steel astragal on the pair of fire rated doors.

3.2 REINSTALLATION

- A. Maintain and protect as much of the existing hardware on the doors as possible in the refinishing of the door edges.
- B. Reinstall the doors to be operable with the required clearances and full functioning of the door hardware. Doors must close completely tight to the door frame.
- C. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

3.3 DOOR PROTECTION

- A. Protect all wood doors from damage during construction.
- B. Repair all door damage done during construction.
- C. Prior to beginning construction document and photograph all existing door damage not noted in the construction documents and transfer copies to the CO/COR.

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SECTION 08 41 13
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section refers to the existing aluminum store front at the PIC entrance work including storefront construction, hung doors, and other components to make a complete assembly. Door A100 frame has two insulated panels on each side of the door. The two insulated panels were not installed per the approved shop drawings. The panels must be removed and installed per the approved shop drawings. Any damage in removing and replacing the existing panels must be repaired. The existing storefront aluminum has scratches. The scratches will have to be touched up with a paint matching the storefront color and provided by the store front manufacturer.

1. PIC Building & Storage Building approved existing products: Aluminum storefront is the T14000 Series Framing by Tubelite, finish is Bone White kynar; Aluminum doors are Wide Stile Standard Entrances by Tubelite, finish is Bone White kynar. Details from existing windows included on drawing sheet A-001.

1.2 RELATED WORK

A. Hardware: Section 08 71 00, DOOR HARDWARE.

1.3 SUBMITTALS

- A. Submit proposed corrections in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Note new panel details to match the original submitted and approved details 5/2 and 5/3.
- B. All materials must be from the original approved frame manufacturer.
- C. Provide shop drawings with the proposed corrections.
- D. Provide literature on the manufacturers touch up paint and the application.

1.4 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.

PART 2 - PRODUCTS

2.1 MATERIALS GENERAL

- A. Aluminum, ASTM B209 and B221: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- B. Thermal Break: Manufacturer standard low conductive material retarding heat flow in the insulating panel. Match the aluminum finish on each side of the insulating panel to the door frame.
Provide coat of aluminum paint primer.

2.2 FABRICATION

- A. Form aluminum shapes before finishing.

2.3 FINISH

- A. In accordance with NAAMM AMP 500 series.
- B. Finish exposed aluminum surfaces as follows:
 - 1. Fluorocarbon Finish: AAMA 2605, superior performing organic coating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Allowable Installation Tolerances: Install work plumb and true, in alignment and in relation to lines and grades shown. Variation of 3 mm (1/8 inch) in 2400 mm (eight feet), non-accumulative, is maximum permissible for plumb, level, warp, bow and alignment.
- B. Set the insulated panel with glazing gaskets matching the adjacent glazing as originally submitted.

3.2 ADJUSTING

- A. After installation of entrance and storefront work is completed, adjust and lubricate operating mechanisms to insure proper performance.

3.3 PROTECTION, CLEANING AND REPAIRING

- A. Remove all mastic smears and other unsightly marks, and repair any damaged or disfiguration of the work. Protect the installed work against damage or abuse.

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SECTION 08 51 13
ALUMINUM-CLAD WOOD WINDOWS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Aluminum-clad, single hung, wood windows are in place and operable. Some of the plastic slide areas or jamb liners have been painted. The paint must be removed from the plastic jamb liner, or the plastic jamb liner must be replaced with the manufacturer's original material. Broken Glazing must be removed and replaced with glazing matching the original supplied by the window manufacturer. All wood windows will have to be sanded and repainted. Do not paint the plastic jamb liners. The existing aluminum clad wood windows are manufactured by Eagle Windows Architectural Collection, a division of Anderson Windows. The windows are from E-Series and are Talon Single-Hung Windows.

1.2 RELATED WORK

- A. Color of finish: Section 09 06 00, SCHEDULE FOR FINISHES.
B. Painting: Section 09 91 00, PAINTING.

1.3 SUBMITTALS

- A. Provide proposed correction for removal of the paint or installing new plastic slide material.
B. Provide proposed matching glazing by the window manufacturer for window glazing replacement.

1.4 WARRANTY

- A. The original ten year aluminum-clad window warranty remains in place.

PART 2- PRODUCTS

2.1 MATERIALS

- A. Any replacement parts must be from the original window manufacturer and the original warranty must remain valid.

2.2 SINGLE HUNG WINDOWS:

- A. AAMA 101/I.S.2. Single.
B. AAMA certified product to the AAMA 101/I.S.2.-97 standard.

2.3 FINISH

- A. Sand existing painted wood and match existing paint color. Verify the window paint color matches the paint listed in the schedule prior to painting.

PART 3 - EXECUTION

3.1 PROTECTION (DISSIMILAR MATERIALS): AAMA 101/I.S.2.

- A. Do not paint the plastic jamb liners.

3.2 INSTALLATION, GENERAL

- A. Remove paint from existing jamb liners or replace the jamb liners with original material from the window manufacturer. Scratch up or damaged plastic liners from the paint removal are not acceptable.
- B. Sand all painted wood smooth and add another coat of paint.

3.3 ADJUST AND CLEAN

- A. Adjust operable sash and hardware to provide tight fit at contact points, and at weather-stripping for smooth operation and weathertight closure.
- B. Clean aluminum surfaces of windows, exercising care to avoid damage to protective coatings and finishes. Remove all labels.
- C. Remove excess glazing and sealant compounds, dirt, and other substances.
- D. Lubricate hardware and moving parts.
- E. Clean glass windows. Remove glazing and sealant compound, labels, 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.

- - - E N D - - -

SECTION 08 56 66
DETENTION WINDOW SCREENS

PART 1 - GENERAL

1.1 DESCRIPTION

Detention and protection screens consist of a sub-frame, main frame with wire cloth and support assembly, detention lock and bolt, hinges and all fittings and anchors required. All detention screens are in place. One storage building screen is damaged and is to be removed and replaced by a new matching screen in this contract. The replacement screen must be provided by the original manufacturer and match the existing screens. No keys for the screens have been found. The Contractor must contact the screen supplier and get the security keys for all the screens on the project. The VA must assist the Contractor in getting permission to duplicate the keys as required. The existing Detention Screens are manufactured by Kane Screens (800)952-6399.

1. Existing product at PIC Building: Hurri-Kane Storm Barriers, Narrow-Line Screen. Frame has White Powder Coat finish, and screen is 12 ga, painted black.
2. Existing product at Storage Building: Hurri-Kane Storm Barriers, Defender Screen. Frame has White Powder Coat finish, and screen is stainless steel, painted black.

1.2 RELATED WORK

- A. Section 08 51 13, ALUMINUM CLAD WOOD WINDOWS.
- B. Color of finish paint: 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: One Corner frame section and screen material sample with colors matching the existing screens
- C. Shop Drawings: Complete details (1/2 full scale), showing details of construction and anchorage, relation to details of the windows and clearances required and window operators.
- D. Manufacturer's Certificates:
 1. Indicating manufacturer's qualification specified.
 2. Indicating wire screen cloth meets the requirements specified.
- E. Manufacturer's Literature and Data:
 1. Detention Screen.
 2. Protection Screen.

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 Material:
A653/A653M (2007).....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

PART 2 - PRODUCTS

2.1 DETENTION SCREEN

Kane Security Screen Design Level 5, Operable with locks; Model No. S-NR5-0 for the PIC Building; and Level 7 operable with locks; Model No. A-DEF-0 for the Storage Building.

2.2 WIRE CLOTH

Stainless steel wire cloth woven from 0.7 mm (0.028-inch) diameter Type 302 or 304 stainless steel wire, woven 12 mesh at PIC and 10 mesh at Storage, black, double crimped.

2.3 SHEET STEEL

ASTM A653/A653M

2.4 FABRICATION

- A. Fabricate Level 5 screens' members from 16 gage thick sheet steel and install at head and jambs of openings.
- B. Fabricate Level 7 screens' members from extruded aluminum with a minimum of .15 inch thickness.
- C. Frames: Weld mitered corners of hinged frames continuously. Outside reinforcements or projections will not be permitted. Dress weld smooth so as to be inconspicuous. Round exposed edges and corners. All frames are to be hinged w/ locks.
- D. Reinforce frames lighter than 2.5 mm (0.105-inch) thick steel at locks and hinges with steel plates not less than 5 mm (3/16-inch) thick.
- E. Provide rubber cushion plugs (bumpers) on lock between fixed and hinged frames. Locate bumpers 150 mm (6-inches) from top and bottom on side of frame where lock bolts or slides occur.
- F. Provide metal emergency egress releases on all frames.

2.5 PROTECTION SCREENS

- A. Reinforce hinged frames over four feet in height horizontally or vertically, or both if width exceeds five feet.
- B. Screens Unit - Level 5:
 - 1. Mainframe:

- a. Certifications: Performance and testing must comply with impact test, sag test and forced entry resistance test of SMA 6001-85. Manufacturer must submit the AAMA Notice of Product Certification in compliance with CFR 200.935 as "Security Screen - Heavy."
 - b. The main frame rails shall be of not less than 16 gage 1" x 1" seamless welded galvanized steel tubing with high strength die case metal corners which are pneumatically inserted into the frame ends with an interference fit.
 - c. A removable face plate, extruded from 6063-T6 aluminum alloy, .062-inch thick .212 lbs/ft., shall be attached to the sides of the main frame using square drive Tek screws. The faceplate corner bead shall integrate with the sub-frame to conceal the hardware and fasteners.
2. Sub-frame
- a. The sub-frame shall be of channel design extruded from 6063-T6 aluminum alloy. Weight shall be .515 lbs./ft. Wall thickness shall be .090 inch. The corners of the sub-frame shall be mitered, secured by an internal tension coupling assembly and shall be resistant to both torsion and flexural failure.
 - b. The sub-frame shall have a continuous groove retaining a combination cushioning strip/insect shield. The depth of the sub-frame shall be no more than 1 3/4."
3. Finish
- a. The main frame: An electrostatically applied white, thermoplastic, polyester coating shall be applied and baked to a hard resistant finish.
 - b. The sub-frame: A white, electrostatically applied thermoplastic, polyester powder coating shall be applied and baked to a hard mar-resistant finish. Coating shall meet or exceed AAMA 2603.
- C. Screens Unit - Level 7:
1. Mainframe - Level 7:
 - a. The main frame shall be of channel design, extruded from 6063-T6 aluminum alloy. Weight shall be not less than 1.30 lbs./ft. Thickness shall be a minimum of .156 and .125-inch. The corners of the main frame shall be mitered, continuous welded on both sides and dressed smooth.
 - b. A removable interlocking concealment plate, extruded from 6063-T6 aluminum alloy, .062-inch thick, .314 lbs./ft., shall be attached to the main frame using TORX (registered name) tamper-resistant screws.

2. Sub-frame

- a. The sub-frame shall be of channel design extruded from 6063-T6 aluminum alloy. Weight shall be .548 lbs./ft. Wall thickness shall be .125 and .156-inch inch. The corners of the subframe shall be mitered, secured by an internal tension coupling assembly and shall be resistant to both torsion and flexural failure.
- b. The sub-frame shall have a continuous groove retaining a combination cushioning strip/insect shield. Color: White.

3. Finish

- a. An electrostatically applied white, thermoplastic, polyester powder coating shall be applied and baked to a hard resistant finish. Coating shall meet or exceed AAMA 2603. Color: White.

2.6 HARDWARE

- A. Operating hardware shall be extra heavy duty type.
- B. Locks for Window Screens: Provide concealed locking system for each screen consisting of one, bit-key operated locking mechanism having a minimum of two operable, concealed 13 mm (1/2-inch) diameter case-hardened steel bolts. Locate bolts near the top and bottom of screen. Design bolts to engage adjustable strike or keepers in the sub-frame when bit key is rotated in lock.
- C. Construct bit key lock of steel construction with three brass tumblers having beryllium copper springs. Fabricate lock case from steel using two piece construction having three brass pedestal bearing supports attached to the lower half of the case to support the slide bar, tumblers, case and cover. Fabricate slide bar of lock from steel with hardened steel guide tumbler block.
- D. Make provisions to insure that the bit key cannot be removed except when the bolts are in a locked (extended) position. Locks shall be keyed alike.

2.7 FINISH

After surface treatment of the frame, apply two coats of baked-on enamel to all surfaces before the wire cloth is installed and secured into the frame.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Drill, tap or cut metal window trim and other materials as required for proper installation of screen units.
- B. Install screen units that can be readily removed without damage to new or existing work and to effectively exclude insects.

- C. Secure screen units with steel case hardened machine screws, spaced at approximately 12 inches on center.
- D. Provide screw fastenings of type, size and head as recommended by manufacturer of screen units.
- E. Anchor screen units to wood with stainless steel flathead wood screws at sill and stainless steel round head wood screws at head, mullions and jambs. Toggle bolts may be used if they do not interfere with sash balances or weights at jambs or mullions.
- F. The General Contractor shall confirm that all interior releases are operable, and review the operation of the security screens with the CO/COR.

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SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The door hardware and related items necessary for complete installation and operation of doors are already in place. The hardware must be adjusted when the doors are removed to finish the tops and bottom edges and reinstalled. Two door hardware items from the original attached schedule (see Appendix to Section 08 71 00) were not provided and installed and are highlighted on the attached hardware schedule. The three items that are highlighted in the hardware finish schedule must be provided and installed as part of this contract.
- B. The entry door to the PIC Building is on a timer with a battery backup. As part of this contract the Contractor will have to provide a hardware and security specialist capable of coordinating and making the PIC entry door completely operable as specified and drawn. Key new hardware to match existing locks.
- C. This contract changes out the hardware on A-201. See schedule for new hardware.

1.2 RELATED WORK

- A. Application of Hardware: Section 08 14 00, INTERIOR WOOD DOORS, Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- B. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Electrical: Division 26, ELECTRICAL.

1.3 GENERAL

- A. All existing hardware complies with UFAS, Uniform Federal Accessible Standards.
- B. Rated door hardware assemblies are in place where required by most current version of the International Building Code (IBC).

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for the three new hardware items.
- B. Hardware Schedule: See the attach hardware schedule. All non-boxed items are in place. Boxed typed items will have to be furnished and installed as part of this contract.
- C. Manufacturers' Literature:

1. Samples are not required for the new 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 must be accompanied by copies of reports as referenced. The testing must have been conducted 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.

1.5 DELIVERY AND MARKING

A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions on the project.

1.6 KEYING

A. Keying: The doors have been previously keyed with a Best System. Keying will not be part of this contract except for providing one additional Best cylinder and four keys at the Storage room door in the Storage Building. This new Best cylinder will also have to be keyed to the master key.

1.7 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. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):

A156.2-11	Bored and Pre-assembled Locks and Latches
A156.4-08	Door Controls (Closers)
A156.5-10	Auxiliary Locks and Associated Products
A156.18-12	Materials and Finishes
A156.23-10	Electromagnetic Locks
A156.24-12	Delayed Egress Locking Systems
A156.31-01	Electric Strikes and Frame Mounted Actuators

C. National Fire Protection Association (NFPA):

80-13	Fire Doors and Fire Windows
101-12	Life Safety Code

D. Underwriters Laboratories, Inc. (UL):

Building Materials Directory

PART 2 - PRODUCTS

2.1 DOOR CLOSING DEVICES

A. Provide closing devices matching the existing.

2.2 LOCKS

A. Match existing Best Lock cylinders at the missing cylinder at the Storage Building. Key to match the existing key system.

2.3 ELECTRICALLY OPERATED EXIT DEVICE

A. PIC has an existing electrically operated panic hardware set that is not operable at this time. It must be made operable with an outside keypad and a timer located in the closet off the office. The contractor shall assume that it will have to be rewired to be made operable. However, any existing usable wiring to this unit may be reused by the Contractor.

2.4 FINISHES

A. All new items to match existing finishes for similar items.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Adjust all existing hardware so the doors close smoothly and fit tight to the frames. Verify all latches and locks are functional. Verify the electrical exit device operates per design and the timer is functional.

3.2 HARDWARE SETS

A. Attached as Appendix to Section 087100, Door Hardware, is the approved Hardware Submittal Schedule from the existing building. Note that four items have been edited or added since this schedule was originally approved.

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APPENDIX FOR SECTION 08 71 00, DOOR HARDWARE

The following schedule is from the original submittal approved for the original construction of the buildings. The four hardware items that were not provided are indicated with boxes. They are to be provided and installed as part of this contract.

Grant's Steel

SASH, DOOR & HARDWARE, INC.

P.O. BOX 27727

2530 FIRST STREET N.W. 87102

ALBUQUERQUE, NEW MEXICO 87125-7727

PHONE (505) 247-8460 • FAX (505) 247-3133

E-MAIL: sales@grantssteel.com • WEBSITE: www.grantssteel.com

FINISH HARDWARE SCHEDULE

JOB: CEMETERY IMPROVEMENT AND NEW MAINTENANCE BLDG.

LOCATION: FT. BAYARD, NM

CONTRACTOR: KEVCON INC.
246 E. GRAND AVE.
ESCONDIDO, CA 92025-2803

ARCHITECT: CHERRY, SEE, REAMES ARCHITECTS LLC
220 A GOLD AVE. SW
ALBUQUERQUE, NM 87102

CONTRACT NO.: 13-242

DATE: APRIL 3, 2013

SUBMITTED BY: HARVEY WEBB

MANUFACTURER'S LISTED:

HINGES, COORDINATOR	IVES
EXIT DEVICES, POWER SUPPLIES	PRECISION
LOCKSETS	BEST
POWER TRANSFERS	VON DUPRIN
DOOR CLOSERS	FALCON
OVERHEAD STOPS	GJ
DOOR PULLS, KICKPLATES, STOPS	ROCKWOOD
AUTOMATIC FLUSHBOLTS, PUSH / PULL	ROCKWOOD
PLATES-SILENCERS	ROCKWOOD
TIMER SWITCH	GRAINGER
LOCK ASTRAGALS	DON-JO

DISTRIBUTOR OF SARGENT, STANLEY & OTHER QUALITY BUILDERS
HARDWARE MANUFACTURERS AND CURRIES HOLLOW DOORS & FRAMES
MANUFACTURERS OF GRANT'S "LITEKITS"

THRESHOLDS, DOOR BOTTOM, WEATHERSTRIPPING

NGP

SMOKESEAL, ASTRAGALS, DRIP CAPS

NGP

KEYING INSTRUCTIONS:

ALL LOCKSETS ARE TO BE SUPPLIED WITH A TEMPORARY BRASS CORE TO BE USED DURING THE CONSTRUCTION PERIOD. PERMANENT KEYING AS DIRECTED BY THE OWNER.

HW-1

1 SINGLE DOOR #A100 EXTERIOR FROM LOBBY 100
3/0 X 7/0 X 1 3/4" AL X AL

RHR

3 EA HINGES 5BB1HW 4.5" X 4.5" X NRP X US26D
1 EA POWER TRANSFER EPT-2 X 689
1 EA EXIT DEVICE ELR-2103 X CA-03 X US32D
1 EA DOOR PULL BF157 X US32D
1 EA POWER SUPPLY ELR151

1 EA TIMER SWITCH TORK DIGITAL TIME SWITCHES MODEL DG100A
1 EA DOOR CLOSER SC71-RW/PA X AL X TB4
1 EA DROP PLATE SC70-18 X AL
1 EA OVERHEAD STOP 904S X US32D
1 EA THRESHOLD 425E X 36"
1 EA DOOR BOTTOM 200NA X 36"
1 SET WEATHERSTRIPPING (BY FRAME SUPPLIER)

HW-2

1 SINGLE DOOR #A101 LOBBY 100 FROM OFFICE 101
3/0 X 7/0 X 1 3/4" WD X HMF

LHR

3 EA HINGES 5BB1 4.5" X 4.5" X NRP X US26D
1 EA LOCKSET 9K37 AB15D X LM X US26D
1 EA DOOR CLOSER SC71-HD-PA X AL X TB4
1 EA KICKPLATE K1050 10" X 34" X US32D
1 EA WALL STOP 409 X US32D
3 EA SILENCERS 608

HW-3

1 SINGLE DOOR #AI02 OFFICE 101 FROM KIOSK 102
3/0 X 7/0 X 1 3/4" WD X HMF

RHR

3 EA HINGES 5BB1 4.5" X 4.5" X NRP X US26D
1 EA LOCKSET 9K37AB15D X LM X US26D
1 EA WALL STOP 409 X US32D
3 EA SILENCERS 608

HW-4

1 SINGLE DOOR #A103 OFFICE 101 FROM CLOSET 103
3/0 X 7/0 X 1 3/4" WD X HMF

RHR

3 EA HINGES 5BB1 4.5" X 4.5" X NRP X US26D
1 EA LOCKSET 9K37RI5D X LM X US26D
1 EA WALL STOP 406 X US32D
3 EA SILENCERS 608

1 EA DOOR CLOSER SC71-HD-PA X AL X TB4

HW-5

1 SINGLE DOOR #A104 LOBBY 100 TO MEN'S 104 RH
1 SINGLE DOOR #A107 LOBBY 100 TO WOMEN'S 107 LH
3/0 X 7/0 X 1 3/4" WD X HMF

6 EA HINGES 5BB1HW 4.5" X 4.5" X US26D
2 EA PUSH PLATES 70C 4" X 16" X US32D
2 EA PULL PLATES 107 X 70C 4" X 16" X US32D
2 EA DOOR CLOSERS SC71-RW/PA X AL X TB4
2 EA KICKPLATES K1050 10" X 34" X US32D
2 EA WALL STOPS 406 X US32D
6 EA SILENCERS 608

HW-6

1 SINGLE DOOR #A105 LOBBY 100 FROM HOUSEKEEPING 105 RHR
1 SINGLE DOOR #A106 HOUSEKEEPING 105 FROM MECHANICAL 106 RHR
3/0 X 7/0 X 1 3/4" WD X HMF

6 EA HINGES 5BB1 4.5" X 4.5" X NRP X US26D
2 EA LOCKSETS 9K37D15D X LM X US26D
2 EA DOOR CLOSERS SC71-HD/PA X AL X TB4
2 EA KICKPLATES K1050 10" X 34" X US32D
2 EA WALL STOPS 406 X US32D
6 EA SILENCERS 608

HW-7

1 PAIR DOORS #A200 BAYS 201 FROM STORAGE 200 RHR/ACT
(2) 3/4 X 7/0 X 1 3/4" WD X HMF 60 MIN. LABEL

6 EA HINGES 5BB1 4.5" X 4.5" X NRP X US26D
1 SET AUTOMATIC FLUSHBOLT WITH BOTTOM FIRE BOLT 2948 X US26D
1 EA COORDINATOR COR9G X US26D
1 EA LOCKSET 9K37RI5D X S3 X 3/4 X LM X US26D (3/4" LATCHBOLT)
1 EA DOOR CLOSER SC71-HD/PA X AL X TB4
1 EA DOOR CLOSER SC71-SS X AL X TB4
2 EA KICKPLATE K1050 10" X 38" X US32D
1 EA WALL STOP 406 X US32D
1 SET SMOKESEAL 2525B X 25"
1 EA ASTRAGAL I39SP X 5050B X 84"
1 EA BEST CYLINDER FOR LOCKSET ABOVE

HW-8

1 SINGLE DOOR #A201 EXTERIOR FROM BAYS 201
 3/8 X 7/0 X 1 3/4" HMD X HMF

RHR

- 3 EA HINGES 5BB1HW 5" X 4.5" X NRP X US26D
- 1 EA LOCKSET 9K37AB15D X S3 X LM X US26D
- 1 EA DOOR CLOSER SC71-HD/PA X AL X TB4
- 1 EA LOCK ASTRAGAL BLP-107 X US32D
- 1 EA KICKPLATE K1050 10" X 42" X US32D
- 1 EA WALL STOP 409 X US32D
- 1 EA THRESHOLD 425E X 44"
- 1 EA DOOR BOTTOM 200NA X 44"
- 1 SET WEATHERSTRIPPING 160S-44" X 84"
- 1 EA DRIP CAP 16A X 48"

DELETE THE FOLLOWING:		
1 EA	ENTRANCE LOCK ND92GD RHO	626 SCH
1 EA	LATCH GUARD BLP-107	630 DON
ADD THE FOLLOWING:		
1 EA	ELEC CLASSROOM LOCK CO-100-CY-70-KP-RHO-PD	626 SCE
1 EA	LATCH GUARD LG1	630 IVE
NOTE: REKEY THE CLASSROOM LOCK WITH A BEST LOCK CYLINDER MATCHING THE EXISTING HARDWARE. TURN THE EXISTING HARDWARE OVER TO THE OWNER.		

HW-9

OVERHEAD COILING DOOR #B201

***ALL HARDWARE BY DOOR SUPPLIER.**

HW-10

1 PAIR DOORS #A400 EXTERIOR FROM PUMP HOUSE 400
 (2) 3/4 X 7/0 X 1 3/4" HMD X HMF

RHR/ACT

- 6 EA HINGES 5BB1 4.5" X 4.5" X NRP X US26D
- 1 SET AUTOMATIC FLUSHBOLT WITH BOTTOM FIRE BOLT 2848 X US26D
- 1 EA COORDINATOR COR9G X US26D
- 1 EA LOCKSET 9K37AB15D X S3 X LM X US26D
- 1 EA DOOR CLOSER SC71-HD/PA X AL X TB4
- 1 EA DOOR CLOSER SC71-SS X AL X TB4
- 1 EA LOCK ASTRAGAL BLP-107 X US32D
- 1 EA THRESHOLD 425E X 80"
- 2 EA DOOR BOTTOMS 200NA X 40"
- 1SET WEATHERSTRIPPING 160S-80" X 84"
- 1 EA DRIP CAP 16A X 84"

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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. Items that are in place are noted as NA. See Appendix A for the approved paint schedule for the existing buildings. Prior to any painting verify the colors in Appendix A match the colors in place.

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 contracting officer for finish requirements.

1.3 SUBMITTALS

Submit SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES in accordance with applicable specification sections.

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.
- B. MASTER PAINTING INSTITUTE: (MPI)
2001: Architectural Painting Specification Manual

PART 2- PRODUCTS

2.1 DIVISION 06 WOOD, PLASTICS, AND COMPOSITES

1. KIOSK OPENING COVER	
Room No. and Name	Finish
PIC LOBBY 100	Clear coat to match doors

2.2 DIVISION 07 - THERMAL AND MOISTURE PROTECTION

A. SECTION 07 92 00, JOINT SEALANTS

Location	Color	Manufacturer	Manufacturer Color
Stone Sealed Joints	Match mortar		

2.3 DIVISION 08 - OPENINGS

A. SECTION 08 14 00, WOOD DOORS

Component	Finish/Color
Doors	Natural finish, see Specifications
Frames	Match Dunn Edwards #DE 6365 "Cold Morning"

B. SECTION 08 51 13, ALUMINUM-CLAD WOOD WINDOWS

Type	Finish	Glazing	Manufacturer	Mfg. Color Name/No.
Hung	White prepainted aluminum exterior	See Specs; Glazing Schedule		
Interior wood	Semi-gloss		Kwal	CLW 1042W Mistaya

2.4 DIVISION 09 - FINISHES

A. SECTION 09 24 00, PORTLAND CEMENT PLASTERING (STUCCO)

Finish code	Integral	Color	Manufacturer	Mfg. Color Name/No.
PIC & Storage and Pump House Buildings: Match paint color on finish coat	3 coat		Parex, sand course texture final coat	Match existing

B. SECTION 09 30 13, CERAMIC TILING

(1) SECTION 09 30 13, PORCELAIN FLOOR TILE GROUT		
Finish Code	Manufacturer	Mfg. Color Name/No.
	Mapei	Keracolor S, match existing color

C. SECTION 09 91 00, PAINT AND COATINGS

See APPENDIX A

2.5 DIVISION II - EQUIPMENT

A. SECTION 08 55 66, DETENTION WINDOW SCREENS
SEE SPECIFICATIONS FOR MATERIALS AND COLORS.

PART 3 EXECUTION

3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

A. See Appendix A.

FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS	
Term	Abbreviation
Acoustical Ceiling	AT
Acoustical Wall Panel	AWP
Acoustical Wall Treatment	AWT
Baked On Enamel	BE
Carpet	CP
Carpet Module Tile	CPT
Ceramic Mosaic Tile	FTCT
Concrete	C
Concrete Masonry Unit	CMU
Epoxy Coating	EC
Epoxy Resin Flooring	ERF
Existing	E
Exposed Divider Strips	EXP
Exterior	EXT
Exterior Finish System	EFS
Exterior Paint	EXT-P
Exterior Stain	EXT-ST
Facing Tile	SCT
Feature Strips	FS
Floor Mats & Frames	FM
Floor Tile, Mosaic	FT
Fluorocarbon	FC

Gypsum Wallboard	GWB
High Glazed Coating	SC
Latex Mastic Flooring	LM
Linear Wood Ceiling	LWC
Material	MAT
Mortar	M
Multi-Color Coating	MC
Natural Finish	NF
Paint	P
Paver Tile	PVT
Perforated Metal Facing (Tile or Panels)	PMF
Plaster	PL
Plastic Laminate	HPDL
Porcelain Paver Tile	PPT
Stain	ST
Suspension Decorative Grids	SDG
Textured Gypsum Ceiling Panel	TGC
Veneer Plaster	VP
Vinyl Base	VB
Vinyl Composition Tile	VCT
Vinyl Sheet Flooring	VSF
Vinyl Sheet Flooring (Welded Seams)	WSF
Wall Border	WB
Wood	WD

3.2 FINISH SCHEDULE SYMBOLS

Symbol Definition

** Same finish as adjoining walls
 - No color required
 E Existing
 XX To match existing
 EFTR Existing finish to remain
 RM Remove

3.3 ROOM FINISH SCHEDULE

SEE DRAWINGS

APPENDIX A

Approved paint colors.

cherry/see/reames architects PC

From: Jim See
Date: May 28, 2013
Re: Ft. Bayard, Submittal # 09 91 00-001 & 002.001 Painting

Approved as Noted:

Comments:

1. Do not paint galvalume materials.
2. Do not paint aspen ceiling in the PIC Lobby.
3. Paint the wood boxcar siding or bead board ceiling at the PIC Porch. Or coat Kwal Comex "Ultra Tech" Wood Primer. Sand smooth two coats "Ultra Tech" C233 low sheen enamel southwest formulation.
4. At the wood laminated beams and wood deck at the Committal Shelter, provide a satin finish in lieu of the clear gloss finish.
5. Steve, please review the paint colors.

Kwal Paint Colors Schedule

1. Exterior steel framing Kwal "Forget-me-not" CLW-1033W, gloss finish.
2. Exterior wood ceiling PIC - Kwal "Gorge Water" CLW-1031W, semi gloss finish.
3. Interior walls gypsum board match Dunn Edwards color DE-6365 "Cold Morning" (I did not find a color matching a Kwal color), eggshell finish.
4. Interior ceilings Kwal "Mistaya" CLW-1042W, semi gloss finish.
5. Accent walls PIC-Kwal CL-2324M "Oxygen" paint at walls of alcove with doors A104, A105, and A107, semi gloss finish.
6. Exterior hollow metal door frames match stucco color, semi gloss finish.
7. Interior hollow metal door frames Kwal CL-3193W "Cornice" semi gloss finish.
8. Interior wood windows Kwal CLW-1042W "Mistaya", semi gloss finish.
9. Steel lintels & channels exposed at exterior, match stucco color. gloss finish.
10. Steel lintels exposed on the inside match ceiling color Kwal CLW-1042W "Mistaya", gloss finish.
11. Wood doors oak trim at storage and window sills are clear satin finish.
12. At storage paint the gypsum board walls matching Dunn Edwards color DE-6365 "Cold Morning", paint the CMU walls Kwal "Kors" CL-2482W.

Stephen E. Davis



Conclur

Cherry/See/Reames Architects		
<input type="checkbox"/> NO EXCEPTIONS TAKEN	<input type="checkbox"/> REJECTED	<input type="checkbox"/> REVISE AND RESUBMIT
<input type="checkbox"/> SUBMIT SPECIFIED ITEM	<input checked="" type="checkbox"/> MAKE CORRECTIONS NOTED	
<small>Corrections or comments made on the shop drawings during this review do not relieve contractor from compliance with requirements of the drawings and specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for: confirming and controlling all quantities and dimensions; selecting fabrication processes and techniques; all construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.</small>		
By: 		Date: 5/28/13

220 gold avenue sw, albuquerque, nm 87102 505-842-1278 fax 505-766-9269

--- E N D ---

SECTION 09 24 00
PORTLAND CEMENT PLASTERING

1.1 DESCRIPTION

A. The Buildings have all been plastered with the required three-coat finish. There are some existing cracks in the plaster finish noted on the drawings. These cracks shall be repaired, and a new finished matching acrylic color coat shall be installed over the entire wall elevation that contains the crack. The colored new coat will be feathered out at the corners to match the existing stucco color. The new acrylic color coat shall be provided by the manufacturer used for the existing. Approved manufacturer of existing is Parex (www.parex.com; (866)516-0061). Existing product is 535 Sand Coarse DPR Standard Acrylic Finishes. Existing custom colors for PIC and Storage Building, match Dunn Edwards DE6141 Salt Box; for Pump House, match Dunn Edwards DE6142 Floating Feather. However, the existing color coat has aged, so a new color matching the existing color coat will have to be developed as part of this contract using the original color coat acrylic materials (see description above). The new color coat must match the existing textures. Provide and install any bonding materials recommended by the color coat manufacturer prior to installing the new color coat. Clean the existing walls prior to repairing and color coating the existing stucco.

1.2 RELATED WORK

A. Room finish schedule and color: Section 09 06 00, SCHEDULE FOR FINISHES, as modified by Description 1.1 above.

1.3 TERMINOLOGY

A. Definitions and description of terms to be in accordance with ASTM C11, C841, and C926 and as specified.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data for the new acrylic color coat and crack repair materials.
- C. Samples:
 - 1. Four Panels showing new finish coat and texture, 1 foot by 1 foot.

1.5 PROJECT CONDITIONS

A. Comply with ASTM C926.

- B. Maintain work areas for interior work at a temperature of not less than 4°C (40°F) for not less than 48 hours prior to application of plaster, during application of plaster and until plaster is completely dry.
- C. Exterior plaster must not be applied when the ambient temperature is less than 4°C (40°F).
- D. Plaster must not be applied to frozen surfaces or surfaces containing frost.
- E. Frozen materials must not be used in the mix.
- F. Plaster coats must be protected against freezing for a period of not less than 24 hours after application.

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. American Society for Testing and Materials (ASTM):
 - C150/C150M-12 Portland Cement
 - C926-12a Application of Portland Cement-Based Plaster
 - C932-06 Surface-Applied Bonding Compounds for Exterior Plastering

PART 2 - PRODUCTS

2.1 BONDING AGENT

- A. ASTM C932.

2.2 FACTORY PREPARED FINISH COAT FOR CEMENT PLASTER (STUCCO)

- A. Factory premixed materials, integrally colored with sand finish, designed for exterior finish coat application, and manufactured by the original approved supplier.
- B. Pigments: ASTM C979, lime proof mineral oxide.

PART 3 - EXECUTION

3.1 EXISTING CONTROL JOINTS

- A. Protect and maintain all existing control joints.

3.2 SURFACE PREPARATION OF SOLID BASES

- A. Prepare and condition surfaces that are to receive plaster in accordance with ASTM C926, except as otherwise specified.

B. Existing surfaces:

1. Clean surface of dirt and other foreign matter that will prevent bond.
2. Repair existing cracks.
3. Apply a bonding agent as specified by the manufacturer.

3.3 SANDED ACYLIC FINISH COAT

A. Finish Coat:

1. After stucco crack repairs apply bonding coat as recommended by the finish coat manufacturer.
2. Verify the cured new finish coat matches the existing coat prior to starting any work.
3. The finish coat to have a sanded finish matching the existing texture and color. The finish coat will cover the entire width and height of the wall with the crack repair.
4. Cure finish coat for a minimum of 48 hours; take care to prevent staining.

3.4 CURING AND PROTECTION

- A. Cure the finish coat as recommended by the manufacturer.

3.5 TOLERANCES

- A. Finish plaster flush with metal accessory surfaces and other built-in items unless otherwise directed. Do not cover the metal accessories.

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SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.1 DESCRIPTION

A. The PIC, Storage Building and Pump House have had the gypsum board installed textured and painted. In some areas gypsum board will have to be cut out for wiring or other repairs. These areas shall have the gypsum board replaced, retextured and repainted. Some areas will require simple gypsum board repair, retexturing and repainting. See the drawings for the extent of the work. The intent is to have all gypsum board replacement and repairs to be indistinguishable from their adjacent surfaces. The original gypsum board manufacturer's materials do not have to be used for the repairs.

1.2 RELATED WORK

A. Sealants: Section 07 92 00, JOINT SEALANTS.

1.3 TERMINOLOGY

A. Definitions and description of terms to be in accordance with ASTM C11, C840, and as specified.

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. Finishing materials.
2. Gypsum board, each type.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

A. In accordance with the requirements of ASTM C840.

1.6 ENVIRONMENTAL CONDITIONS

A. In accordance with the requirements of ASTM C840.

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

C11-13	Terminology Relating to Gypsum and Related Building Materials and Systems
C475/C475M-12	Joint Compound and Joint Tape for Finishing Gypsum Board

C840-11	Application and Finishing of Gypsum Board
C954-11	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

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

2.2 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. For fire rated construction, type and size same as used in fire rating test.

2.3 FINISHING MATERIALS AND LAMINATING ADHESIVE

- A. ASTM C475 and ASTM C840.
- B. Provide material free of antifreeze, vinyl adhesives, preservatives and biocides; VOC content within limits of stated performance requirements.
- C. Joint Tape: Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

PART 3 - EXECUTION

3.1 INSTALLING GYPSUM BOARD

- A. Install gypsum board in accordance with ASTM C840, except as otherwise specified.

3.2 FINISHING OF GYPSUM BOARD

- A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840.
- B. Use Level 5 finish for all finished areas open to public view; level 2 finish in utility, maintenance and service areas and level 1 in plenums, attics and other concealed areas. Note all existing textures will be matched. Repairs showing visible repair lines shall be redone.
- C. Follow manufacturer's fire testing reports where fire resistant construction is shown on drawings.

3.3 REPAIRS

- A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including non-decorated surfaces.
- B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.
- C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 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 fire protection equivalent to the fire rated construction.

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**SECTION 09 30 13
CERAMIC/PORCELAIN TILING**

PART 1 - GENERAL

1.1 DESCRIPTION

A. The ceramic tile is in place in the PIC Building. Some minor tile and grout repairs are required for this project. See the drawings for locations of the repairs. Match all tile and grout materials. Extra tile and grout materials are located in the Pump House. Sort and box the extra materials and turn them over to the CO/COR at the end of the project. Dispose of frozen or unusable materials. Any excess materials that are still in good condition may be used for the tile repairs. The existing tile was manufactured by American Olean.

1. Floor Tile: American Olean Shadow Bay (12x12) SH53 Rocky Shore; Floor Grout: Mapai Keracolor Sanded Grout.
2. Wall Tile: American Olean Brights & Mattes (4x4), 0045 Salt & Pepper (field color), 0004 Matte Light Smoke (accent A), 0081 Summer Rain (accent B); Wall Grout: Mapai Keracolor Unsanded Grout.

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, and color of grout specified: 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. Submittals will only be required for any materials that cannot be found in the Pump House. In case of a new submittal being required, the submittal materials must match the approved existing materials, noted above.

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 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):
 - A108.10-05.....Installation of Grout in Tilework
 - A118.4-05.....Latex-Portland Cement Mortar
 - A118.7.....Tile Grout

- C. 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.
- B. Glazed Wall Tile: Cushion edges, glazing, as specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Porcelain Ceramic Tile
 - 1. Match existing.
- D. Glazed Ceramic Tile:
 - 1. Match existing.
 - 2. Cove base, match existing.
- E. Trim Shapes:
 - 1. Conform to applicable requirements of adjoining floor and wall tile.
 - 2. 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.
 - 3. Internal and External Corners:
 - a. Match existing corners.
 - b. External corners including edges: Use bullnose shapes.
 - c. External corners, do not use any lengths less than 4" to the bullnose.

2.2 SETTING MATERIALS OR BOND COATS

- A. Conform to TCA Handbook for Ceramic Tile Installation.
- B. Latex-Portland Cement Mortar: ANSI A118.4.
 - 1. Match previously submitted and approved materials..

2.3 GROUTING MATERIALS

- A. Coloring Pigments:
 - 1. Pure mineral pigments, lime proof and nonfading, complying with ASTM C979.
 - 2. Match previously submitted and approved materials
- B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
 - 1. Match previously submitted and approved materials.
- C. Polymer-Modified Tile Grout: ANSI A118.7, color as indicated.
 - 1. Polymer Type: Match previously submitted and approved materials.

2.4 WATER

Clean, potable and free from salts and other injurious elements to mortar and grout materials.

2.5 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 are not acceptable.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperature of work areas at not less than 16 degree C (60 degrees F), without interruption, for not less than 24 hours before installation and not less than three days after installation.
- B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation and ANSI Specifications for installation.
- C. Do not install tile when the temperature is above 38 degrees C (100 degrees F).
- D. Do not install materials when the temperature of the substrate is below 16 degrees C (60 degrees F).
- E. Do not allow temperature to fall below 10 degrees C (50 degrees F) after fourth day of completion of tile work.

3.2 ALLOWABLE TOLERANCE

- A. Variation in plane of sub-floor, including concrete fills leveling compounds and mortar beds:
 - 1. Not more than 1/4 inch in 10 feet from required elevation where Portland cement mortar setting bed is used.
- B. Variation in Plane of Wall Surfaces:
 - 1. Not more than 1/4 inch in eight feet from required plane where Portland cement mortar setting bed is used.
 - 2. Not more than 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. Walls:
 - 1. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces that are out of required plane.
 - 2. Remove any previously applied mortar and seal the surface of gypsum board.

3.4 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. Workmanship:
 - 1. Lay out tile work so that no tile less than one-half full size is used. Make all cuts on the outer edge of the field.
 - 2. Set tile firmly in place with finish surfaces in true planes. Align tile flush with adjacent tile unless shown otherwise.
 - 3. Form intersections and returns accurately.
 - 4. Cut and drill tile neatly without marring surface.
 - 5. Cut edges of tile abutting penetrations, finish, or built-in items:
 - a. Fit tile closely around electrical outlets, piping, fixtures and fittings, so that plates, escutcheons, collars and flanges will overlap cut edge of tile.
 - 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. Joints:
 - a. Keep all joints in line, straight, level, perpendicular and of even width unless shown otherwise.
 - b. Make joints 1/16 inch wide for glazed wall tile and mosaic tile work.
 - c. Make joints in Paver tile, porcelain type; maximum 1/8 inch wide.

3.5 CERAMIC TILE INSTALLED WITH PORTLAND CEMENT MORTAR

- A. Mortar Mixes for Floor, Wall and Base Tile: 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 1/8 inch per foot.

3.6 PORCELAIN TILE INSTALLED WITH LATEX PORTLAND CEMENT BONDING MORTAR

Due to the denseness of porcelain tile use latex Portland cement bonding mortar that meets the requirements of ANSI A118.4. Bonding mortars shall be mixed in accordance with manufacturer's instructions. Improper liquid ratios and dwell time before placement of bonding mortar and tile shall affect bond.

3.7 GROUTING

- A. Grout Type and Location:

1. Grout for glazed wall and base tile, paver tile and unglazed mosaic tile Portland cement grout, latex-Portland cement grout, dry-set grout, or commercial Portland cement grout.

B. Workmanship:

1. Install and cure grout in accordance with the applicable standard.
2. Portland Cement grout: ANSI A108.10..

3.8 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 all paint, gypsum board materials, etc. from tile.

3.9 PROTECTION

- A. Keep traffic off tile, until grout and setting material is firmly set and cured.

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SECTION 09 91 00
PAINTING

PART 1-GENERAL

1.1 DESCRIPTION

A. The project has been painted. All new paint work will involve repainting repaired work and additional coats needed on various items. The same paint manufacturer, Kwal, and paints, all Kwal premium products recommended for the surface type being painted, are to be used for the new work. Paint color schedule is found in Section 09 06 00 SCHEDULE FOR FINISHES, Appendix A. If an alternate paint manufacturer is proposed, the quality and color match must equal that of those used originally. The substitution must be submitted in compliance with section 1.3, Submittals, below. The Contractor shall verify the color matches with the existing work in place for all items prior to purchasing large amounts of paint. Sanding gypsum board repair and other preparation work will have to take place prior to painting. Wood door top and bottom edges will have to be refinished with clear coats as part of the painting specifications. See the drawings for locations of the painting work.

1.2 RELATED WORK

- A. Items to be painted or repainted will include wood, metal, gypsum board, and CMU.
- B. All repair work will have to be primed and painted.

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. Provide manufacturers recommendations for painting individual items.
- C. Samples:
 - 1. Provide color samples matching existing colors and finishes.
- D. Manufacturers' Certificates indicating compliance with specified requirements.

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).

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide materials matching the existing paint. See colors on Appendix A, and products on Appendix B.

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

- A. Paint materials must conform to the restrictions of the local Environmental and Toxic Control jurisdiction or the requirements of this section, whichever is most stringent.
1. Lead-Based Paint:
 - a. Lead based paint is not permitted to be used.
 2. Asbestos: Materials must not contain asbestos.
 3. Chromate, Cadmium, Mercury, and Silica: Materials must not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
 4. Human Carcinogens: Materials must not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.

5. Use high performance acrylic paints in place of alkyd paints, where possible.
6. VOC content for solvent-based paints must not exceed specified performance requirement; aromatic hydro carbons contained in solvent-based paints must not exceed one percent 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 day's 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.
 2. Do not exceed application conditions recommended by the manufacturer.
 3. Maintain interior temperatures until paint dries hard.
 4. Do no exterior painting when it is windy and dusty.
 5. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
 6. 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.

7. Clear coats:

- a. Apply in clean areas and in still air.
- b. Before applying clear coats, vacuum and dust area.
- c. Immediately before clear coats sand the wood and 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 Knot Sealer before applying paint.
 - b. Apply two coats of 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 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. 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.

F. 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. 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 CO/COR.
- E. Finish surfaces to show solid even color, free from runs, lumps, brush marks, laps, holidays, or other defects.
- F. Apply by brush, or roller, except as otherwise specified.
- G. 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 [REPAIRED OR NEW SURFACES ONLY]

- 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. Wood and Wood Particleboard:
 - 1. Use same kind of primer specified for exposed face surface.
 - a. Interior wood except for transparent finish: MPI 45 Interior Primer Sealer.
 - b. Transparent finishes as specified under Transparent Finishes on Wood.
- D. Gypsum Board
 - 1. Primer: MPI 50 Interior Latex Primer Sealer.

3.6 EXTERIOR FINISHES [NOTED USE PREVIOUSLY APPROVED MATERIALS]

- A. Apply following finish coats where specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Steel and Ferrous Metal, Steel columns, prime exposed metal, apply two additional finish coats over primed areas. One additional coat over previously painted areas. Paint columns from top to bottom.
- C. Wood at P.I.C. porch ceiling. Prime and two coats at repaired areas where failing wood filler is removed and replaced. One additional coat over the previously P.I.C. painted porch ceiling.

3.7 INTERIOR FINISHES [NOTE USE PREVIOUSLY APPROVED MATERIALS]

- A. Apply following finish coats over prime coats in spaces or on surfaces specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Gypsum Board: Apply two finish coats over newly primed areas. One finish coat over previously painted areas.
- C. Masonry and Concrete Walls:
 - 1. See notes on drawings for any Masonry wall painting repair or touch up.
- D. Wood:
 - 1. Sanding:
 - a. Sand between clear coats or paint coats, see notes on drawings for areas of work. Use 220-grit sandpaper.
 - b. Sand enough to scarify surface to assure good adhesion of subsequent coats, to level roughly applied paint or clear coat,

and to knock off "whiskers" of any raised grain as well as dust particles.

2. Paint Finish:

- a. Wood doors and at P.I.C. Kiosk cover clear coat.
- b. Wood windows Glossy finish
- c. Gypsum board eggshell finish.

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 finish described in Section 09 06-00, SCHEDULE OF 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 Knot Sealer before refinishing.
- I. Sand or dull the 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: [NOTE USE PREVIOUSLY APPROVED COLORS]

- A. Color and gloss of finish coats is specified in Section 09 06 00, SCHEDULE FOR FINISHES. The approved paint colors are included as Appendix A to Section 09 06 00.
- B. 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 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 refinish in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

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APPENDIX TO SECTION 09 91 00 PAINTING

Coordinate the following abbreviations used in Section 09 91 00, PAINTING, with other Sections, especially Section 09 06 00, SCHEDULE FOR FINISHES and other COATING SECTIONS listed. Use the same abbreviation and terms consistently.

Paint or coating	Abbreviation
Acrylic Emulsion	AE (MPI 10 - flat/MPI 11 - semigloss/MPI 119 - gloss)
Alkyd Gloss Enamel	G (MPI 48)
Alkyd Semigloss Enamel	SG (MPI 47)
Aluminum Paint	AP)
Cementitious Paint	CEP (TT-P-1411)
Exterior Latex	EL (MPI 10 / 11 / 119)
Exterior Oil	EO (MPI 9 - gloss/MPI 8 - flat/MPI 94 - semigloss)
Fire Retardant Paint	FR
Fire Retardant Coating (Clear)	FC (intumescent type)
Heat Resistant Paint	HR
Latex Emulsion	LE (MPI 53, flat/MPI 52, eggshell/MPI 54, semigloss/MPI 114, gloss Level 6
Latex Flat	LF (MPI 138)
Latex Gloss	LG (MPI 114)
Latex Semigloss	SG (MPI 141)
Latex Low Luster	LL (MPI 139)
Plastic Floor Coating	PL
Polyurethane Varnish	PV
Rubber Paint	RF (CID-A-A-3120 - Paint for Swimming Pools (RF))
Water Paint, Cement	WPC (CID-A-A-1555 - Water Paint, Powder).
Wood Stain	WS

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SECTION 10 14 00
EXTERIOR SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the work required to furnish and install the indicated and specified exterior cemetery site signage systems.
- B. Signs shall be products of manufacturers or installers regularly engaged in manufacturing or installing signs of types specified.
- C. Section includes the following
 - 1. Standard Granite Section Marker
 - 2. Incised (sandblasted) lettering at Columbarium
 - 3. Bronze plaque installation

1.2 MANUFACTURER'S QUALIFICATIONS

- A. Sign manufacturer/fabricator shall regularly and presently manufacture signs similar to those specified as one of their principal products. Sign manufacturer shall submit qualifications demonstrating a minimum of three years of experience manufacturing the qualifying signs and shall, if possible, demonstrate the successful manufacturing of exterior site signs installed at one or more State or National Veteran Cemeteries.
- B. Personnel performing the incised lettering work shall submit qualifications demonstrating a minimum of three years of experience performing similar work.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Submit 3 sets. One set to the Contractor, one set to the Contracting Officer's Representative (CO/COR) and one set to the A/E Designer.
 - 1. Granite section marker: samples showing range of color and texture of granite material and indicating match to existing. Size: 6" x 6" x 1" thick.
 - 2. Incised lettering:
 - a. Provide full size samples of sandblasted lettering for columbarium. Provide full size sample on limestone of same type as existing. Provide samples of one letter and one number.
 - b. Installer shall demonstrate their ability to perform the work on site on existing stone by preparing a mockup at the Cemetery.

Installer shall provide all necessary equipment including stone. No work shall be done on the existing columbarium stone until the samples, mockup, and proofs have been approved.

3. Bronze plaque: attachment hardware and fasteners.

C. Shop drawings:

1. Provide full size proofs for all signs and lettering.
2. Drawings and product data showing material, finish, colors, size of members, details of construction, letter spacing, size and type, numbers, symbols or image details, and mounting details. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes. All text and graphics for the exterior signage shall be provided in detailed submittal information. Each sign face shall be represented in scaled drawings, with exact font, letter style, font, letter spacing, graphics being shown. Provide samples and drawings indicating all details of the installation as part of the submittal process. Submittals shall be revised and resubmitted until approved, and installation shall not proceed without approved submittals and/or samples.
3. Final sign fabrication shall not proceed until samples and shop drawings detailing the sign system as it will be installed, have been submitted and approved during the submittal process.

1.4 DELIVERY AND STORAGE

- A. 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.
- B. Deliver signs only when the site, mounting materials, and equipment are ready for installation work to proceed.
- C. Store products in dry condition inside enclosed facilities.

1.5 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. VA Signage Design Guide:

Section 12 National Cemetery Signs -

<http://wbdg.org/ccb/VA/VASIGN/signage12.pdf//>

PART 2 - PRODUCTS

2.1 MATERIALS

A. Granite Section Markers: to match existing granite at Cemetery.

2.2 SIGNAGE GENERAL

A. Signs shall be of type, size and design shown on the drawings.

B. Signs shall be complete with lettering, framing, and related components for a complete sign installation.

C. Do not scale drawings for dimensions. Verify all dimensions and conditions shown by the drawings. CO/COR is to be notified of any discrepancy in drawing(s), in field directions or conditions, and/or of any changes required for any such related construction details.

2.3 GRANITE SECTION MARKERS

A. Granite Section Markers shall match existing.

2.4 INCISED (SANDBLASTED) LETTERS

A. Lettering text content, size, location and style shall be as shown on the design drawings and as approved in a submittal reviewed and approved during the shop drawing submittal and review process.

B. Unless otherwise noted on the drawings and details, the font for the incised lettering shall be New Times Roman Regular.

C. Depth of incised letters - 3/16" or per approved sample.

2.5 BRONZE PLAQUE

A. Bronze plaque is existing plaque at the Rostrum to be salvaged and reinstalled.

PART 3 - EXECUTION

3.1 SECTION MARKER INSTALLATION

A. Verify that behind or beneath each sign location there are no utility lines, or other buried infrastructure elements, that will be affected by installation of signs. Any damage during installation of signs to utilities, or other buried infrastructure will be the sole responsibility of the Contractor to correct and repair.

B. Set section markers level and plumb, meeting the criteria shown in the details.

C. Replace markers damaged during installation at no additional cost to the government.

3.2 INCISED (SANDBLASTED) LETTERS

A. Protect surrounding columbarium areas from damage during sandblasting operations.

- B. Columbarium stone is already installed. Sandblasting must be done on site.
- C. Align stencils or templates centered on and aligned with niche rows and columns, as shown in the Contract Documents.
- D. Perform sandblasting operations in accordance with OSHA regulations and any applicable codes.

3.3 PLAQUE INSTALLATION

- A. Remove bronze plaque from existing concrete wall cap; handle and store plaque to prevent damage. Photograph condition of plaque and existing mounting method. Report differing conditions to CO/COR.
- B. Attach bronze plaque to new cap using stainless steel machine screw anchors and stainless steel screws as detailed on drawings.

3.3 CLEANING

- A. After installation, all items shall be cleaned as recommended by the manufacturer and protected from damage until completion of the project.

3.4 PROTECTION

- A. Protect finished surfaces from damage during fabrication, erection and after completion of the work.

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**SECTION 10 21 13
TOILET COMPARTMENTS**

PART 1 - GENERAL

1.1 DESCRIPTION

A. The toilet partitions are in place. The toilet partition door hardware has been installed incorrectly and will require new doors or pilasters to correct. Placing a screw in an unused hole in the doors or pilaster will not be an acceptable repair. Some trim pieces are missing and will need to be replaced. Dented partitions will have to be replaced. All partition colors must match. If color matches cannot be done, new doors and pilasters must be provided.

1.2 RELATED INFORMATION

A. The manufacturer of the existing toilet compartment is Flush Metal Partitions (631)580-2932. The existing product is Overhead Braced Baked Enamel and Stainless Steel Partitions, color is #68 Dusty Gray.

1.3 SUBMITTALS

- A. Submit proposed corrections in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data: Specified items indicating all hardware and fittings, material, finish, and latching. All items must be furnished by the original manufacturer.
- C. Shop Drawings: Proposed correction construction details at 1/2 scale, showing installation details, anchoring and leveling devices.

1.4 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. 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. American Society for Testing and Materials (ASTM):
- | | |
|---------------|---|
| A123/A123M-12 | Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| A385/A385M-11 | High Quality Zinc Coatings (Hot-Dip) |

PART 2 - PRODUCTS

2.1 FABRICATION

- A. For any replacement materials match all existing units and hardware with new color matching material supplied by the original manufacturer.
- B. Conform to ICC A117.1 code for access for the handicapped operation of toilet compartment door and hardware.
- C. Fabricate to existing dimensions making all doors and hardware operable. Doors and pilasters with holes drilled in the wrong locations must be replaced and made operable.
- D. Toilet Enclosures:
 - 1. Type 1, Style C (overhead braced, matching in-place original units).
 - 2. Finish:
 - a. Baked enamel on steel doors, pilasters, and enclosure panels matching the existing color and shapes.

2.2 ANCHORING DEVICES

- A. All anchoring devices are in place.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install all corrections in rigid manner, straight, plumb and with all horizontal lines level. The intent is to have a finished installation with operable hardware as detailed by the toilet partition manufacturer that matches the existing panel color.
 - 2. If panel colors cannot be matched, new panels must be provided.
 - 3. Conceal evidence of drilling, cutting and fitting in finish work. No holes in the doors or pilasters may be repaired by installing an exposed chrome screw head.
 - 4. Add two ADA approved coat hooks mounted 4'-0" above the finished floor at the center of the inside swing of the handicapped toilet stall doors.
 - 5. Use hex-bolts for through-bolting.
 - 6. Adjust hardware and leave in freely working order.
 - 7. Clean finished surfaces and leave free of imperfections.
- B. Panels and Pilasters:
 - 1. Support panels and pilaster abutting building walls near top and bottom by stirrup supports secured to partitions with through-bolts.

2. Secure stirrups to walls with two suitable anchoring devices for each stirrup.
3. Secure panels to faces of pilaster near top and bottom with stirrup supports, through-bolted to panels and machine screwed to each pilaster.
4. Secure edges of panels to edges of pilasters near top and bottom with "U" shaped brackets.
5. Where overhead braced, secure pilasters to building walls by headrails clamped on or set into top of each pilaster.
 - a. Secure clamps to pilasters with two through-bolts to each clamp.
 - b. When headrails are set into pilasters, through-bolt them to the pilasters.
 - c. Support headrails on wall flange fittings secured to building walls with minimum of two anchor bolts to each flange fitting.

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SECTION 22 05 11
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section shall apply to all sections of Division 22.
- B. Definitions:
 - 1. Exposed: Piping and equipment exposed to view in finished rooms.
- C. Abbreviations/Acronyms:
 - 1. ABS: Acrylonitrile Butadiene Styrene
 - 2. AC: Alternating Current
 - 3. ACR: Air Conditioning and Refrigeration
 - 4. AI: Analog Input
 - 5. AISI: American Iron and Steel Institute
 - 6. AO: Analog Output
 - 7. AWG: American Wire Gauge
 - 8. BACnet: Building Automation and Control Network
 - 9. BA9: Silver-Copper-Zinc Brazing Alloy
 - 10. BAS: Building Automation System
 - 11. BCuP: Silver-Copper-Phosphorus Brazing Alloy
 - 12. BSG: Borosilicate Glass Pipe
 - 13. CDA: Copper Development Association
 - 14. C: Celsius
 - 15. CLR: Color
 - 16. CO: Carbon Monoxide
 - 17. COR: Contracting Officer's Representative
 - 18. CPVC: Chlorinated Polyvinyl Chloride
 - 19. CR: Chloroprene
 - 20. CRS: Corrosion Resistant Steel
 - 21. CWP: Cold Working Pressure
 - 22. CxA: Commissioning Agent
 - 23. db(A): Decibels (A weighted)
 - 24. DDC: Direct Digital Control
 - 25. DI: Digital Input
 - 26. DISS: Diameter Index Safety System
 - 27. DO: Digital Output
 - 28. DVD: Digital Video Disc

29. DN: Diameter Nominal
30. DWV: Drainage, Waste and Vent
31. ECC: Engineering Control Center
32. EPDM: Ethylene Propylene Diene Monomer
33. EPT: Ethylene Propylene Terpolymer
34. ETO: Ethylene Oxide
35. F: Fahrenheit
36. FAR: Federal Acquisition Regulations
37. FD: Floor Drain
38. FED: Federal
39. FG: Fiberglass
40. FNPT: Female National Pipe Thread
41. FPM: Fluoroelastomer Polymer
42. GPM: Gallons Per Minute
43. HDPE: High Density Polyethylene
44. Hg: Mercury
45. HOA: Hands-Off-Automatic
46. HP: Horsepower
47. HVE: High Volume Evacuation
48. ID: Inside Diameter
49. IPS: Iron Pipe Size
50. Kg: Kilogram
51. kPa: Kilopascal
52. lb: Pound
53. L/s: Liters Per Second
54. L/min: Liters Per Minute
55. MAWP: Maximum Allowable Working Pressure
56. MAX: Maximum
57. MED: Medical
58. m: Meter
59. MFG: Manufacturer
60. mg: Milligram
61. mg/L: Milligrams per Liter
62. ml: Milliliter
63. mm: Millimeter
64. MIN: Minimum
65. NF: Oil Free Dry (Nitrogen)
66. NPTF: National Pipe Thread Female

- 67. NPS: Nominal Pipe Size
- 68. NPT: Nominal Pipe Thread
- 69. OD: Outside Diameter
- 70. OSD: Open Sight Drain
- 71. OS&Y: Outside Stem and Yoke
- 72. OXY: Oxygen
- 73. PBPU: Prefabricated Bedside Patient Units
- 74. PH: Power of Hydrogen
- 75. PLC: Programmable Logic Controllers
- 76. PP: Polypropylene
- 77. PPM: Parts per Million
- 78. PSIG: Pounds per Square Inch
- 79. PTFE: Polytetrafluoroethylene
- 80. PVC: Polyvinyl Chloride
- 81. PVDF: Polyvinylidene Fluoride
- 82. RAD: Radians
- 83. RPM: Revolutions Per Minute
- 84. SCFM: Standard Cubic Feet Per Minute
- 85. SPEC: Specification
- 86. STD: Standard

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 03 30 53, CAST-IN-PLACE CONCRETE: Concrete and Grout.
- D. Section 07 92 00, JOINT SEALANTS.
- E. Section 09 91 00, PAINTING.
- F. Section 22 07 11, PLUMBING INSULATION.
- G. Section 31 20 00, EARTH MOVING: Excavation and Backfill.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
 - ASME Boiler and Pressure Vessel Code -
 - BPVC Section IX-2013....Welding, Brazing, and Fusing Qualifications
 - B31.1-2012.....Power Piping

- C. American Society for Testing and Materials (ASTM):
 - A36/A36M-2012.....Standard Specification for Carbon Structural Steel
 - A575-96 (R2013)e1.....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
 - E84-2013a.....Standard Test Method for Surface Burning Characteristics of Building Materials
 - E119-2012a.....Standard Test Methods for Fire Tests of Building Construction and Materials
 - F1760-01 (R2011).....Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
- D. International Code Council, (ICC):
 - IBC-2012.....International Building Code
 - IPC-2012.....International Plumbing Code
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
 - SP-58-2009.....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation
 - SP-69-2003.....Pipe Hangers and Supports - Selection and Application
- F. Military Specifications (MIL):
 - P-21035B.....Paint High Zinc Dust Content, Galvanizing Repair (Metric)
- G. National Electrical Manufacturers Association (NEMA):
 - MG 1-2011.....Motors and Generators
- H. National Fire Protection Association (NFPA):
 - 51B-2014.....Standard for Fire Prevention During Welding, Cutting and Other Hot Work
 - 54-2012.....National Fuel Gas Code
 - 70-2014.....National Electrical Code (NEC)
- I. NSF International (NSF):
 - 5-2012.....Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
 - 14-2012.....Plastic Piping System Components and Related Materials

61-2012.....Drinking Water System Components - Health
Effects

372-2011.....Drinking Water System Components - Lead Content

J. Department of Veterans Affairs (VA):

PG-18-10.....Plumbing Design Manual

PG-18-13-2011.....Barrier Free Design Guide

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.
- C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Installing Contractor shall provide lists of previous installations for selected items of equipment. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- G. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
 - 1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
 - 2. Equipment and materials identification.
 - 3. Firestopping materials.
 - 4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.

5. Wall, floor, and ceiling plates.
- H. 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.
- I. Coordination Drawings: Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8 inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, controls, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.
1. Mechanical equipment rooms.
 2. Interstitial space.
 3. Hangers, inserts, supports, and bracing.
 4. Pipe sleeves.
 5. Equipment penetrations of floors, walls, ceilings, or roofs.
- J. 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. Include complete list indicating all components of the systems with diagrams of the internal wiring for each item of equipment.
 2. Include listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.5 QUALITY ASSURANCE

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 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 5 years.
2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the Contracting Officers Representative (COR).
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
 8. Asbestos products or equipment or materials containing asbestos shall not be used.
 9. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.
- B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
 3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
 4. All welds shall be stamped according to the provisions of the American Welding Society.
- C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- D. Execution (Installation, Construction) Quality:
1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the

- manufacturer's instructions and the contract documents shall be referred to the COR for resolution. Printed copies or electronic files of manufacturer's installation instructions shall be provided to the COR at least 10 working days 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: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution.
 3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by VA.
 4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.
 5. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or additional time to the Government.
- E. Guaranty: Warranty of Construction, FAR clause 52.246-21.
- F. Plumbing Systems: IPC, International Plumbing Code. Unless otherwise required herein, perform plumbing work in accordance with the latest version of the IPC. For IPC codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall". Reference to the "code official" or "owner" shall be interpreted to mean the CO/COR.
- G. Cleanliness of Piping and Equipment Systems:
1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost or additional time to the Government.
3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

1.7 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished.

Information explaining any special knowledge or tools the CO/COR will be required to employ shall be inserted into the As-Built documentation.

- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version 2012 provided on compact disk or DVD. 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.
- D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall 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 specified.

PART 2 - PRODUCTS

2.1 MATERIALS FOR VARIOUS SERVICES

- A. Non-pressure PVC pipe shall contain a minimum of 25 percent recycled content. Steel pipe shall contain a minimum of 25 percent recycled content.
- B. Plastic pipe, fittings and solvent cement shall meet NSF 14 and shall bear the NSF seal "NSF-PW". Polypropylene pipe and fittings shall comply with NSF 14 and NSF 61. Solder or flux containing lead shall not be used with copper pipe.
- C. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.
- D. In-line devices such as water meters, building valves, check valves, stops, valves, fittings, tanks and backflow preventers shall comply with NSF 61 and NSF 372.
- E. End point devices such as drinking fountains, lavatory faucets, kitchen and bar faucets, ice makers supply stops, and end-point control valves used to dispense drinking water must meet requirements of NSF 61 and NSF 372.

2.2 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 - 1. All components of an assembled unit need not be products of same manufacturer.
 - 2. Constituent parts that are alike shall be products of a single manufacturer.
 - 3. Components shall be compatible with each other and with the total assembly for intended service.
 - 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly at no additional cost or time to the Government.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, shall be the same make and model.

2.3 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.4 SAFETY GUARDS

- A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 8 mm (1/4 inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.
- B. All Equipment shall have moving parts protected from personal injury.

2.5 LIFTING ATTACHMENTS

- A. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered,

without bending or distortion of shape, such as rapid lowering and braking of load.

2.6 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

- A. All material and equipment furnished and installation methods used shall conform to the requirements of Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT; Section 26 29 11, MOTOR CONTROLLERS; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. All electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems shall be provided. Premium efficient motors shall be provided. Unless otherwise specified for a particular application, electric motors shall have the following requirements.
- B. Special Requirements:
1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional cost or time to the Government.
 2. Assemblies of motors, starters, and controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
 3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
 - a. Wiring material located where temperatures can exceed 71° C (160° F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers and water heaters.
 - b. Other wiring at boilers and water heaters, and to control panels, shall be NFPA 70 designation THWN.
 - c. Shielded conductors or wiring in separate conduits for all instrumentation and control systems shall be provided where recommended by manufacturer of equipment.
 4. Motor sizes shall be selected so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
 5. Motors utilized with variable frequency drives shall be rated "inverter-ready" per NEMA Standard, MG1.

- C. Motor Efficiency and Power Factor: All motors, when specified as "high efficiency or Premium Efficiency" by the project specifications on driven equipment, shall conform to efficiency and power factor requirements in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as "NEMA premium efficient" and the requirements generally exceed those of the Energy Policy Act (EPACT), revised 2005. Motors not specified as "high efficiency or premium efficient" shall comply with EPACT.
- D. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal pumps may be split phase or permanent split capacitor (PSC).
- E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. A time delay (20 seconds minimum) relay shall be provided for switching from high to low speed.
- F. Rating: Rating shall be continuous duty at 100 percent capacity in an ambient temperature of 40° C (104° F); minimum horsepower as shown on drawings; maximum horsepower in normal operation shall not exceed nameplate rating without service factor.
- G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame shall be measured at the time of final inspection.

2.7 VARIABLE SPEED MOTOR CONTROLLERS

- A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Section 26 29 11, MOTOR CONTROLLERS for specifications.
- B. The combination of controller and motor shall be provided by the respective pump manufacturer, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. pumps, shall be product of a single manufacturer.
- C. Motors shall be premium efficient type, "invertor duty", and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor 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, or shown in the maintenance manuals. Coordinate equipment and valve identification with local VAMC shops. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 7 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, etc. shall be identified.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 7 mm (3/16 inch) high riveted or bolted to the equipment.
- D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
 2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gage, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
 3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3-ring binder notebook. An additional copy of the valve list shall be mounted in picture frames for mounting to a wall. COR shall instruct contractor where frames shall be mounted.
 4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided in the

3-ring binder notebook. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling or access door.

2.9 FIRESTOPPING

- A. 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 22 07 11, PLUMBING INSULATION, for pipe insulation.

2.10 GALVANIZED REPAIR COMPOUND

- A. Mil. Spec. DOD-P-21035B, paint.

2.11 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC and Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Submittals based on the International Building Code (IBC) and Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS requirements, or the following paragraphs of this Section shall be stamped and signed by a professional engineer registered in the state where the project is located. The Support system of suspended equipment over 227 kg (500 pounds) shall be submitted for approval of the COR in all cases. See the above specifications for lateral force design requirements.
- B. Type Numbers Specified: For materials, design, manufacture, selection, application, and installation refer to MSS SP-58. For selection and application refer to MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.
- C. For Attachment to Concrete Construction:
 - 1. Concrete insert: Type 18, MSS SP-58.
 - 2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
 - 3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
- D. For Attachment to Steel Construction: MSS SP-58.
 - 1. Welded attachment: Type 22.
 - 2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.

- E. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING. Section 05 36 00, COMPOSITE METAL DECKING.
- F. For Attachment to Wood Construction: Wood screws or lag bolts.
- G. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM 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 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- H. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 43 mm by 43 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.
1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 8 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
- I. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
1. General Types (MSS SP-58):
 - a. Standard clevis hanger: Type 1; provide locknut.
 - b. Riser clamps: Type 8.
 - c. Wall brackets: Types 31, 32 or 33.
 - d. Roller supports: Type 41, 43, 44 and 46.
 - e. Saddle support: Type 36, 37 or 38.
 - f. Turnbuckle: Types 13 or 15.
 - g. U-bolt clamp: Type 24.
 - h. Copper Tube:
 - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint,

- copper-coated, plastic coated or taped with isolation tape to prevent electrolysis.
- 2) For vertical runs use epoxy painted, copper-coated 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. Spring Supports (Expansion and contraction of vertical piping):
- 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.
- j. Spring hangers are required on all plumbing system pumps one horsepower and greater.
2. Plumbing Piping (Other Than General Types):
- a. Horizontal piping: Type 1, 5, 7, 9, and 10.
 - b. Chrome plated piping: Chrome plated supports.
 - c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
 - d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gage) minimum.
- J. Pre-insulated Calcium Silicate Shields:
1. Provide 360 degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.
 2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
 3. Shield thickness shall match the pipe insulation.
 4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.

- a. Shields for supporting cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal.
 - b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.
5. Shields may be used on steel clevis hanger type supports, trapeze hangers, roller supports or flat surfaces.
- K. Seismic Restraint of Piping: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

2.12 PIPE PENETRATIONS

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
- B. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
 1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
 2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
 3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- D. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of COR.
- E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.

- G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
- H. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.
- I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.
- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
- K. Pipe passing through roof shall be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and set in a solid coating of bituminous cement. Extend flashing a minimum of 250 mm (10 inches) up the pipe. Pipe passing through a waterproofing membrane shall be provided with a clamping flange. The annular space between the sleeve and pipe shall be sealed watertight.

2.13 TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the COR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- D. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application. Bio-based materials shall be utilized when possible.

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 75 mm (3 inch) pipe, 0.89 mm (0.035 inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

2.15 ASBESTOS

- A. Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.
- B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.
- C. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation of all devices including, but not limited to: all equipment items, valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.
- D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.

- E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- F. Cutting Holes:
1. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
 2. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
 3. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other services are not shown but must be provided.
- H. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- 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 COR. Damaged or defective items in the opinion of the COR, shall be replaced at no additional cost or time to the Government.
 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- J. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psig) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, shall be used for all pad or floor mounted equipment.

- K. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- L. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, alarms, instruments and computer workstations. Comply with NFPA 70.
- M. Many plumbing systems interface with the HVAC control system.
- N. Work in Existing Building:
1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
 2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will cause the least interfere with normal operation of the facility.
- O. Work in Animal Research Areas: Seal all pipe penetrations with silicone sealant to prevent entrance of insects.
- P. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.
- Q. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above data equipment, and electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Drain valve shall be provided in low point of casement pipe.
- R. 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 or additional time to the Government.
 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling

under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

- A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of paragraph 3.1 shall apply.
- C. Temporary facilities and piping shall be completely removed back to the nearest active distribution branch or main pipe line and any openings in structures sealed. Dead legs are not allowed in potable water systems. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

3.3 RIGGING

- A. Openings in building structures shall be planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered and will be considered by Government under specified restrictions of phasing and service requirements as well as structural integrity of the building.
- C. All openings in the building shall be closed when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.
- E. Contractor shall check all clearances, weight limitations and shall provide a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to COR for evaluation prior to actual work.

3.4 PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the COR.
- B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.
- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work shall be provided.
- D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC) and these specifications.
- E. Overhead Supports:
 - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
 - 2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
 - 3. Tubing and capillary systems shall be supported in channel troughs.
- F. Floor Supports:
 - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
 - 2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
 - 3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves,

anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.

4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 LUBRICATION

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
- B. All devices and equipment shall be equipped with required lubrication fittings. A minimum of one liter (one quart) of oil and 0.45 kg (1 pound) of grease of manufacturer's recommended grade and type for each different application shall be provided. All materials shall be delivered to COR in unopened containers that are properly identified as to application.
- C. A separate grease gun with attachments for applicable fittings shall be provided for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
- E. All lubrication points shall be extended to one side of the equipment.

3.6 PLUMBING SYSTEMS DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity by the COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating plant, cleanliness and safety shall be maintained. The plant shall be kept in an operating condition. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting shall be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. All work shall be performed in accordance with recognized fire protection standards including NFPA 51B. Inspections will be made by personnel of the VA Medical Center,

and the Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.

- C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate. Coordinate with the COR and Infection Control.

3.7 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.
- B. In addition, the following special conditions apply:
1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
 2. The following Material and Equipment shall NOT be painted:
 - a. Motors, controllers, control switches, and safety switches.
 - b. Control and interlock devices.
 - c. Regulators.

- d. Pressure reducing valves.
 - e. Control valves and thermostatic elements.
 - f. Lubrication devices and grease fittings.
 - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
 - h. Valve stems and rotating shafts.
 - i. Pressure gages and thermometers.
 - j. Glass.
 - k. Name plates.
- 3. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint type and color obtained from manufacturer or computer matched.
 - 4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.
 - 5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats per Section 09 91 00, Painting.
 - 6. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this. Lead based paints shall not be used.

3.8 IDENTIFICATION SIGNS

- A. Laminated plastic signs, with engraved lettering not less than 7 mm (3/16 inch) high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, and performance data shall be placed on factory built equipment.
- C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.9 STARTUP AND TEMPORARY OPERATION

- A. Startup of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

- B. The commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer's Representative and Commissioning Agent. Provide a minimum of two (2) weeks prior notice.

3.10 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COR.
- 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 systems occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings during the first actual seasonal use of the respective systems following completion of work. Rescheduling of these tests shall be requested in writing to COR for approval.
- D. Perform tests as required for commissioning provisions in accordance with Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

3.11 OPERATION AND MAINTENANCE MANUALS

- A. All new and temporary equipment and all elements of each assembly shall be included.
- B. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- C. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.
- D. Lubrication instructions, type and quantity of lubricant shall be included.
- E. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.
- F. Set points of all interlock devices shall be listed.

- G. Trouble-shooting guide for the control system troubleshooting shall be inserted into the Operations and Maintenance Manual.
- H. The control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
- I. Emergency procedures for shutdown and startup of equipment and systems.

3.12 COMMISSIONING

- A. NOT USED.

3.13 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four (4) hours to instruct VA Personnel in operation and maintenance of the system.

- - - E N D - - -

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

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. American Society of Mechanical Engineers (ASME):
A112.14.1-2003.....Backwater Valves
- C. American Society of Sanitary Engineering (ASSE):
1001-2008.....Performance Requirements for Atmospheric Type Vacuum Breakers
1003-2009.....Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems
1011-2004.....Performance Requirements for Hose Connection Vacuum Breakers
1013-2011.....Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers
1015-2011.....Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
1017-2009.....Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems

- 1020-2004.....Performance Requirements for Pressure Vacuum
Breaker Assembly
- 1035-2008.....Performance Requirements for Laboratory Faucet
Backflow Preventers
- 1069-2005.....Performance Requirements for Automatic
Temperature Control Mixing Valves
- 1070-2004.....Performance Requirements for Water Temperature
Limiting Devices
- 1071-2012.....Performance Requirements for Temperature
Actuated Mixing Valves for Plumbed Emergency
Equipment
- D. American Society for Testing and Materials (ASTM):
 - A126-2004 (R2009).....Standard Specification for Gray Iron Castings
for Valves, Flanges, and Pipe Fittings
 - A276-2013a.....Standard Specification for Stainless Steel Bars
and Shapes
 - A536-1984 (R2009).....Standard Specification for Ductile Iron
Castings
 - B62-2009.....Standard Specification for Composition Bronze
or Ounce Metal Castings
 - B584-2013.....Standard Specification for Copper Alloy Sand
Castings for General Applications
- E. International Code Council (ICC):
 - IPC-2012.....International Plumbing Code
- F. Manufacturers Standardization Society of the Valve and Fittings
Industry, Inc. (MSS):
 - SP-25-2008.....Standard Marking Systems for Valves, Fittings,
Flanges and Unions
 - SP-67-2011.....Butterfly Valves
 - SP-70-2011.....Gray Iron Gate Valves, Flanged and Threaded
Ends
 - SP-71-2011.....Gray Iron Swing Check Valves, Flanged and
Threaded Ends
 - SP-80-2013.....Bronze Gate, Globe, Angle, and Check Valves
 - SP-85-2011.....Gray Iron Globe & Angle Valves, Flanged and
Threaded Ends
 - SP-110-2010.....Ball Valves Threaded, Socket-Welding, Solder
Joint, Grooved and Flared Ends

- G. National Environmental Balancing Bureau (NEBB):
 - 7th Edition 2005 Procedural Standards for Testing, Adjusting,
Balancing of Environmental Systems
- H. NSF International (NSF):
 - 61-2012.....Drinking Water System Components - Health
Effects
 - 372-2011.....Drinking Water System Components - Lead Content
- I. University of Southern California Foundation for Cross Connection
Control and Hydraulic Research (USC FCCCHR):
 - 9th Edition.....Manual of Cross-Connection Control

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Ball Valves.
 - 2. Gate Valves.
 - 3. Butterfly Valves.
 - 4. Balancing Valves.
 - 5. Check Valves.
 - 6. Globe Valves.
 - 7. Water Pressure Reducing Valves and Connections.
 - 8. Backwater Valves.
 - 9. Backflow Preventers.
 - 10. Chainwheels.
 - 11. Thermostatic Mixing Valves.
- D. Test and Balance reports for balancing valves.
- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
4. Piping diagrams of thermostatic mixing valves to be installed.
- F. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- G. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Valves shall be prepared for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set angle, gate, and globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Valves shall be prepared for storage as follows:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature.
- C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Asbestos packing and gaskets are prohibited.
- B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.
- C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.

- D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
- E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.

2.2 SHUT-OFF VALVES

- A. Cold, Hot and Re-circulating Hot Water:
 - 1. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be non-lead solder.
 - 2. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A536, ductile iron.
 - 3. 100 mm DN100 (4 inches) and larger:
 - a. Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A126, grey iron with bolted bonnet, flanged ends, bronze trim, and positive-seal resilient solid wedge disc. The gate valve shall be gear operated for sizes under 200 mm or DN200 (8 inches) and crank operated for sizes 200 mm or DN200 (8 inches) and above.
 - b. Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The butterfly valve shall be lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.
 - c. Grooved end, ductile iron butterfly valves. The grooved butterfly valve shall meet the MSS SP-67 standard. The grooved butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall be epoxy coated ductile iron conforming to ASTM

A536 with two piece stainless steel stem, //Buna-N//EPDM// encapsulated ductile iron disc, and EPDM seal. The butterfly valve shall be gear operated.

- B. Reagent Grade Water: Valves for reagent grade, reverse osmosis, or deionized water service shall be ball type of same material as used for pipe.

2.3 BALANCING VALVES

- A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.
- B. Larger than 75 mm or DN75 (3 inches): Manual balancing valves shall be of heavy duty cast iron flanged construction with 861 kPa (125 psig) flange connections. The flanged manual balancing valves shall have either a brass ball with glass and carbon filled TFE seal rings or fitted with a bronze seat, replaceable bronze disc with EPDM seal insert and stainless steel stem. The design pressure shall be 1200 kPa (175 psig) at 121 degrees C (250 degrees F).

2.4 CHECK VALVES

- A. 75 mm or DN75 (3 inches) and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.
- B. 100 mm or DN100 (4 inches) and larger:
1. Check valves shall be Class 125, iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a clear or full waterway body

- design with gray iron body material conforming to ASTM A126, bolted bonnet, flanged ends, bronze trim.
2. All check valves on the discharge side of submersible sump pumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

2.5 GLOBE VALVES

- A. 75 mm or DN75 (3 inches) or smaller: Class 150, bronze globe valve with non-metallic disc. The globe valve shall meet MSS SP-80, Type 2 standard. The globe valve shall have a CWP rating of 2070 kPa (300 psig). The valve material shall be bronze with integral seal and union ring bonnet conforming to ASTM B62 with solder ends, copper-silicon bronze stem, PTFE or TFE disc, and malleable iron hand wheel.
- B. Larger than 75 mm or DN75 (3 inches): Similar to above, except with cast iron body and bronze trim, Class 125, iron globe valve. The globe valve shall meet MSS SP-85, Type 1 standard. The globe valve shall have a CWP rating of 1380 kPa (200 psig). The valve material shall be gray iron with bolted bonnet conforming to ASTM A126 with flanged ends, bronze trim, and malleable iron handwheel.

2.6 WATER PRESSURE REDUCING VALVE AND CONNECTIONS

- A. 75 mm or DN75 (3 inches) or smaller: The pressure reducing valve shall consist of a bronze body and bell housing, a separate access cover for the plunger, and a bolt to adjust the downstream pressure. The pressure reducing valve shall meet ASSE 1003. The bronze bell housing and access cap shall be threaded to the body and shall not require the use of ferrous screws. The assembly shall be of the balanced piston design and shall reduce pressure in both flow and no flow conditions. The assembly shall be accessible for maintenance without having to remove the body from the line.
- B. 100 mm or DN100 (4 inches) and larger: The pressure reducing valve shall consist of a flanged cast iron body and rated to 1380 kPa (200 psig). The valve shall have a large elastomer diaphragm for sensitive response. The pressure reducing valve shall meet ASSE 1003.
- C. The regulator shall have a tap for pressure gauge.
- D. The regulator shall have a temperature rating of 100 degrees C (212 degrees F) for hot water or hot water return service. Pressure regulators shall have accurate pressure regulation to 6.9 kPa (+/- 1 psig).

- E. Setting: Entering water pressure, discharge pressure, capacity, size, and related measurements shall be as shown on the drawings.
- F. Connections Valves and Strainers: Shut off valves shall be installed on each side of reducing valve and a bypass line equal in size to the regulator inlet pipe shall be installed with a normally closed globe valve. A strainer shall be installed on inlet side of, and same size as pressure reducing valve. A pressure gage shall be installed on the inlet and outlet of the valve.

2.7 BACKWATER VALVE

- A. The backwater valve shall have a cast iron body, automatic thermoplastic type valve seat and flapper suited for water service. The flapper shall be slightly open during periods of non-operation. The pressure reducing valve shall meet ASME A112.14.1. The cleanout shall be extended to the finish floor and fit with a threaded countersunk plug. A clamping device shall be included when the cleanout extends through the waterproofing membrane.
- B. When the backwater valve is installed greater than 600 mm (24 inches) below the finish floor elevation, a pit or manhole large enough for a repair person can enter to service the backwater valve shall be installed.

2.8 BACKFLOW PREVENTERS

- A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. The backflow prevention assembly shall be approved by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USCFCCC).
- B. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port OS&Y positive-seal resilient gate valves and an integral relief monitor switch. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade 4. The seat ring and check valve shall be the thermoplastic type suited for water service. The stem shall be stainless steel conforming to ASTM A276. The seat disc shall be the elastomer type suited for water service. The checks and the relief valve shall be accessible for maintenance without removing the device from the line. An epoxy coated wye type strainer with flanged connections shall be installed on the

inlet. Reduced pressure backflow preventers shall be installed in the following applications.

1. Deionizers.
 2. Sterilizers.
 3. Stills.
 4. Dialysis, Deionized or Reverse Osmosis Water Systems.
 5. Water make up to heating systems, cooling tower, chilled water system, generators, and similar equipment consuming water.
 6. Water service entrance from loop system.
 7. Dental equipment.
 8. Power washer.
 9. Medical equipment.
 10. Process equipment.
 11. Autopsy, on each hot and cold water outlet at each table or sink.
 12. Reclaimed water systems.
- C. The pipe applied or integral atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be cast bronze. The seat disc shall be the elastomer type suited for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable. Atmospheric vacuum breakers shall be installed in the following applications.
1. Hose bibs and sinks with threaded outlets.
 2. Disposers.
 3. Showers (telephone/handheld type).
 4. Hydrotherapy units.
 5. All kitchen equipment, if not protected by air gap.
 6. Ventilating hoods with wash down system.
 7. Film processor.
 8. Detergent system.
 9. Fume hoods.
 10. Glassware washers.
 11. Service sinks (integral with faucet only).
 12. Laundry tubs (integral with faucet only).
 13. Sitz baths.
- D. The hose connection vacuum breaker shall be ASSE listed 1011. The main body shall be cast brass with stainless steel working parts. The

diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to hose thread outlets. Hose connection vacuum breakers shall be installed in the following locations requiring non-continuous pressure:

1. Hose bibbs and wall hydrants.

E. The pressure vacuum breaker shall be ASSE listed 1020. The main body shall be brass. The disc and O-ring seal shall be the elastomer type. The valve seat and disc float shall be the thermoplastic type. Tee handle or lever handle shut-off ball valves. Test cocks for testing and draining where freezing conditions occur. All materials shall be suitable for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable. Pressure vacuum breakers shall be installed in the following locations requiring continuous pressure and no backpressure including equipment with submerged inlet connections:

1. Lawn Irrigation.

F. The laboratory faucet vacuum breaker shall be ASSE listed 1035. The main body shall be cast brass. Dual check valves with stainless steel working parts. The diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to laboratory faucets for non-continuous pressure applications.

G. The double check backflow prevention assembly shall be ASSE listed 1015 and supply with full port, OS&Y, positive-seal, resilient gate valves. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade. The seat ring and check valve shall be the thermoplastic type suited for water service. The stem shall be stainless steel conforming to ASTM A276. The seat disc shall be the elastomer type suited for water service. The first and second check valve shall be accessible for maintenance without removing the device from the line. Double check valves shall be installed in the following location requiring continuous pressure subject to backpressure and backsiphonage conditions.

1. Lawn Irrigation.

2. Food Processing Equipment.

3. Laundry equipment.

2.9 CHAINWHEELS

- A. Not Used.

2.10 THERMOSTATIC MIXING VALVES

- A. Thermostatic Mixing Valves shall comply with the following general performance requirements:
1. Shall meet ASSE requirements for water temperature control.
 2. The body shall be cast bronze or brass with corrosion resistant internal parts preventing scale and biofilm build-up. Provide chrome-plated finish in exposed areas.
 3. No special tool shall be required for temperature adjustment, maintenance, replacing parts and disinfecting operations.
 4. Valve shall be able to be placed in various positions without making temperature adjustment or reading difficult.
 5. Valve finish shall be chrome plated in exposed areas.
 6. Valve shall allow easy temperature adjustments to allow hot water circulation. Internal parts shall be able to withstand disinfecting operations of chemical and thermal treatment of water temperatures up to 82°C (180°F) for 30 minutes or 50 mg/L (50 ppm) chlorine residual concentration for 24 hours.
 7. Parts shall be easily removed or replaced without dismantling the valves, for easy scale removal and disinfecting of parts.
 8. Valve shall have a manual adjustable temperature control with locking mechanism to prevent tampering by end user. Outlet temperature shall be visible to ensure outlet temperature does not exceed specified limits, particularly after thermal eradication procedures.
 9. Provide mixing valves with integral check valves with screens and stop valves.
- B. Master Thermostatic Water Mixing Valves:
1. Application: Tempered water distribution from hot water source.
 2. Standard: ASSE 1017.
 3. Pressure Rating: 861 kPa (125 psig).
 4. Type: Exposed-mounting or Cabinet-type, as indicated, thermostatically controlled water mixing valve.
 5. Connections: Flanged or threaded union inlets and outlet.
 6. Valve Finish: Chrome plated.

7. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
 8. Thermometers shall be provided to indicate mixed water temperature.
 9. Provide a high temperature alarm device to detect mixing valve failure
- C. Hi-Lo Water-Mixing-Valve Assemblies:
1. Application: Tempered water distribution from hot water source covering a wide range of flow.
 2. Description: Factory-fabricated, cabinet-type or exposed-mounting, thermostatically controlled, water-mixing-valve assembly in two-valve parallel arrangement including pressure regulators, pressure gages and thermometer.
 3. Large-Flow Parallel: Master thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
 4. Small-Flow Parallel: Master thermostatic water mixing valve.
 5. Master Thermostatic Mixing Valves: Comply with ASSE 1017.
 6. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
 7. Component Pressure Ratings: 861 kPa (125 psig) minimum, unless otherwise indicated.
 8. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
 9. Connections: Soldered or threaded union inlets and outlet.
 10. Thermometers shall be provided to indicate mixed water temperature.
 11. Provide a high temperature alarm device to detect mixing valve failure.
- D. Automatic Water Temperature Control Mixing Valves:
1. Application: Gang plumbing fixtures point-of-use when no other mixing at fixtures occurs.
 2. Standard: ASSE 1069.
 3. Pressure Rating: 861 kPa (125 psig).
 4. Type: Thermostatically controlled water mixing valve set at 43 degrees C (110 degrees F).
 5. Connections: Threaded union or soldered inlets and outlet.
 6. Thermometers shall be provided to indicate mixed water temperature.
 7. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.5 gpm maximum.

8. Provide a high temperature alarm device to detect mixing valve failure.

E. Water Temperature Limiting Devices:

1. Application: Single plumbing fixture point-of-use such as sinks or lavatories.
2. Standard: ASSE 1070.
3. Pressure Rating: 861 kPa (125 psig).
4. Type: Thermostatically controlled water mixing valve set at 43 degrees C (110 degrees F).
5. Connections: Threaded union, compression or soldered inlets and outlet.
6. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.2 gpm maximum.

F. Temperature Activated Mixing Valves:

1. Application: Emergency eye/face/drench shower equipment.
2. Standard: ASSE 1071.
3. Pressure Rating: 861 kPa (125 psig).
4. Type: Thermostatically controlled water mixing valve set at 24-30 degrees C (75-85 degrees F).
5. Connections: Soldered or threaded union inlets and outlet.
6. Thermometers shall be provided to indicate mixed water temperature.
7. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.5 gpm maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
- B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
- C. Threads on valve and mating pipe shall be examined for form and cleanliness.
- D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its

material composition is suitable for service and free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.

C. Valves shall be installed in horizontal piping with stem at or above center of pipe.

D. Valves shall be installed in a position to allow full stem movement.

E. Install chain wheels on operators for ball, butterfly, gate, and globe valves NPS 100 mm or DN100 (4 inches) and larger and more than 3.6 m (12 feet) above floor. Chains shall be extended to 1524 mm (60 inches) above finished floor.

F. Check valves shall be installed for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level and on top of valve.

G. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment or system.

1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

H. Install pressure gages on outlet of backflow preventers.

I. Do not install bypass piping around backflow preventers.

J. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets.

1. Install thermometers if specified.

2. Install cabinet-type units recessed in or surface mounted on wall as specified.

K. If an installation is unsatisfactory to the CO/COR, the Contractor shall correct the installation at no cost to the Government.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Calibrated balancing valves.
2. Master, thermostatic, water mixing valves.
3. Manifold, thermostatic, water-mixing-valve assemblies.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

3.4 ADJUSTING

A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.

B. Set field-adjustable flow set points of balancing valves and record data. Ensure recorded data represents actual measured or observed conditions. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

D. Testing and adjusting of balancing valves shall be performed by an independent NEBB Accredited Test and Balance Contractor. A final settings and flow report shall be submitted to the CO/COR.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four (4) hours to instruct VA Personnel in operation and maintenance of the system.

- - E N D - - -

SECTION 22 11 00
FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 07 92 00, JOINT SEALANTS.
- D. Section 09 91 00, PAINTING.
- E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- F. Section 22 07 11, PLUMBING INSULATION.

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. American Society of Mechanical Engineers (ASME):
 - A13.1-2007 (R2013).....Scheme for Identification of Piping Systems
 - B16.3-2011.....Malleable Iron Threaded Fittings: Classes 150 and 300
 - B16.9-2012.....Factory-Made Wrought Buttwelding Fittings
 - B16.11-2011.....Forged Fittings, Socket-Welding and Threaded
 - B16.12-2009 (R2014).....Cast Iron Threaded Drainage Fittings
 - B16.15-2013Cast Copper Alloy Threaded Fittings: Classes 125 and 250
 - B16.18-2012.....Cast Copper Alloy Solder Joint Pressure Fittings
 - B16.22-2013.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
 - B16.24-2011.....Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
 - B16.51-2013.....Copper and Copper Alloy Press-Connect Fittings
- ASME Boiler and Pressure Vessel Code -

BPVC Section IX-2015....Welding, Brazing, and Fusing Qualifications

C. American Society of Sanitary Engineers (ASSE):

1010-2004.....Performance Requirements for Water Hammer
Arresters

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

A47/A47M-1999 (R2014)...Standard Specification for Ferritic Malleable
Iron Castings

A53/A53M-2012.....Standard Specification for Pipe, Steel, Black
and Hot-Dipped, Zinc-Coated, Welded and
Seamless

A183-2014.....Standard Specification for Carbon Steel Track
Bolts and Nuts

A269/A269M-2014e1.....Standard Specification for Seamless and Welded
Austenitic Stainless Steel Tubing for General
Service

A312/A312M-2015.....Standard Specification for Seamless, Welded,
and Heavily Cold Worked Austenitic Stainless
Steel Pipes

A403/A403M-2014.....Standard Specification for Wrought Austenitic
Stainless Steel Piping Fittings

A536-1984 (R2014).....Standard Specification for Ductile Iron
Castings

A733-2013.....Standard Specification for Welded and Seamless
Carbon Steel and Austenitic Stainless Steel
Pipe Nipples

B32-2008 (R2014).....Standard Specification for Solder Metal

B43-2014.....Standard Specification for Seamless Red Brass
Pipe, Standard Sizes

B61-2008 (R2013).....Standard Specification for Steam or Valve
Bronze Castings

B62-2009.....Standard Specification for Composition Bronze
or Ounce Metal Castings

B75/B75M-2011.....Standard Specification for Seamless Copper Tube

B88-2014.....Standard Specification for Seamless Copper
Water Tube

B584-2014.....Standard Specification for Copper Alloy Sand
Castings for General Applications

- B687-1999 (R2011).....Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
- C919-2012.....Standard Practice for Use of Sealants in Acoustical Applications
- D1785-2012.....Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2000-2012.....Standard Classification System for Rubber Products in Automotive Applications
- D2564-2012.....Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
- D2657-2007.....Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
- D2855-1996 (R2010).....Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
- D4101-2014.....Standard Specification for Polypropylene Injection and Extrusion Materials
- E1120-2008.....Standard Specification for Liquid Chlorine
- E1229-2008.....Standard Specification for Calcium Hypochlorite
- F2389-2010.....Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems
- F2620-2013.....Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
- F2769-2014.....Standard Specification for Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems
- E. American Water Works Association (AWWA):
 - C110-2012.....Ductile-Iron and Gray-Iron Fittings
 - C151-2009.....Ductile Iron Pipe, Centrifugally Cast
 - C153-2011.....Ductile-Iron Compact Fittings
 - C203-2008.....Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
 - C213-2007.....Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
 - C651-2014.....Disinfecting Water Mains

- F. American Welding Society (AWS):
 - A5.8M/A5.8-2011-AMD1....Specification for Filler Metals for Brazing and Braze Welding
- G. International Code Council (ICC):
 - IPC-2012.....International Plumbing Code
- H. Manufacturers Specification Society (MSS):
 - SP-58-2009.....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
 - SP-72-2010a.....Ball Valves with Flanged or Butt-Welding Ends for General Service
 - SP-110-2010.....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
- I. NSF International (NSF):
 - 14-2015.....Plastics Piping System Components and Related Materials
 - 61-2014a.....Drinking Water System Components - Health Effects
 - 372-2011.....Drinking Water System Components - Lead Content
- J. Plumbing and Drainage Institute (PDI):
 - PDI-WH 201-2010.....Water Hammer Arrestors
- K. Department of Veterans Affairs:
 - H-18-8-2013.....Seismic Design Handbook

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 11 00, FACILITY WATER DISTRIBUTIONS", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. All items listed in Part 2 - Products.
- D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

- A. A certificate shall be submitted prior to welding of steel piping showing the Welder's certification. The certificate shall be current and no more than one year old. Welder's qualifications shall be in accordance with ASME BPVC Section IX.
- B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.
- C. All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.
- D. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.

1.6 SPARE PARTS

- A. For mechanical press-connect fittings, provide tools required for each pipe size used at the facility.

1.7 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on compact disc or DVD inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A list of recommended

spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the CO/COR will be required to employ shall be inserted into the As-Built documentation.

- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2012 provided on compact disk or DVD. 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.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certificate if applicable that all results of tests were within limits specified. If a certificate is not available, all documentation shall be on the Certifier's letterhead.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead are prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.
- B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

2.2 UNDERGROUND WATER SERVICE CONNECTIONS TO BUILDINGS

- A. From inside face of exterior wall to a distance of approximately 1500 mm (5 feet) outside of building and underground inside building, material to be the same for the size specified inside the building.
- B. 75 mm (3 inch) Diameter and Greater: Ductile iron, AWWA C151, 2413 kPa (350 psig) pressure class, exterior bituminous coating, and cement lined. Bio-based materials shall be utilized when possible. Provide flanged and anchored connection to interior piping.
- C. Under 75 mm (3 inch) Diameter: Copper tubing, ASTM B88, Type K, seamless, annealed. Fittings are as specified in paragraph "Above

Ground (Interior) Water Piping". Use brazing alloys, AWS A5.8M/A5.8, Classification BCuP.

- D. Flexible Expansion Joint: Ductile iron with ball joints rated for 1725 kPa (250 psig) working pressure conforming to AWWA C153, capable of deflecting a minimum of 20 degrees in each direction. Flexible expansion joint size shall match the pipe size it is connected to and shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure containing parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213 and shall be factory tested with a 1500 volt spark test. Flexible expansion joint shall have flanged connections conforming to AWWA C110. Bolts and nuts shall be 316 stainless steel and gaskets shall be neoprene. The flexible expansion fitting shall not expand or exert an axial thrust under internal water pressure. Provide piping joint restraints at each mechanical joint end connection and piping restraints at the penetration of the building wall. The restraints shall be provided to address the developed thrust at the change of piping direction.

2.3 ABOVE GROUND (INTERIOR) 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 40 shall be used.
- B. Fittings for Copper Tube:
1. Wrought copper or bronze castings conforming to ASME B16.18 and B16.22. Unions shall be bronze, MSS SP-72, MSS SP-110, solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
 2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75/B75M C12200, 125 to 150 mm (5 to 6 inch) bronze casting ASTM B584, C84400. Mechanical grooved couplings, 2070 kpa (300 psig) minimum ductile iron, ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
 3. Mechanical press-connect fittings for copper pipe and tube shall conform to the material and sizing requirements of ASME B16.51, NSF 61 approved, 50 mm (2 inch) size and smaller mechanical press-connect fittings, double pressed type, with EPDM (ethylene propylene

- diene monomer) non-toxic synthetic rubber sealing elements and un-pressed fitting identification feature.
4. 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 ensure 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.
 5. Flanged fittings, bronze, class 150, solder-joint ends conforming to ASME B16.24.
- C. Fittings for Stainless Steel:
1. Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ASME B16.9.
 2. Grooved fittings, stainless steel, Type 316, Schedule 40 conforming to ASTM A403/A403M. Segmentally fabricated fittings are not allowed. Mechanical grooved couplings, ductile iron, 4138 kPa (600 psig), ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
- D. Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.
- E. Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.
- F. Brazing alloy: AWS A5.8M/A5.8, brazing filler metals shall be BCuP series for copper to copper joints and BA9 series for copper to steel joints.
- G. Re-agent Grade Water Piping and Dialysis Water Piping:
1. Polypropylene, ASTM F2389, Schedule 80 pressure pipe without additions of modifiers, plasticizers, colorants, stabilizers or lubricants. Bio-based materials shall be utilized when possible. This virgin un-plasticized pipe and fittings shall transport 10 megohm water with no loss of purity. Provide socket or butt end fittings with ASTM D2657 heat fusion joints.
 2. Polyethylene, ASTM F2769, Schedule 80, food and medical grade, capable of transporting 10 megohm water with no loss of purity. Processed by continuous compression molding without the addition of

fillers, polymer modifiers or processing aids. Uniform color with no cracks, flaws, blisters or other imperfections in appearance. Provide ASTM D2657 or ASTM F2620 heat fusion butt welded joints. In accordance with manufacturer's recommendations, provide continuous channel support under all horizontal piping.

3. Reverse Osmosis (RO) Water Piping:
 - a. Low Pressure Feed, Reject and Recycle Piping: Less than or equal to 520 kPa (75 psig): ASTM D1785, Schedule 80 PVC, ASTM D2855 socket welded and flanged.
 - b. RO Product Tubing From Each Membrane Housing: ASTM D1785, Schedule 80 PVC, ASTM D2855 socket welded and flanged.
 - c. Low Pressure Control and Pressure Gage Tubing: Polyethylene.
 - d. High Pressure Reject and Recycle Piping: Greater than 520 kPa (75 psig): ASTM A269/A269M, Type 304 schedule 10 stainless steel with butt welded joints.
 - e. High Pressure Control and Pressure Gage Tubing: 6895 kPa (1000 psig) burst nylon.

2.4 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: ASTM B43, standard weight.
 2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish.
 3. Nipples: ASTM B687, Chromium-plated.
 4. Unions: MSS SP-72, MSS 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.

2.5 ETHYLENE OXIDE (ETO) STERILIZER WATER SUPPLY PIPING

- A. Not Used.

2.6 TRAP PRIMER WATER PIPING

- A. Pipe: Copper tube, ASTM B88, type K, hard drawn.
- B. Fittings: Bronze castings conforming to ASME B16.18 Solder joints.
- C. Solder: ASTM B32 alloy type Sb5. Provide non-corrosive flux.

2.7 STRAINERS

- A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.
- B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.
- C. Body: Less than 75 mm (3 inches), brass or bronze; 75 mm (3 inches) and greater, cast iron or semi-steel.

2.8 DIELECTRIC FITTINGS

- A. Provide dielectric couplings or unions between pipe of dissimilar metals.

2.9 STERILIZATION CHEMICALS

- A. Not Used

2.10 WATER HAMMER ARRESTER

- A. Closed copper tube chamber with permanently sealed 413 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N O-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010. Access shall be provided where devices are concealed within partitions or above ceilings. Size and install in accordance with PDI-WH 201 requirements. Provide water hammer arrestors at:
 - 1. All solenoid valves.
 - 2. All groups of two or more flush valves.
 - 3. All quick opening or closing valves.
 - 4. 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. Pipe, except for plastic and glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.

3. All pipe runs shall be laid out to avoid interference with other work/trades.
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 the IPC, H-18-8 Seismic Design Handbook, MSS SP-58, and SMACNA as required.
 - b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
 - c. Floor, Wall and Ceiling Plates, Supports, Hangers:
 - 1) Solid or split un-plated 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) Pipe Hangers and Riser Clamps: Malleable iron or carbon steel. Pipe Hangers and riser clamps shall have a copper finish when supporting bare copper pipe or tubing.
 - 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 (minimum) metal protection shield centered on and welded to the hanger and support. The shield thickness and length shall be engineered and sized for distribution of loads to preclude crushing of insulation without breaking the vapor barrier. The shield shall be sized for the insulation and have flared edges to protect vapor-retardant jacket facing. To prevent the shield from sliding out of the clevis hanger during pipe movement, center-ribbed shields shall be used.
 - 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 6.1 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.

- 12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints. Restraint calculations shall be based on the criteria from the manufacturer regarding their restraint design.
6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
 7. Penetrations:
 - a. Firestopping: 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 firestopping 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. Bio-based materials shall be utilized when possible.
 - c. Acoustical sealant: Where pipes pass through sound rated walls, seal around the pipe penetration with an acoustical sealant that is compliant with ASTM C919.
 8. Mechanical press-connect fitting connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. Ensure the tube is completely inserted to the fitting stop (appropriate depth) and squared with the fitting prior to applying the pressing jaws onto the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer. Minimum distance between fittings shall be in

accordance with the manufacturer's requirements. When the pressing cycle is complete, visually inspect the joint to ensure the tube has remained fully inserted, as evidenced by the visible insertion mark.

B. Domestic Water piping shall conform to the following:

1. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.
2. 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. Submit testing plan to COR 10 working days prior to test date.
- 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 1035 kPa (150 psig) 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. Pressure gauge shall have 1 psig increments.
- C. Re-agent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 1380 kPa (200 psig) 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.
- E. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

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 liquid chlorine or hypochlorite for sterilization.

3.4 COMMISSIONING

- A. NOT USED.

3.5 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four (4) hours to instruct VA Personnel in operation and maintenance of the system.

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SECTION 22 33 00
ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for installing a complete electric domestic water heater system ready for operation including the water heaters, thermometers, and all necessary accessories, connections, and equipment.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.
- D. Section 09 91 00, PAINTING: Preparation and finish painting.
- E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- F. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING
- G. Section 22 07 11, PLUMBING INSULATION.
- H. Section 22 11 00, FACILITY WATER DISTRIBUTION: Piping, Fittings, Valves and Gages.

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. American National Standard Institute (ANSI):
Z21.22B-2001 (R2008)....Relief Valves for Hot Water Supply Systems
- C. American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
90.1 (2013).....Energy Standard for Buildings Except Low-Rise Residential Buildings
- D. American Society of Mechanical Engineers (ASME):
ASME Boiler and Pressure Vessel Code
BPVC Section IV-2013....Rules for Construction of Heating Boilers
BPVC Section VIII-1-2013 Rules for Construction of Pressure Vessels, Division 1
Form U-1.....Manufacturer's Data Report for Pressure Vessels
B1.20.1-2013.....Pipe Threads, General Purpose (Inch)

- B16.5-2013.....Pipe Flanges and Flanged Fittings: NPS 1/2
through NPS 24 Metric/Inch Standard
- B16.24-2011.....Cast Copper Alloy Pipe Flanges and Flanged
Fittings: Classes 150, 300, 600, 900, 1500, and
2500
- CSD-1-2012.....Controls and Safety Devices for Automatically
Fired Boilers
- E. American Society of Sanitary Engineering (ASSE):
1005-1999.....Performance Requirements for Water Heater Drain
Valves, 3/4 Inch Size
- F. National Fire Protection Association (NFPA)
70-2011.....National Electrical Code (NEC)
- G. NSF International (NSF):
5-2012.....Water Heaters, Hot Water Supply Boilers, and
Heat Recovery Equipment
- 61-2012.....Drinking Water System Components - Health
Effects
- 372-2011.....Drinking Water System Components - Lead Content
- H. Underwriters Laboratories, Inc. (UL):
174-04 (R2012).....Standard for Household Electric Storage Tank
Water Heaters
- 499-05 (R2013).....Standard for Electric Heating Appliances
- 1453-04 (R2011).....Standard for Electric Booster and Commercial
Storage Tank Water Heaters

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 33 00, ELECTRIC DOMESTIC WATER HEATERS", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
1. Water Heaters.
 2. Pressure and Temperature Relief Valves.
 3. Thermometers.

4. Pressure Gages.
 5. Vacuum Breakers.
 6. Expansion Tanks.
- D. For each electric domestic hot water heater type and size, the following characteristics shall be submitted:
1. Rated Capacities.
 2. Operating characteristics.
 3. Electrical characteristics.
 4. Furnished specialties and accessories.
 5. A form U-1 or other documentation stating compliance with the ASME Boiler and Pressure Vessel code.
- E. Shop drawings shall include wiring diagrams for power, signal and control functions.
- F. Seismic qualification certificates shall be submitted that details equipment anchorage components, identifies equipment center of gravity with mounting and anchorage provisions, and whether the seismic qualification certificate is based on an actual test or calculations.
- G. Submit documentation indicating compliance with applicable requirements with ASHRAE 90.1 for Service Water Heating or FEMP.
- H. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
1. Include complete list indicating all components of the systems.
 2. Include complete diagrams of the internal wiring for each item of equipment.
 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

- A. For commercial applications, comply with American Society of Heating, Refrigerating and Air - Conditioning Engineers (ASHRAE) for efficiency performance. ASHRAE 90.1, "Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings, for commercial water heaters."
- B. Electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application.
- C. ASME code construction shall be a vessel fabricated in compliance with the ASME BPVC Section VIII-1.
- D. Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

- E. The electric domestic water heater shall conform to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS, withstanding seismic movement without separation of any parts from the equipment when subjected to a seismic event.
- F. The domestic water heater shall be certified and labeled by an independent testing agency.
- G. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.

1.6 AS-BUILT DOCUMENTATION

- A. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the CO/COR will be required to employ shall be inserted into the As-Built documentation.
- B. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version 2012 provided on compact disk or DVD. 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.

PART 2 - PRODUCTS

2.1 ELECTRIC DOMESTIC WATER HEATERS

- A. The tank construction shall be steel shell, with an inner tank liner complying with NSF 61 and NSF 372 for barrier materials for potable water. The inner liner shall be extended into the openings. The vessel shall be ASME BPVC Section VIII-1, fabricated with a pressure rating of 1035 kPa (150 psig). Provide with access for cleaning and disinfection.
- B. Tapping (openings) shall be Factory fabricated of materials compatible with the tank and in accordance with appropriate ASME standards B1.20.1 for piping connections, pressure and temperature relief valve, pressure gauge, thermometer, drain valve, anode rods and controls as required. Tappings shall comply with the following ASME standards listed below:
 - 1. 50 mm or DN50 (2 inch) and smaller: Threaded ends according to ASME B1.20.1.
 - 2. 65 mm or DN65 (2 1/2-inch) and Larger: Flanged ends according to ASME B16.5 for steel and stainless steel flanges, and according to ASME B16.24.
- C. Tank insulation shall comply with ASHRAE 90.1 and ENERGY STAR requirements.
- D. For domestic water heater sizes greater than 9 KW, the heating element shall be arranged in multiples of three elements. For heaters less than 9 KW, the heater elements shall be arranged in double elements. Heater capacities are scheduled on the drawings.
- E. The domestic water heaters shall have screw in or bolt on immersion type, thermostatically adjustable elements. Set thermostat for minimum water storage temperature of 60 degrees C (140 degrees F). The electrical characteristics are scheduled on the drawings. Heaters shall be capable of raising the discharge temperature to 77 to 82 degrees C (170 to 180 degrees F) for thermal eradication.
- F. The Combination Pressure and Temperature relief Valve shall be ANSI Z21.22 and ASME rated.
- G. The anode rod shall be replaceable magnesium.
- H. The drain valve shall be corrosion resistant metal complying with ASSE 1005.
- I. Comply with NSF 5 for water heaters.

2.2 ELECTRIC, TANKLESS, DOMESTIC WATER HEATER

- A. Electric, Tankless, domestic water heaters shall be constructed with copper piping or tubing complying with NSF 61 and NSF 372 for barrier materials for potable water heaters without storage capacity.
- B. The pressure rating shall be 1035 kPa (150 psig).
- C. The heating element shall be resistance heating system type.
- D. Temperature control shall be made with flow control fittings or thermostat.
- E. The safety control shall be a high temperature limit cutoff device or system.
- F. The heater shall have an enameled jacket with an aluminum or steel floor stand or wall bracket for off-floor mounting.
- G. Heater capacities and electrical characteristics are scheduled on the drawings.

2.3 DOMESTIC HOT WATER EXPANSION TANKS

- A. A steel pressure rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as scheduled. The air precharge shall be set to minimum system operating pressure at tank.
- B. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.
- C. The interior finish shall comply with NSF 61 and NSF 372 for barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.
- D. The air charging valve shall be factory installed.

2.4 ELECTRIC WATER HEATER DRAIN PAN

- A. A stainless steel drain pan shall be provided that is large enough to contain the volume of the heater. The drain pan shall include a drain outlet not less than 20 mm or DN 20 (NPS 3/4 inch) with ASME B1.20.7 garden hose threads.

2.5 HEAT TRAPS

- A. Heat traps shall be installed in accordance with ASHRAE 90.1 unless provided integrally with the heater.

2.6 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

- A. The combination pressure and temperature relief valve shall be ANSI Z21.22 and ASME rated and constructed of all brass or bronze with a self-closing reseating valve. The relief valves shall include a relieving capacity greater than the heat input and include a pressure

setting less than the water heater's working pressure rating. Sensing element shall extend into storage tank.

2.7 THERMOMETERS

- A. Thermometers shall be rigid stem or remote sensing, scale or dial type with an aluminum, black metal, stainless steel, or chromium plated brass case. The thermometer shall be back connected, red liquid (alcohol or organic-based) fill, vapor, bi-metal or gas actuated, with 225 mm (9 inches) high scale dial or circular dial 50 to 125 mm (2 to 5 inches) in diameter graduated from 4 to 100 degrees C (40 to 212 degrees F), with two-degree graduations guaranteed accurate within one scale division. The 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. The thermometer shall be suitable for 20 mm (3/4 inch) pipe threads. Thermometers may be console-mounted with sensor installed in separate thermometer well.

2.8 SUPPORTS

- A. Water heater stands shall be factory-fabricated steel for floor mounting capable of supporting water heater and water a minimum of 450 mm (18 inches) above the floor.
- B. Wall brackets for wall mounted heaters shall be factory-fabricated steel capable of supporting water heater and water.

2.9 MANIFOLD KITS

- A. For multiple water heater installation, provide factory-fabricated copper manifold kits to include ball-type shutoff valves to isolate each water heater and balancing valves to provide balanced flow through each water heater.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Water heaters shall be installed on concrete bases unless elevated above the floor. Refer to Specification Section 03 30 00, CAST-IN-PLACE CONCRETE and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- B. The water heaters shall be installed level and plumb and securely anchored.
- C. The water heaters shall be installed and connected in accordance with manufacturer's written instructions with manufacturer's recommended clearances.
- D. All pressure and temperature relief valves discharge shall be piped to nearby floor drains with air gap or break.

- E. Thermometers shall be installed on the water heater inlet and outlet piping and shall be positioned such that they can be read by an operator or staff standing on floor or walkway.
- F. The thermostatic control shall be set for a minimum setting of 60 degrees C (140 degrees F) for storage heaters and regulated to a maximum discharge temperature of 54 degrees C (130 degrees F) for distribution to personnel.
- G. Dielectric unions shall be provided if there are dissimilar metals between the water heater connections and the attached piping.
- H. Provide vacuum breakers per ANSI Z21.22 on the inlet pipe if the water heater is bottom fed. Refer to Specification Section 22 11 00, FACILITY WATER DISTRIBUTION.
- I. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.
- J. All manufacturer's required clearances shall be maintained.
- K. The electric domestic water heaters shall be installed with seismic restraint devices.
- L. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank in accordance with manufacturer's recommendations. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by positive air gap into a floor drain.
- M. Piping type heat traps shall be installed on the inlet and outlet piping of the electric domestic water heater storage tanks if not provided integrally with the tanks.
- N. Water heater drain piping shall be installed as indirect waste to spill by positive air gap into open drains or over floor drains. Hose end drain valves shall be installed at low points in water piping for electric domestic water heaters without integral drains.
- O. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.

3.2 LEAKAGE TEST

- A. Before piping connections are made, water heaters shall be tested with hydrostatic pressure of 1380 kPa (200 psig) and 1654 kPa (240 psig) for a unit with a MAWP of 1103 kPa (160 psig). Any domestic water heater leaking water shall be replaced with a new unit at no additional cost to the VA.

3.3 PERFORMANCE TEST

- A. All of the remote water outlets shall have a minimum of 43 degrees C (110 degrees F) and a maximum of 49 degrees C (120 degrees F) water flow at all times.

3.4 STARTUP AND TESTING

- A. As recommended by product manufacturer and listed standards and under actual or simulated operating conditions, tests shall be conducted to prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with each integrated system.
- B. The tests shall include system capacity, control function, and alarm functions.
- C. When any defects are detected, correct defects and repeat test at no additional costs to the Government.
- D. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer's Representative and Commissioning Agent. Provide a minimum of 7 days prior to notice.

3.5 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four (4) hours to instruct VA Personnel in operation and maintenance of the system.

- - - E N D - - -

SECTION 23 05 11
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 23.
- B. Definitions:
 - 1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
 - 2. Option or optional: Contractor's choice of an alternate material or method.
 - 3. CO/COR: Contracting Officer / Contracting Officer's Representative

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES
- D. Section 03 30 53, CAST-IN-PLACE CONCRETE
- E. Section 07 92 00, JOINT SEALANTS
- F. Section 09 91 00, PAINTING
- G. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC
- H. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- I. Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUITS and CABLES.

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
- B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- C. Equipment Vibration Tolerance:
 - 1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.

2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.

D. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). 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 and/or additional requirements.
2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the CO/COR.
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 within 50 miles to the site.

- F. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
 3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
- G. Execution (Installation, Construction) Quality:
1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the CO/COR for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the CO/COR 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. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.
- H. 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.

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. 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.
- F. NOT USED.
- G. Mock-ups: Mock-ups are required for critical items and typical component installations replicated numerous times throughout the project as directed by the CO/COR. The CO/COR and Medical Center Representatives shall review and approve the mock-up prior to installation of additional applicable components.
- H. Layout Drawings:
 - 1. Submit complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Refer to 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.
- I. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
 - 1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the CO/COR.
 - 2. Submit electric motor data and variable speed drive data with the driven equipment.
 - 3. Equipment and materials identification.
 - 4. Fire-stopping materials.
 - 5. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
 - 6. Wall, floor, and ceiling plates.
- J. HVAC Maintenance Data and Operating Instructions:
 - 1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
 - 2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.
- K. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating and Refrigeration Institute (AHRI):
430-2009.....Central Station Air-Handling Units
- C. American National Standard Institute (ANSI):
B31.1-2007.....Power Piping
- D. Rubber Manufacturers Association (ANSI/RMA):
IP-20-2007.....Specifications for Drives Using Classical
V-Belts and Sheaves
IP-21-2009.....Specifications for Drives Using Double-V
(Hexagonal) Belts
IP-22-2007.....Specifications for 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 I-2007.....Power Boilers
 - Section IX-2007.....Welding and Brazing Qualifications
 - Code for Pressure Piping:
 - B31.1-2007.....Power Piping
- G. American Society for Testing and Materials (ASTM):
 - A36/A36M-08.....Standard Specification for Carbon Structural Steel
 - A575-96(2007).....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
 - E84-10.....Standard Test Method for Surface Burning Characteristics of Building Materials
 - E119-09c.....Standard Test Methods for Fire Tests of Building Construction and Materials
- H. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
 - SP-58-2009.....Pipe Hangers and Supports-Materials, Design and Manufacture, Selection, Application, and Installation
 - 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-1-2009.....Motors and Generators
- J. National Fire Protection Association (NFPA):
 - 31-06.....Standard for Installation of Oil-Burning Equipment
 - 54-09.....National Fuel Gas Code
 - 70-08.....National Electrical Code
 - 85-07.....Boiler and Combustion Systems Hazards Code
 - 90A-09.....Standard for the Installation of Air Conditioning and Ventilating Systems
 - 101-09.....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 CO/COR. Such repair or replacement shall be at no additional cost to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
4. Boilers shall be left clean following final internal inspection by Government insurance representative or inspector.
5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.7 JOB CONDITIONS - WORK IN EXISTING BUILDING

- A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities, that serve the medical center.
- B. Maintenance of Service: Schedule all work to permit continuous service as required by the medical center.
- C. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the CO/COR during periods when the demands are not critical to the operation of the

medical center. These non-critical periods are limited to between 8 pm and 5 am in the appropriate off-season (if applicable). Provide at least one week advance notice to the CO/COR.

- D. Phasing of Work: Comply with all requirements shown on drawings or specified.
- E. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. No storm water or ground water leakage permitted. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA.
- F. Acceptance of Work for Government Operation: As new facilities are made available for operation and these facilities are of beneficial use to the Government, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

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.
- I. Drive Types, Based on ARI 435:
1. Provide adjustable-pitch 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 19, 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 premium efficiency type motors as scheduled.

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 premium efficiency 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.
- E. Controller shall be provided with the following operating features and accessories:
 - 1. Suitable for variable torque load.

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.
- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. 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. Supports for Roof Mounted Items:
 - 1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gauge), with integral baseplate, continuous welded corner seams, factory installed 50 mm by 100 mm (2 by 4) treated wood nailer, 1.3 mm (18 gauge) galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum

- height 280 mm (11 inches). For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
2. Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.
- C. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.
- D. Attachment to Concrete Building Construction:
1. Concrete insert: MSS SP-58, Type 18.
 2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the CO/COR 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 CO/COR for each job condition.
- E. Attachment to Steel Building Construction:
1. Welded attachment: MSS SP-58, Type 22.
 2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23mm (7/8-inch) outside diameter.
- F. Not Used.
- G. Attachment to existing structure: Support from existing floor/roof frame.
- H. Attachment to Wood Construction: Wood screws or lag bolts.
- I. 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.
- J. 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.

K. 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. Converter and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.
- L. 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.
- M. 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 CO/COR.
- 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 DUCT PENETRATIONS

- A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 18 inches high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.
- B. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See section 07 84 00, FIRESTOPPING.

2.14 SPECIAL TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the CO/COR, 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. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.
- D. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the CO/COR.
- E. 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.

2.15 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. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

2.16 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 CO/COR 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 CO/COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to CO/COR for approval.
 - 3. Do not penetrate membrane waterproofing.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.

- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- I. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the CO/COR. Damaged or defective items in the opinion of the CO/COR, shall be replaced.
 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- J. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- K. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- L. Install steam piping expansion joints as per manufacturer's recommendations.
- M. Work in Existing Building:
1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
 2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service

- piping at times that will least interfere with normal operation of the facility.
3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the CO/COR. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the CO/COR for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After CO/COR's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.
- N. Work in Animal Research Areas: Seal all pipe and duct penetrations with silicone sealant to prevent entrance of insects.
- O. Switchgear/Electrical Equipment 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. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 ft.) above the equipment of to ceiling structure, whichever is lower (NFPA 70).
- P. 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 Paragraph 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 CO/COR 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 CO/COR.
- 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.

4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 MECHANICAL DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided by the Contractor after approval for structural integrity by the CO/COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating facility, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Do not permit debris to accumulate in the area to the detriment of plant operation. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VA Medical Center, and Contractor shall follow all directives of the CO/COR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Completely remove all piping, wiring, conduit, and other devices associated with the equipment not to be re-used in the new work. This includes all pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to CO/COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications.

Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

3.6 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.
- B. In addition, the following special conditions apply:
 - 1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
 - 2. Material And Equipment Not To Be Painted Includes:
 - a. Motors, controllers, control switches, and safety switches.
 - b. Control and interlock devices.
 - c. Regulators.
 - d. Pressure reducing valves.
 - e. Control valves and thermostatic elements.
 - f. Lubrication devices and grease fittings.
 - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
 - h. Valve stems and rotating shafts.
 - i. Pressure gauges and thermometers.
 - j. Glass.
 - k. Name plates.
 - 3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
 - 4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
 - 5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
 - 6. Paint shall withstand the following temperatures without peeling or discoloration:
 - a. Condensate and feedwater -- 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.
- 7. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

3.7 IDENTIFICATION SIGNS

- A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16-inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.
- C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.8 MOTOR AND DRIVE ALIGNMENT

- A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

3.9 LUBRICATION

- A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.
- B. Equip all devices with required lubrication fittings or devices. Provide a minimum of one liter (one quart) of oil and 0.5 kg (one pound) of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to CO/COR in unopened containers that are properly identified as to application.
- C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.10 COMMISSIONING

- A. NOT USED.

3.11 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.

3.12 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS and submit the test reports and records to the CO/COR.
- 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.

3.13 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 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 38, "Testing, Adjusting and Balancing" of 2011 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. NOT USED.
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 flowrate from values (design) in the contract documents.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.3 QUALITY ASSURANCE

A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC, Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANTS and STEAM GENERATION, and Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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 CO/COR 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 CO/COR 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 CO/COR. 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. The lead technician shall be certified by AABC or NEBB
- 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 38, 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 2011 ASHRAE Handbook "HVAC Applications", Chapter 38, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop 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 5 percent to plus 10 percent except if the

- air to a space is 100 CFM or less the tolerance would be minus 5 to plus 5 percent.
- f. Heating hot water pumps and hot water coils: Minus 5 percent to plus 5 percent.
 - g. Chilled water and condenser water pumps: Minus 0 percent to plus 5 percent.
 - h. Chilled water coils: Minus 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 CO/COR for one air distribution system (including all fans, three terminal units, three rooms randomly selected by the CO/COR) 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 CO/COR 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. Field Review Report within 30 days.
 - 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):
2011HVAC Applications ASHRAE Handbook, Chapter 38, Testing, Adjusting, and Balancing and Chapter 48, 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 2005Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
2nd Edition 2006Procedural Standards for the Measurement of Sound and Vibration
3rd Edition 2009Procedural Standards for Whole Building Systems Commissioning of New Construction
- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
3rd Edition 2002HVAC 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 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 CO/COR 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

TAB Agency shall perform the leakage test as outlined in "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. The TAB Contractor shall measure existing air and water flow rates associated with existing systems utilized to serve renovated areas as indicated on drawings. Submit report of findings to CO/COR.
- B. Inspect each System to ensure that it is complete including installation and operation of controls. Submit report to CO/COR.
- C. Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB are installed. Provide a report to the CO/COR.

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 CO/COR 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 at no additional cost to the CO/COR.

- D. Do not proceed with the remaining systems until intermediate report is approved by the CO/COR.

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 existing systems and any phased construction completion requirements for the project. Provide TAB reports for all existing HVAC equipment.
- D. Allow 14 days 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 biological safety cabinets.
1. Artificially load air filters by partial blanking to produce air pressure drop of manufacturer's recommended pressure drop.
 2. Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements, are specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
 3. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.

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 Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANTS and STEAM GENERATION. Provide measurements for all rotating HVAC equipment of 373 watts (1/2 horsepower) and larger,

including centrifugal/screw compressors, cooling towers, pumps, fans and motors.

- B. Record initial measurements for each unit of equipment on test forms and submit a report to the CO/COR. 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 CO/COR.

3.9 SOUND TESTING

- A. Perform and record required sound measurements in accordance with Paragraph, QUALITY ASSURANCE in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
 - 1. Take readings in rooms, approximately three (3) to fifteen (15) percent of all rooms.
- 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 2011 ASHRAE Handbook, "HVAC Applications", Chapter 48, 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 ten (10) feet for sound level location.
 - E. Where measured sound levels exceed specified level, the installing contractor or equipment manufacturer shall take remedial action approved by the CO/COR and the necessary sound tests shall be repeated.
 - F. Test readings for sound testing could go higher than 15 percent if determination is made by the CO/COR based on the recorded sound data.

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 CO/COR.

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.

3.12 PHASING

- A. Phased Projects: Testing and Balancing Work to follow project with areas shall be completed per the project phasing. Upon completion of the project all areas shall have been tested and balanced per the contract documents.

- B. Existing Areas: Systems that serve areas outside of the project scope shall not be adversely affected. Measure existing parameters where shown to document system capacity.

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SECTION 23 11 23
FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

Fuel gas systems, including piping, equipment and all necessary accessories as designated in this section. Fuel gas piping for central boiler plants is not included.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Section 07 92 00, JOINT SEALANTS.
- C. Section 09 91 00, PAINTING.
- D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. Section 22 05 23, GENERAL DUTY VALVES FOR PLUMBING PIPING

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Pipe & Fittings.
 - 2. Valves.
 - 3. Strainers.
 - 4. All items listed in Part 2 - Products.
- C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
 - A-A-59617.....Unions, Brass or Bronze Threaded, Pipe
Connections and Solder-Joint Tube Connections
- C. American National Standards Institute (ANSI):
 - American Society of Mechanical Engineers (ASME): (Copyrighted Society)
 - A13.1-(2007)Scheme for Identification of Piping Systems
 - B16.3-(2006).....Malleable Iron Threaded Fittings: Classes 150
and 300 ANSI/ASME
 - B16.9-2007.....Factory-Made Wrought Steel Buttwelding Fittings
ANSI/ASME

- B16.11-2009.....Forged Steel Fittings, Socket-Welding and Threaded ANSI/ASME
- B16.15-2006.....Cast Copper Alloy Threaded Fittings: Classes 125 and 250 ANSI/ASME
- B31.8-2010Gas Transmission and Distribution Piping Systems ANSI/ASME
- D. American Society for Testing and Materials (ASTM):
 - A47-99(2009)Standard Specification for Ferritic Malleable Iron Castings
 - A53-10.....Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless
 - A183-09.....Standard Specification for Carbon Steel Track Bolts and Nuts
 - A536-09.....Standard Specification for Ductile Iron Castings
 - A733-03(2009)e1.....Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
 - B687-99(2005)e1.....Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
- E. National Fire Protection Association (NFPA):
 - 54-2009National Fuel Gas Code
- F. International Code Council
 - IPC 2009International Plumbing Code
 - IFGC 2009.....International Fuel Gas Code
- G. International Association of Plumbing and Mechanical Officials (IAPMO):
 - Uniform Plumbing Code - 2009
 - IS6-06.....Installation Standard
- H. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - SP-72-2010Ball Valves with Flanged or Butt-Welding For General Service
 - SP-110-2010.....Ball Valve Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

1.5 SYSTEM PRESSURE

LPG systems are designed and materials and equipment selected to provide entering government property 7"WC at downstream side of pressure regulators.

PART 2 - PRODUCTS

2.1 FUEL GAS SERVICE CONNECTIONS TO BUILDING

- A. From inside face of exterior wall to a distance of approximately 1500 mm (5 feet) outside of building, use coated piping.
- B. Pipe: Black steel, ASTM A53, Schedule 40. Shop-applied pipe coating shall be one of the following types:
 - 1. Coal Tar Enamel Coating: Exterior of pipe and fittings shall be cleaned, primed with Type B primer and coated with hot-applied coal tar enamel with bonded layer of felt wrap in accordance with AWWA C203. Asbestos felt shall not be used; felt material shall be fibrous glass mat as specified in Appendix Section A2.1 of AWWA C203.
 - 2. Adhesive-thermoplastic Resin Coating: Fed. Spec. L-C-530, Type I
 - 3. Thermosetting Epoxy Coating: Fed. Spec. L-C-530, Type II
 - 4. Field-applied plastic tape material used on pipe joints and for repairing damaged areas of shop-applied coatings, Fed. Spec. L-T-1512, Type I, 10 mils nominal thickness for pipe joints, and Type II, 20 mils nominal thickness for coating repairs.
- C. Holiday Inspections: Procedure for holiday inspection: Holiday Inspection shall be conducted on all coatings to determine the presence and number of discontinuities in those coatings referenced in 2.6/B - 1, 2, 3, and 4 using a Tinker & Rasor model AP/W Holiday Detector. Holiday inspection shall be performed in a manner spelled out in the Tinker & Rasor operating instructions and at a voltage level recommended by the coating manufacturer or applicable NACE International Standard such as RPO 274-93 or RPO 490-90 in the case thermosetting epoxy coating. Holiday Detectors shall be calibrated and supplied with a certificate of calibration from the factory. A calibration of the Holiday Detector shall be performed once every 6 months to verify output voltages are true and correct.
- D. Fittings:
 - 1. Butt weld fittings, wrought steel, ANSI B16.9.
 - 2. Socket weld and threaded fittings forged steel, ANSI B16.11.
 - 3. Grooved End: Ductile iron (ASTM A536, Grade 65-45-12), malleable iron (ASTM A47, Grade 32510), or steel (ASTM A53, Type F or Type E or S, Grade B).
- E. Joints: Welded, ANSI B31.8.

2.2 FUEL GAS PIPING

- A. Pipe: Black steel, ASTM A53, Schedule 40.
- B. Nipples: Steel, ASTM A733, Schedule 40.
- C. Fittings:
 - 1. Sizes 50 mm (2 inch) under ANSI B 16.3 threaded malleable iron.
 - 2. Over 50 mm (2 inch) and up to 100 mm (4 inch) ANSI B16.11 socket welded.
 - 3. Over 100 mm (4 inch) ANSI 16.9 butt welded.
- D. Joints: Provide welded or threaded joints.

2.3 EXPOSED FUEL GAS PIPING

- A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed fuel gas piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
 - 1. Pipe: Fed. Spec. WW-P-351, standard weight
 - 2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
 - 3. Nipples: ASTM B 687, Chromium-plated.
 - 4. Unions: 50 mm (2 inches and smaller) Mss SP-72, SP-110, Brass or Bronze threaded with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
 - 5. Valves: Mss SP-72, SP-110, Brass or bronze with chrome finish.
- B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING

2.4 VALVES

- A. Ball Valve: Bronze body, rated for 1025 kPa at 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.
- B. Gas Vent Cocks: Type 701: Bronze body, tee handle, rated for 205 kPa at 38°C (30 psi at 100°F), ground plug, rated for tight shut-off on fuel gas service.

2.5 WATERPROOFING

- A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.

B. Floors: Provide cast iron stack sleeve with flashing device and a underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.

C. Walls: See detail shown on drawings.

2.6 STRAINERS

A. Provide on high pressure side of pressure reducing valves, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Gas Lines: "Y" type with removable mesh lined brass strainer sleeve.

C. Body: Smaller than 80 mm (3 inches), brass or bronze; 80 mm (3 inches) and larger, cast iron or semi-steel.

2.7 DIELECTRIC FITTINGS

Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

2.8 GAS EQUIPMENT CONNECTORS

Flexible connectors with teflon core, interlocked galvanized steel protective casing, AGA certified design.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International Fuel Gas Code and the following:

1. Install branch piping for fuel gas and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, shall be reamed to full size after cutting.
3. All pipe runs shall be laid out to avoid interference with other work.
4. Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible.
5. Install union and shut-off valve on pressure piping at connections to equipment.
6. Pipe Hangers, Supports and Accessories:
 - a. All piping shall be supported per the International Fuel Gas Code, Chapter No. 4.
 - b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with red

lead or zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

c. Floor, Wall and Ceiling Plates, Supports, Hangers:

- 1) Solid or split unplated cast iron, chrome plated in finished areas.
- 2) All plates shall be provided with set screws.
- 3) Pipe Hangers: Height adjustable clevis type.
- 4) Adjustable Floor Rests and Base Flanges: Steel.
- 5) Concrete Inserts: "Universal" or continuous slotted type.
- 6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
- 7) Riser Clamps: Malleable iron or steel.
- 8) Rollers: Cast iron.
- 9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
- 10) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories.

7. Install cast chrome plated escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

8. Penetrations:

- a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Completely fill and seal clearances between piping and openings with the fire stopping materials.
- b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

B. Piping shall conform to the following:

1. Fuel Gas:

- a. Entire fuel gas piping installation shall be in accordance with requirements of NFPA 54.
- b. Provide fuel gas piping with plugged drip pockets at low points.

3.2 CLEANING OF SYSTEM AFTER INSTALLATION

Clean all piping systems to remove all dirt, coatings and debris.

Remove all valves, controls etc., and reinstall after piping system has been cleaned.

3.3 TESTS

- A. General: Test system either in its entirety or in sections after system is installed or cleaned.
- B. Test shall be made in accordance with Section 406 of the International Fuel Gas Code. The system shall be tested at a minimum of 1.5 times maximum working pressure, but not less than 3 psig (20 kPa) gage), 100 psig (690 kPa).

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SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field refrigerant piping for direct expansion HVAC systems. Field refrigerant piping and associated drain and condenser water piping for condensers, including required pipe insulation.
- B. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The schematic piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.
- C. Definitions:
 - 1. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
 - a. Low side means the parts of a refrigerating system subjected to evaporator pressure.
 - b. High side means the parts of a refrigerating system subjected to condenser pressure.
 - 2. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 449 degrees C (840 degrees F) but less than the melting temperatures of the joined parts.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

1.3 QUALITY ASSURANCE

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.
- C. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.

- D. Products shall comply with UL 207 "Refrigerant-Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrical Operated Valves."

1.4 SUBMITTALS

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Shop Drawings:
1. Complete information for components noted, including valves and refrigerant piping accessories, clearly presented, shall be included to determine compliance with drawings and specifications for components noted below:
 - a. Tubing and fittings
 - b. Valves
 - c. Strainers
 - d. Moisture-liquid indicators
 - e. Filter-driers
 - f. Flexible metal hose
 - g. Liquid-suction interchanges
 - h. Oil separators (when specified)
 - i. Gages
 - j. Pipe and equipment supports
 - k. Refrigerant and oil
 - l. Pipe/conduit roof penetration cover
 - m. Soldering and brazing materials
 2. Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.
- C. Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.
- D. Design Manual: Furnish two copies of design manual of refrigerant valves and accessories.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating, and Refrigeration Institute (ARI/AHRI):
495-1999 (R2002).....Standard for Refrigerant Liquid Receivers

- 730-2005.....Flow Capacity Rating of Suction-Line Filters
and Suction-Line Filter-Driers
- 750-2007.....Thermostatic Refrigerant Expansion Valves
- 760-2007.....Performance Rating of Solenoid Valves for Use
with Volatile Refrigerants
- C. American Society of Heating Refrigerating and Air Conditioning
Engineers (ASHRAE):
 - ANSI/ASHRAE 15-2007.....Safety Standard for Refrigeration Systems
(ANSI)
 - ANSI/ASHRAE 17-2008.....Method of Testing Capacity of Thermostatic
Refrigerant Expansion Valves (ANSI)
 - 63.1-95 (RA 01).....Method of Testing Liquid Line Refrigerant
Driers (ANSI)
- D. American National Standards Institute (ANSI):
 - ASME (ANSI)A13.1-2007...Scheme for Identification of Piping Systems
 - Z535.1-2006.....Safety Color Code
- E. American Society of Mechanical Engineers (ASME):
 - ANSI/ASME B16.22-2001 (R2005)
Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ANSI)
 - ANSI/ASME B16.24-2006 Cast Copper Alloy Pipe Flanges and Flanged
Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500 (ANSI)

 - ANSI/ASME B31.5-2006....Refrigeration Piping and Heat Transfer
Components (ANSI)
 - ANSI/ASME B40.100-2005..Pressure Gauges and Gauge Attachments
 - ANSI/ASME B40.200-2008..Thermometers, Direct Reading and Remote Reading
- F. American Society for Testing and Materials (ASTM)
 - A126-04.....Standard Specification for Gray Iron Castings
for Valves, Flanges, and Pipe FittingsB32-08
Standard Specification for Solder Metal
 - B88-03.....Standard Specification for Seamless Copper
Water Tube
 - B88M-05.....Standard Specification for Seamless Copper
Water Tube (Metric)
 - B280-08.....Standard Specification for Seamless Copper Tube
for Air Conditioning and Refrigeration Field
Service

G. American Welding Society, Inc. (AWS):

Brazing Handbook

A5.8/A5.8M-04.....Standard Specification for Filler Metals for
Brazing and Braze Welding

H. Federal Specifications (Fed. Spec.)

Fed. Spec. GG

I. Underwriters Laboratories (U.L.):

U.L.207-2009.....Standard for Refrigerant-Containing Components
and Accessories, Nonelectrical

U.L.429-99 (Rev.2006)...Standard for Electrically Operated Valves

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Refrigerant Piping: For piping up to 100 mm (4 inch) use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer. For piping over 100 mm (4 inch) use A53 Black SML steel.
- B. Water and Drain Piping: Copper water tube, ASTM B88M, Type B or C (ASTM B88, Type M or L). Optional drain piping material: Schedule 80 flame retardant Polypropylene plastic.
- C. Fittings, Valves and Accessories:
1. Copper fittings: Wrought copper fittings, ASME B16.22.
 - a. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
 - b. Solder Joints, water and drain: 95-5 tin-antimony, ASTM B32 (95TA).
 2. Steel fittings: ASTM wrought steel fittings.
 - a. Refrigerant piping - Welded Joints.
 3. Flanges and flanged fittings: ASME B16.24.
 4. Refrigeration Valves:
 - a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.
 - b. Pressure Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; UL listed. Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.

- c. Solenoid Valves: Comply with ARI 760 and UL 429, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location and normally closed.
 - d. Thermostatic Expansion Valves: Comply with ARI 750. Brass body with stainless-steel or non-corrosive non ferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.
 - e. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end connections. Direction of flow shall be legibly and permanently indicated on the valve body.
5. Strainers: Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines DN 25 (NPS 1) and smaller, 60 mesh in liquid lines larger than DN 25 (NPS 1), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.
6. Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
7. Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown on drawings. Conform to ARI Standard 730 and ASHRAE Standard 63.1. Heavy gage steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter driers with replaceable filters shall be furnished with one spare element of each type and size.

8. Flexible Metal Hose: Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends. Provide in suction and discharge piping of each compressor.

2.2 GAGES

- A. Temperature Gages: Comply with ASME B40.200. Industrial-duty type and in required temperature range for service in which installed. Gages shall have Celsius scale in 1-degree (Fahrenheit scale in 2-degree) graduations and with black number on a white face. The pointer shall be adjustable. Rigid stem type temperature gages shall be provided in thermal wells located within 1525 mm (5 feet) of the finished floor. Universal adjustable angle type or remote element type temperature gages shall be provided in thermal wells located 1525 to 2135 mm (5 to 7 feet) above the finished floor. Remote element type temperature gages shall be provided in thermal wells located 2135 mm (7 feet) above the finished floor.
- B. Vacuum and Pressure Gages: Comply with ASME B40.100 and provide with throttling type needle valve or a pulsation dampener and shut-off valve. Gage shall be a minimum of 90 mm (3-1/2 inches) in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Each gage range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.
 1. Suction: 101 kPa (30 inches Hg) vacuum to 1723 kPa (gage) (250 psig).
 2. Discharge: 0 to 3445 kPa (gage) (0 to 500 psig).

2.3 THERMOMETERS AND WELLS

- A. Refer to specification Section 23 21 13, HYDRONIC PIPING.

2.4 PIPE SUPPORTS

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

2.5 ELECTRICAL HEAT TRACING SYSTEM

- A. Refer to specification Section 23 21 13, HYDRONIC PIPING. Provide for freezer unit cooler drain piping.

2.6 REFRIGERANTS AND OIL

- A. Provide EPA approved refrigerant and oil for proper system operation.

2.7 PIPE/CONDUIT ROOF PENETRATION COVER

- A. Prefabricated Roof Curb: Galvanized steel or extruded aluminum 300 mm (12 inches) overall height, continuous welded corner seams, treated wood nailer, 38 mm (1-1/2 inch) thick, 48 kg/cu.m (3 lb/cu.ft.) density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs shall be constructed for pitched roof or ridge mounting as required to keep top of curb level.
- B. Penetration Cover: Galvanized sheet metal with flanged removable top. Provide 38 mm (1-1/2 inch) thick mineral fiber board insulation.
- C. Flashing Sleeves: Provide sheet metal sleeves for conduit and pipe penetrations of the penetration cover. Seal watertight penetrations.

2.8 PIPE INSULATION FOR DX HVAC SYSTEMS

Refer to specification Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5
 - 1. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
 - 2. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
 - 3. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.
 - 4. Use copper tubing in protective conduit when installed below ground.
 - 5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.
- B. Joint Construction:

1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
 - a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
 - b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
 - c. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
 - d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.
- C. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.
- D. Pipe relief valve discharge to outdoors for systems containing more than 45 kg (100 lbs) of refrigerant.
- E. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, and BOILER PLANT INSULATION.
- F. Seismic Bracing: Refer to specification Section 13 05 41, SEISMIC RESTRAINTS REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS, for bracing of piping in seismic areas.

3.2 PIPE AND TUBING INSULATION

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

3.3 SIGNS AND IDENTIFICATION

- A. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.
- B. Systems containing more than 50 kg (110 lb) of refrigerant shall be provided with durable signs, in accordance with ANSI A13.1 and ANSI

Z535.1, having letters not less than 13 mm (1/2 inch) in height designating:

1. Valves and switches for controlling refrigerant flow, the ventilation and the refrigerant compressor(s).
2. Signs on all exposed high pressure and low pressure piping installed outside the machinery room, with name of the refrigerant and the letters "HP" or "LP."

3.4 FIELD QUALITY CONTROL

Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.

- A. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of CO/COR. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.
 1. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.
 2. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 20 degrees C (68 degrees F) minimum.
- B. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gage on the outlet side. The pressure

relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.5 SYSTEM TEST AND CHARGING

- A. System Test and Charging: As recommended by the equipment manufacturer or as follows:
1. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 70 kPa (10 psi) gage. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.
 2. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.
 3. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in mPa (microns). Pull the system down to 665 mPa (500 microns) 665 mPa (2245.6 inches of mercury at 60 degrees F) and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

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SECTION 23 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 1-66.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- G. 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 261, 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 210.
 - 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 shall show the design air volume and static pressure. Select the fan motor HP by increasing the fan BHP by 10 percent to account for the drive losses and field conditions.
 - 2. Select the fan operating point as follows:
 - a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point
 - b. Air Foil, Backward Inclined, or Tubular: At or near the peak static efficiency
- G. Safety Criteria: Provide manufacturer's standard screen on fan inlet and discharge where exposed to operating and maintenance personnel.
- H. Corrosion Protection:
 - 1. Except for fans in fume hood exhaust service, 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.
2. Fans for general purpose fume hoods, or chemical hoods, and radioisotope hoods shall be constructed of materials compatible with the chemicals being transported in the air through the fan.
- I. Spark resistant construction: If flammable gas, vapor or combustible dust is present in concentrations above 20% of the Lower Explosive Limit (LEL), the fan construction shall be as recommended by AMCA's Classification for Spark Resistant Construction. Drive set shall be comprised of non-static belts for use in an explosive.

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.
 - b. Tubular Centrifugal Fans.
 - c. Up-blast kitchen hood exhaust fans.
 - d. Industrial fans.
 - e. Utility fans and vent sets.
 3. Prefabricated roof curbs.
 4. Power roof and wall ventilators.
 5. Centrifugal ceiling fans.
- C. Certified Sound power levels for each fan.
- D. Motor ratings types, electrical characteristics and accessories.
- E. Roof curbs.
- F. Belt guards.
- G. Maintenance and Operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
- H. Certified fan performance curves for each fan showing cubic feet per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Movement and Control Association International, Inc. (AMCA):

- 99-86.....Standards Handbook
- 210-06.....Laboratory Methods of Testing Fans for
Aerodynamic Performance Rating
- 261-09.....Directory of Products Licensed to bear the AMCA
Certified Ratings Seal - Published Annually
- 300-08.....Reverberant Room Method for Sound Testing of
Fans

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

- B117-07a.....Standard Practice for Operating Salt Spray
(Fog) Apparatus
- D1735-08.....Standard Practice for Testing Water Resistance
of Coatings Using Water Fog Apparatus
- D3359-08.....Standard Test Methods for Measuring Adhesion by
Tape Test
- G152-06.....Standard Practice for Operating Open Flame
Carbon Arc Light Apparatus for Exposure of Non-
Metallic Materials
- G153-04.....Standard Practice for Operating Enclosed Carbon
Arc Light Apparatus for Exposure of Non-
Metallic Materials

D. National Fire Protection Association (NFPA):

- NFPA 96-08.....Standard for Ventilation Control and Fire
Protection of Commercial Cooking Operations

E. National Sanitation Foundation (NSF):

- 37-07.....Air Curtains for Entrance Ways in Food and Food
Service Establishments

F. Underwriters Laboratories, Inc. (UL):

- 181-2005.....Factory Made Air Ducts and Air Connectors

1.6 EXTRA MATERIALS

- A. Provide one additional set of belts for all belt-driven fans.

PART 2 - PRODUCTS

2.1 FAN SECTION (CABINET FAN)

Refer to specification Section 23 73 00, INDOOR CENTRAL-STATION AIR-
HANDLING UNITS.

2.2 CENTRIFUGAL FANS

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY
ASSURANCE. Record factory vibration test results on the fan or furnish
to the Contractor.

- B. Fan arrangement, unless noted or approved otherwise:
1. DWD1 fans: Arrangement 3.
 2. SWS1 fans: Arrangement 1, 3, 9 or 10, except for fume hood (H7 or H13) exhaust fans Arrangement 3 shall not be acceptable.
- C. 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 inches) wire mesh screens for fan inlets without duct connections.
 2. Wheel: Steel plate with die formed blades welded or riveted in place, factory balanced statically and dynamically.
 3. Shaft: Designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fans class.
 4. Bearings: Heavy duty ball or roller type sized to produce a B10 life of not less than 50,000 hours, and an average fatigue life of 200,000 hours. Extend filled lubrication tubes for interior bearings or ducted units to outside of housing.
 5. Belts: Oil resistant, non-sparking and non-static.
 6. Belt Drives: Factory installed with final alignment belt adjustment made after installation.
 7. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15HP, fixed pitch for use with motors larger than 15HP. Select pulleys so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
 8. Motor, adjustable motor base, drive and guard: Furnish from factory with fan. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC 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.

2.3 POWER ROOF VENTILATOR

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE.
- B. Type: Centrifugal fan, backward inclined blades. Provide down-blast or up-blast type as indicated.
- C. Construction: Steel or aluminum, completely weatherproof, for curb mounting, exhaust cowl or entire drive assembly readily removable for servicing, aluminum bird screen on discharge, UL approved safety disconnect switch, conduit for wiring, vibration isolators for wheel, motor and drive assembly. Provide self acting back draft damper. Provide electric motor operated damper where indicated.
- D. Motor and Drive: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Bearings shall be pillow block ball type with a minimum L-50 life of 200,000 hours. Motor shall be located out of air stream.
- E. Prefabricated Roof Curb: As specified in paragraph 2.3 of this section.
- F. Up-blast Type: Top discharge exhauster, motor out of air stream. For kitchen hood exhaust applications, provide grease trough on base and threaded drain. The mounting height of the kitchen up-blast exhaust fan shall be in compliance with NFPA 96. (Provide vented curb extension if required to maintain required clearances.)

2.4 POWER WALL VENTILATOR

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE.
- B. Type: Centrifugal fan, backward inclined blades.
- C. Construction: Steel or aluminum, completely weatherproof, for wall mounting, exhaust cowl or entire drive assembly readily removable for servicing, aluminum bird screen on discharge, UL approved safety disconnect switch, conduit for wiring, vibration isolators for wheel, motor and drive assembly. Provide self acting back draft damper.
- D. Motor and Drive: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION. Bearings shall be pillow block ball type with a minimum L-50 life of 200,000 hours. Motor shall be located out of air stream.

2.5 CENTRIFUGAL CEILING FANS (SMALL CABINET FAN)

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE.

- B. Steel housing, baked enamel finish, direct connected fan assembly, attached grille. Provide gravity back draft assembly, aluminum wall cap and bird or insect screen. Provide electric motor operated damper where indicated.
- C. Acoustical Lining: 12.5 mm (1/2 inch) thick mineral fiber, dark finish. Comply with UL 181 for erosion.
- D. Motor: Shaded pole or permanent split capacitor, sleeve bearings, supported by steel brackets in combination with rubber isolators.
- E. Ceiling Grille, (Where indicated): White plastic egg crate design, 80 percent free area.
- F. Control: Provide solid state speed control (located at unit) for final air balancing.

2.6 PROPELLER FANS

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE.
- B. Belt-driven or direct-driven fans as indicated on drawings.
- C. Square steel panel, deep drawn venturi, arc welded to support arms and fan/motor support brackets, baked enamel finish. Provide wall collar for thru-wall installations.
- D. Motor, Motor Base and Drive: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION. Motor shall be totally enclosed type.
- E. Wall Shutter: Fan manufacturer's standard, steel frame, aluminum blades, heavy duty stall type electric damper motor, spring closed.
- F. Wire Safety Guards: Provide on exposed inlet and outlet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fan, motor and drive in accordance with manufacturer's instructions.
- B. Align fan and motor sheaves to allow belts to run true and straight.
- C. Bolt equipment to curbs with galvanized lag bolts.
- D. Install vibration control devices as shown on drawings and specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

3.2 PRE-OPERATION MAINTENANCE

- A. Lubricate bearings, pulleys, belts and other moving parts with manufacturer recommended lubricants.

- B. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.
- C. Clean fan interiors to remove foreign material and construction dirt and dust.

3.3 START-UP AND INSTRUCTIONS

- A. Verify operation of motor, drive system and fan wheel according to the drawings and specifications.
- B. Check vibration and correct as necessary for air balance work.
- C. After air balancing is complete and permanent sheaves are in place perform necessary field mechanical balancing to meet vibration tolerance in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

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SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Roof Curbs
- B. Air Outlets and Inlets: Diffusers, Registers, and Grilles.

1.2 RELATED WORK

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. 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. Air intake/exhaust hoods.
 - 2. 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):
 - ASCE7-05.....Minimum Design Loads for Buildings and Other Structures
- D. American Society for Testing and Materials (ASTM):
 - A167-99 (2004).....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
 - B209-07.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

- E. National Fire Protection Association (NFPA):
90A-09.....Standard for the Installation of Air
Conditioning and Ventilating Systems
- F. Underwriters Laboratories, Inc. (UL):
181-08.....UL Standard for Safety Factory-Made Air Ducts
and Connectors

PART 2 - PRODUCTS

2.1 GRAVITY INTAKE/EXHAUST VENTILATORS (ROOF MOUNTED)

- A. Aluminum, ASTM B209, louvered, spun, or fabricated using panel sections with roll-formed edges, 13 mm (1/2 inch) mesh aluminum welded wire bird screen, with gravity or motorized dampers where shown, accessible interior, designed for wind velocity specified in Paragraph 3.3.
 - 1. Spun Intake/Exhaust Ventilators: Spun aluminum structural components shall be constructed of minimum 1.3 mm (16 Gauge) marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The spun aluminum baffle shall have a rolled bead for added strength.
 - 2. Louvered Intake/Exhaust Hoods: Louvered hood constructed from 0.081 Gauge extruded aluminum tiers welded to a minimum 3.3 mm (8 Gauge) aluminum support structure. The aluminum hood shall be constructed of a minimum 0.064 marine alloy aluminum and provided with a layer of anti-condensate coating. The aluminum base shall have continuously welded curb cap corners for maximum leak protection.
 - 3. Low Silhouette Intake/Exhaust Ventilator: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 1.60 mm (14 Gauge) marine alloy aluminum, bolted to a minimum 3.25 mm (8 Gauge) aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. Birdscreen constructed of 13 mm (1/2 inch) mesh shall be mounted across the relief opening.
- B. See ventilator schedule on the drawings. Sizes shown on the drawings designate throat size. Area of ventilator perimeter opening shall be not less than the throat area.
- C. Dampers for Gravity Ventilators without Duct Connection: Construct damper of the same material as the ventilator and of the design to completely close opening or remain wide open. Hold damper in closed

position by a brass chain and catch. Extend chains 300 mm (12 inches) below and engage catch when damper is closed.

D. See paragraph 3.3 for Intake/Exhaust exposed to high wind velocities.

E. Provide Roof Curb by unit manufacturer. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION for additional requirements.

2.2 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.

2.3 AIR OUTLETS AND INLETS

A. Materials:

1. Steel or aluminum.
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.

2. Linear Bar Grilles and Diffusers: Extruded aluminum, manufacturer's standard finish, and positive holding concealed fasteners.
 - a. Margin Frame: Flat, 20 mm (3/4 inch) wide.
 - b. Bars: Minimum 5 mm (3/16 inch) wide by 20 mm (3/4 inch) deep, zero deflection unless otherwise shown. Bar spacing shall be a minimum of 3 mm (1/8 inch) on center. Reinforce bars on 450 mm (18 inch) center for sidewall units and on 150 mm (6 inch) center for units installed in floor or sills.
 - c. Provide opposed blade damper and equalizing or control grid where shown.
3. Operating Room Air Distribution Devices:
 - a. Devices shall consist of a non-aspirating perforated panel center air supply providing downward airflow over the operating table and fixed nonadjustable multiple slot perimeter panels surrounding the operating table area to provide an air curtain which shall be projected outward from the operating table area at not less than a five degree angle nor more than a 15 degree angle. Velocity of air distribution at operating table height shall not exceed 12 m/min (40 feet per minute) for the center supply or 15 m/min (50 feet per minute) for the air curtain. Perforated pressure plates shall be provided over the perimeter and center air distribution faces to equalize pressure and airflow throughout the system.
 - b. All components of the system inside the operating room shall be fabricated of 1.0 mm (20 Gauge) thick 18-8 stainless steel (ASTM A167), No. 4 finish, and outside the operating room shall be of the manufacturer's standard aluminum finish. All distribution components and pressure plates shall be attached to the face panels at both the perimeter and center. The face panels shall be retained with 1/4 turn fasteners. Plenums shall be supplied by the manufacturer and shall be sized to permit them to be easily wiped out by hand with germicidal solution for sterilization purposes and all horizontal corners of the plenums shall have a minimum radius of 20 mm (3/4 inch). Connecting elbows shall be radialized and be sized to permit manual sterilization of the plenums.

4. Supply Registers: Double deflection type with horizontal face bars and opposed blade damper with removable key operator.
 - a. Margin: Flat, 30 mm (1-1/4 inches) wide.
 - b. Bar spacing: 20 mm (3/4 inch) maximum.
 - c. Finish: Off white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded with manufacturer's standard finish.
5. Supply Grilles: Same as registers but without the opposed blade damper.
- D. Return and Exhaust Registers and Grilles: Provide opposed blade damper without removable key operator for registers.
 1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded aluminum with manufacturer's standard aluminum finish.
 2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 30 mm (1-1/4 inch) margin.
 3. Perforated Face Type: To match supply units.
 4. 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. Egg Crate Grilles: Aluminum or Painted Steel 1/2 by 1/2 by 1/2 inch grid providing 90% free area.
 - a. Heavy extruded aluminum frame shall have countersunk screw mounting. Unless otherwise indicated, register blades and frame shall have factory applied white finish.
 - b. Grille shall be suitable for duct or surface mounting as indicated on drawings. All necessary appurtenances shall be provided to allow for mounting.
- E. Acoustic Transfer Grille: Aluminum, suitable for partition or wall mounting.

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: 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 CO/COR. 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

- - - E N D - - -

SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 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, switchgear, panelboards, motor control centers, 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 power company's system) shall conform to the power company's requirements. Coordinate fuses, circuit breakers and relays with the power company's system, and obtain power company 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 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 or device of a kind mentioned which:
 - a. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.
 - b. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.
2. Labeled; equipment or device is when:
 - a. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
 - b. The laboratory makes periodic inspections of the production of such equipment.
 - c. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.
3. Certified; equipment or product is 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 Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
 - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the CO/COR a minimum of 15 working days prior to the manufacturers making the factory tests.
 - 2. Four copies of certified test reports containing all test data shall be furnished to the CO/COR prior to final inspection and not more than 90 days after completion of the tests.
 - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.6 EQUIPMENT REQUIREMENTS

Where variations from the contract requirements are requested in accordance with 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.

1.7 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 CO/COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
 3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.8 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 CO/COR. 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 Director of the Medical Center.
- D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times.
- E. 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.
- F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working spaces shall not be less than specified in the NEC for all voltages specified.
- C. Inaccessible Equipment:
 - 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 - 2. "Conveniently accessible" is defined as being capable of being reached 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.

1.10 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, switchgear and motor control assemblies, control devices and other significant 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.

1.11 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or

assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION _____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.

- d. Installation and maintenance instructions.
 - e. Safety precautions.
 - f. Diagrams and illustrations.
 - g. Testing methods.
 - h. Performance data.
 - i. Lubrication schedule including type, grade, temperature range, and frequency.
 - j. 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.
 - k. 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 CO/COR 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, outlet box, manual motor starter, device plate, engraved nameplate, wire and cable splicing and terminating material and single pole molded case circuit breaker.
 - 6. Each type of light fixture specified in Section 26 51 00, INTERIOR LIGHTING or shown on the drawings.

1.12 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.

1.13 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 CO/COR at least 30 days prior to the planned training.

END OF SECTION

SECTION 26 05 21

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of new low voltage power and lighting wiring.

1.2 RELATED WORK

- A. General electrical requirements that are common to more than one section in 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. 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 CO/COR 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)
- C. National Fire Protection Association (NFPA):
 - 70-05.....National Electrical Code (NEC)
- D. 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. Direct burial: UF or USE shall be in accordance with UL 493.
 - 3. 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	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

- 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 coordinates for a final color coding with the CO/COR.
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 CO/COR.
 - 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 Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

3.3 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 EXISTING 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.

3.7 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.

END OF SECTION

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.

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.

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 CO/COR:
 - 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):
 - 44-2005Thermoset-Insulated Wires and Cables
 - 83-2003Thermoplastic-Insulated Wires and Cables
 - 467-2004Grounding and Bonding Equipment
 - 486A-486B-2003Wire 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 3/4 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 mm² (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.
 - 3. Isolation transformers and isolated power systems shall not be system grounded.
- 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 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. Switchgear, Switchboards, Unit Substations, and Motor Control Centers:
 - 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. 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.

- F. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- G. 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.
- H. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
- I. 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.
- J. 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.
- K. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

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.
- 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.

3.5 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 Government. 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.

END OF SECTION

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 new conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems. New 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. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- B. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- C. 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. Layout of required conduit penetrations through structural elements.
 - 2. 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 CO/COR 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 (1/2 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 aluminum: Shall Conform to UL 6A, ANSI C80.5.
 - 3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
 - 4. 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.
 - 5. Flexible galvanized steel conduit: Shall Conform to UL 1.
 - 6. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
 - 7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
 - 8. 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. Rigid aluminum conduit fittings:
- a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
 - b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
 - c. Set screw fittings: Not permitted for use with aluminum conduit.
3. 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.
- 4. Flexible steel conduit fittings:
 - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp type, with insulated throat.
- 5. Liquid-tight flexible metal conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and 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.
- 6. 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 CO/COR 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 CO/COR 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, 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. Do not use aluminum conduits in wet locations.
 12. 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 CO/COR.

3.3 CONCEALED WORK INSTALLATION

- A. Furred or Suspended Ceilings and in Walls:
1. Conduit for conductors above 600 volts:
 - a. Rigid steel or rigid aluminum.
 - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
 2. 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.
 3. Align and run conduit parallel or perpendicular to the building lines.

4. 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.
5. 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 or rigid aluminum.
 2. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
- C. Conduit for Conductors 600 volts and below:
 1. Rigid steel, IMC, rigid aluminum, 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.

3.5 WET OR DAMP LOCATIONS

- A. Unless otherwise shown, use conduits of rigid steel or IMC.
- B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces building exterior walls, roofs) or similar spaces.
- C. Unless otherwise shown, use rigid steel or IMC conduit within 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.

3.6 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. 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.

3.7 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.

3.8 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.

3.9 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.

END OF SECTION

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SECTION 26 05 41
UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of 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 11, 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 CO/COR 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 CO/COR:
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 2003Standard Specification for joints concrete
pipe, Manholes and Precast Box using performed
flexible Joint sealants.
- C. Institute of Electrical and Electronic Engineers (IEEE):
C2-2002National 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. DUCTS:

A. Number and sizes shall be as shown on drawings.

B. Ducts (concrete encased):

1. Plastic Duct:

a. 651A Schedule 40 PVC.

b. Duct shall be suitable for use with 90 degree C rated conductors.

2. Conduit Spacers: Prefabricated plastic.

C. Ducts (direct burial):

1. Plastic duct:

a. NEMA TC2 and TC3

b. UL 651, 651A and 651B, Schedule 40.

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.

2.4 GROUNDING

A. Rods: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL
SYSTEMS and UL 467

B. Ground Wire: Stranded bare copper 16 mm² (6 AWG) minimum.

2.5 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".

2.6 PULL ROPE:

Plastic with 890N (200 pound) minimum tensile strength.

PART 3 - EXECUTION

3.2 TRENCHING

- A. Refer to Section 31 20 11, 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, handholes, 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 ($\frac{1}{4}$ inch) at the top and a depth of 6 mm ($\frac{1}{4}$ 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.
- 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 ($\frac{1}{2}$ 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 CO/COR.
- 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.

END OF SECTION

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 CO/COR.
- D. Certifications:
 - 1. Two weeks prior to final inspection, submit four copies of the following certifications to the CO/COR:

- a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Green Seal (GS):
GC-12.....Occupancy Sensors
- C. Illuminating Engineering Society of North America (IESNA):
IESNA LM-48.....Guide for Calibration of Photoelectric Control Devices
- D. Underwriters Laboratories, Inc. (UL):
20.....Standard for General-Use Snap Switches
773.....Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting
773ANonindustrial Photoelectric Switches for Lighting Control
98.....Enclosed and Dead-Front Switches
917.....Clock Operated Switches

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

- A. Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: SPST.
 - 2. Contact Rating: 20-A ballast load, 120/240-V ac.
 - 3. Astronomical Clock: Capable of switching a load on at sunset and off at sunrise, and automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Additionally, it shall be programmable to a fixed on/off weekly schedule.
 - 4. Battery Backup: For schedules and time clock.

2.2 ELECTROMECHANICAL-DIAL TIME SWITCHES

- A. Electromechanical-dial time switches; complying with UL 917.
 - 1. Contact Configuration: SPST.
 - 2. Contact Rating: 20-A ballast load, 120/240-V ac.
 - 3. Wound-spring reserve carryover mechanism to keep time during power failures.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Solid state, with SPST 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.

2.4 INDOOR OCCUPANCY SENSORS

- A. Wall- or ceiling-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.
- 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: as scheduled on drawings.

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. Locate light level sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the scheduled light level at the typical work plane for that area.
- F. 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.

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.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of panelboards.
- B. All panelboards are in place. This section addresses any new and/or modifications to the panelboards.

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 and outlet 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 for possible ground fault currents.

1.3 SUBMITTALS

- A. All panelboards are in place so no panelboard submittals are required.

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):
 - 70-2005National 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. All panelboards are in place and they meet the requirements.

2.2 CABINETS AND TRIMS

A. All cabinets are in place and they meet the requirements.

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. New 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.

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 terminal as indicated on the drawings.

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

2.4 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

- A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.
- B. Enclosures are to be of the NEMA types shown on the drawings. Where the types are not shown, they are to be the NEMA type most suitable for the environmental conditions where the breakers are being installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install an updated typewritten schedule of circuits in each panelboard after being submitted to and approved by the CO/COR. 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.
- B. 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.
- C. Provide ARC flash identification per NFPA 70E.

END OF SECTION

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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 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 CO/COR: 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 CO/COR: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, 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 basic designation only.
- B. National Fire Protection Association (NFPA):
 - 70-02.....National Electrical Code (NEC)

- C. National Electrical Manufacturers Association (NEMA):
 - WD 1-99.....General Color Requirements for Wiring Devices
 - WD 6-02Wiring Devices - Dimensional Requirements
- D. Underwriter's Laboratories, Inc. (UL):
 - 5-96.....Surface Metal Raceways and Fittings
 - 20-00.....General-Use Snap Switches
 - 231-98.....Power Outlets
 - 467-93.....Grounding and Bonding Equipment
 - 498-01.....Attachment Plugs and Receptacles
 - 943-03.....Ground-Fault Circuit-Interrupters

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall be duplex receptacles and shall be single phase, 20 ampere, 120 volts, 2-pole, 3-wire, and conform to the NEMA 5-20R configuration in NEMA WD 6 (unless noted otherwise on drawings). 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 gray in color.
 - 2. Safety Type Duplex Receptacles:
 - a. Bodies shall be gray in color.
 - b. Shall be as above with the following additional requirements.
 - 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. Shall be installed in the following locations:
 - 1) Psychiatric rooms and wards, O.T. areas, PMR areas and other locations where psychiatric patients are not under constant supervision.
 - 2) Housekeeping quarters, buildings, waiting areas and lobbies where children might be present.
 - 3. Isolated Ground Type Duplex Receptacles:
 - a. Bodies shall be orange in color.
 - b. Shall be UL listed as "Isolated Ground".
- B. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete with appropriate cord grip plug. Devices shall meet UL 231.
- C. 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 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 gray in color unless otherwise specified. The rocker type switch is not acceptable and will not be approved.
 - 1. Switches installed in hazardous areas shall be explosion proof type in accordance with the NEC and as shown on the drawings.
 - 2. 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 plaster ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
 - 3. Shall be color coded for current rating, listed by Underwriters Laboratories, Inc., and meet the requirements of NEMA WD 1, Heavy-Duty and UL 20.
 - 4. Ratings:
 - a. 120 volt circuits: 20 amperes at 120-277 volts AC.
 - b. 277 volt circuits: 20 amperes at 120-277 volts AC.
 - 5. The switches shall be mounted on the striker plate side of doors.
 - 6. Incorporate barriers between switches with multigang outlet boxes where required by the NEC.
 - 7. Switches connected to isolated type electrical power systems shall be double pole.
 - 8. All toggle switches shall be of the same manufacturer.

2.3 WALL PLATES

- A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.
- B. Color shall be stainless steel 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 WD1.
- 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.

2.4 SURFACE MULTIPLE-OUTLET ASSEMBLIES

- A. Assemblies shall conform to the requirements of NFPA 70 and UL 5.
- B. Shall have the following features:

1. Enclosures:
 - a. Thickness of steel shall be not less than 1 mm (0.040 inch) steel for base and cover. Nominal dimension shall be 40 by 70 mm (1-1/2 by 2-3/4 inches) with inside cross sectional area not less than 2250 square mm (3.5 square inches). The enclosures shall be thoroughly cleaned, phosphatized and painted at the factory with primer and the manufacturer's standard baked enamel or lacquer finish.
2. Receptacles shall be duplex. See paragraph 'RECEPTACLES' in this section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
3. Unless otherwise shown on drawings, spacing of the receptacles along the strip shall be 600 mm (24 inches) on centers.
4. Wires within the assemblies shall be not less than No. 12 AWG copper, with 600 volt ratings.
5. Installation fittings shall be designed for the strips being installed including bends, offsets, device brackets, inside couplings, wire clips, and elbows.
6. Bond the strips to the conduit systems for their branch supply circuits.

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.

END OF SECTION

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of the interior lighting systems.
- B. All rough-ins, backboxes, and interior lighting fixtures are in place. This section addresses the replacement of interior lighting fixtures as called out in the contract documents.

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 27 26, WIRING DEVICES: Wiring devices used as part of the lighting systems.
- 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

- A. 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, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, lenses, louvers, lamps, and controls.
 - 3. When catalog data and/or shop drawings for fluorescent fixtures are submitted for approval, photometric data from an independent testing laboratory shall be included with the submittal, indicating average brightness and efficiency of the fixture, as specified in specification or as shown on the drawings. Coefficient of utilization data will not be considered a suitable substitute.
- 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 CO/COR.

E. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the CO/COR:
 - a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.
 - b. Include with shop drawings, certification from the manufacturers that all electronic high-frequency ballasts meet the transient protection required by IEEE C62.41, Cat. A. Include with initial shop drawing submittal.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):
 - C78.1-91.....Fluorescent Lamps - Rapid-Start Types -
Dimensional and Electrical Characteristics
 - C78.2-91.....Fluorescent Lamps - Preheat-Start Types -
Dimensional and Electrical Characteristics
 - C78.3-91.....Fluorescent Lamps - Instant Start and Cold-
Cathode Types - Dimensional and Electrical
Characteristics
 - C78.376-91.....Chromaticity of Fluorescent Lamps (ANSI/NEMA
C78/376-96)
- C. Certified Ballast Manufacturers Association (CBM):
Requirements for Ballast Certification.
- D. Institute of Electrical and Electronic Engineers (IEEE):
 - C62.41-91.....Recommended Practice on Surge Voltage in Low
Voltage AC Power Circuits
- E. National Fire Protection Association (NFPA):
 - 70-02.....National Electrical Code (NEC)
 - 101-00.....Life Safety Code
- F. 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
- G. 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
 - 1598-00.....Luminaires
- H. 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, UL 1598 and shall be 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. Where lighting fixtures are detailed with minimum 20 gauge housing, minimum 22 gauge housings will be acceptable provided they have strengthening embossed rib and break formations, which give the equivalent rigidity of a 20 gauge housing.
 - 4. 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.
 - 5. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, and 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. Contacts for recessed double contact lampholders and for slimline lampholders shall be silver plated. Lampholders for bi-pin lamps, with the exception of those for "U" type 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 incandescent fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- F. Fluorescent fixtures with louvers or light transmitting panels shall have hinges, latches and safety catches to facilitate safe, convenient cleaning and relamping. Vapor tight fixtures shall have pressure clamping devices in lieu of the latches.
- G. 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.
- H. Metal Finishes:
 1. The manufacturer shall apply his 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.
 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.
- I. Provide all lighting fixtures with a specific means for grounding their metallic wireways and housings to an equipment grounding conductor.
- J. Light Transmitting Components for Fluorescent Fixtures:
 1. Shall be 100 percent virgin acrylic plastic or water white, annealed, crystal glass.
 2. Flat lens panels shall have not less than 3.2 mm (1/8 inch) 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.

- K. Lighting Fixtures in Hazardous Areas: Fixtures shall be suitable for installation in flammable atmospheres (Class and Group) as defined in NFPA 70 and shall comply with UL 844.
- L. Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall be designed for lamps as specified.

2.2 FLUORESCENT LAMP BALLASTS

- A. Where applicable, fluorescent lamps and ballasts shall comply with the National Energy Policy Act of 1992.
- B. Ballasts shall comply with NEMA 82.1, 82.2 and 82.11, NFPA 70, and UL 935 unless otherwise specified.
- C. Lamp types F32T8 and F32T8/U shall be operated by electronic, high frequency ballasts. All other fluorescent lamp types shall be operated by the standard energy saving electromagnetic core-and-coil ballasts. For these applications, the lamps shall be operated by core-and-coil ballasts where specifically required on the drawings as "core-and-coil".
- D. Electronic high-frequency ballasts:
 - 1. Ballasts shall operate the lamps at a frequency between 20 and 60 KHz from an input frequency of 60Hz.
 - 2. Ballast package:
 - a. Size: The ballast case shall be sized to be physically interchangeable with standard core-and-coil ballasts and suitable for standard mounting in new or existing lighting fixtures.
 - b. Case marking: Mark the ballast to indicate the required supply voltage, frequency, RMS current, current surge during starting, input watts, and power factor at the design center voltage, open circuit voltage, crest factor and efficacy.
 - 3. Performance:
 - a. Light output:
 - 1) At the design voltage, the light output shall be at least equal to that obtained by a core-and-coil ballasted system meeting ANSI, NEMA and CBM standards. The comparison test shall be measured in the same fixture at 25 degrees C (plus or minus one degree) ambient room temperature.
 - 2) Tests shall be made in fixtures designed only for the number of lamps being tested.

- 3) For other applications (higher ambients, etc.) the tests should be operated with equivalent lamp wall temperatures plus or minus 4 degrees C.
- b. Efficacy: The efficacy of the high-frequency, electronically ballasted system shall be at least 15 percent greater than the equivalent CBM core-and-coil ballasted system (see "Light output" above).
- c. Starting: The ballast shall be capable of starting and maintaining operation of lamps at an ambient temperature of 10 degrees C (50 degree F) or more for an input voltage of plus or minus 10 percent about the center design voltage unless otherwise indicated. The ballast shall never be started in the instant start mode at any temperature.
- d. Operation:
 - 1) The ballast shall safely and reliably operate in a room ambient temperature from 10 degrees C (50 degree F) to 40 degrees C (105 degree F).
 - 2) The light output shall not vary by more than plus or minus 5 percent for a plus or minus 10 percent variation of the input voltage about the center design voltage. Light output shall remain constant for a plus or minus 5 percent variation of the input voltage.
 - 3) The ballast shall operate the lamps in a manner that will not adversely curtail the normal life of the lamp.
- e. Transient protection: The ballast shall comply with IEEE C62.41, Cat. A.
- f. Flicker: The flicker shall be less than 5 percent and without visible flicker.
- g. Noise: The audible noise levels should be equivalent to or better than the Class A rating of CBM certified ballasts.
- h. Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI): The EMI and RFI limits shall meet the requirements of the Federal Communications Commission Rules and Regulations (CFR 47 Part 18).
- i. Rated life: The ballast shall have a rated life of 10 years or 30,000 hours (based on a 10 hour day).
- j. The two-lamp ballast shall safely operate two F32T8 RS, 32-watt lamps or two F32T8/U lamps. The single lamp ballast shall safely operate one F32T8 RS, 32-watt lamp or one F32T8/U lamp.
- k. Power factor: Not less than 95 percent.
- l. Reliability:

- 1) Labels: Ballasts must be labeled or listed by UL and CBM/ETL.
 - 2) Submit, simultaneously with shop drawings, a certified test report by an independent testing laboratory showing that the electronic ballasts meet or exceed all the performance requirements in this specification.
- m. Total harmonic distortion (THD) shall be less than 10 percent.
- E. Core-and-coil ballasts (for lamps other than F32T8 and F32T8/U or where shown on drawings as "core-and-coil"):
1. Shall be rapid starting type.
 2. Shall comply with NEMA 82.1 and UL 935.
 3. Shall be UL Class P with automatic-resetting, internal, thermal protection.
 4. Shall be CBM/ETL certified.
 5. Power factor shall be not less than 95 percent. Capacitors in ballasts shall not contain PCB (Polychlorinated Biphenyl) fluids or other fluids recognized as hazardous when discharged into the environment.
 6. Sound ratings shall be Class A or better, except for ballast sizes which are not available with Class A ratings, as standard products from any manufacturer. Ballasts which are not available with Class A ratings shall have the quietest ratings available.
 7. Where core-and-coil ballasts are specified or detailed in lieu of the normally required electronic high-frequency types, two lamp ballasts shall be energy-saving type, UL listed to operate F40T12 rapid start lamps for both standard 40 watt lamps and the reduced wattage 35/34 watts energy-saving lamps. Lamp output shall be within 5 percent of nominal rating. When operating energy-saving lamps, the input watts to the ballast shall not exceed 78 watts at 120 V.A.C. or 79 watts at 277 V.A.C. Energy-saving type ballasts should not be used in ambient temperatures below manufacturer's recommendations.
- F. Ballasts for lighting fixtures controlled by dimming devices shall be the electronic, high frequency type as specified herein, equipped for dimming and conform to the recommendations of the manufacturer of the associated dimming devices to assure satisfactory operation of the lighting system.
- G. All ballasts serving straight or "U" type lamps shall be mounted by four non-turning studs (or captive bolts) equipped with lock washers and nuts or locking type nuts, or by four thread cutting (TC) sheet metal screws which are firmly secured against the fixture body (or wireway) to maximize dissipation of heat and minimize noise. Exception: electronic

high-frequency ballasts may be mounted at a minimum of two points, one at each end of unit.

- H. 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.
- I. 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.
- J. 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.

2.3 LAMPS

A. Fluorescent Lamps:

- 1. Rapid start fluorescent lamps shall comply with ANSI C78.1; preheat-start type shall comply with ANSI C78.2; and instant-start and cold-cathode lamps shall comply with ANSI C78.3.
- 2. Chromacity of fluorescent lamps shall comply with ANSI C78.376.
- 3. The lamps shall include the F32T8, F32T8/U 32 watt energy saving type and EPACT approved F40T12 type if specifically required by contract drawings for special applications.
- 4. Except as indicated below, lamps shall be energy saving type, have a color temperature between 3500 and 4100°K, a Color Rendering Index (CRI) of not less than 75, and an initial lumen output not less than 2800. "U" tube lamps shall have the same color temperature and CRI limits as the above.
 - a. In utility areas (Electrical, Communication and Mechanical) Service rooms and closets), maintenance closets and non-medical storage spaces, utilize energy saving light-white lamps.
 - b. In areas with ambient temperatures below 60 degrees use the 40 watt version of the lamp above.
 - c. Other areas as indicated on the drawings.

- B. Compact Fluorescent Lamps: Shall be 3500°K 10,000 hours average rated life, and as follows:

1. T4, twin tube, as indicated.
2. T4, double twin tube rated as indicated.

2.4 OCCUPANT SENSOR LIGHTING CONTROL SYSTEMS

- A. General: An active or passive sensor shall be utilized to control the "On-Off" actuation of fluorescent or incandescent lighting loads. It shall provide control of an isolated set of contacts on exposure to a perceived change in environmental conditions indicating the presence or absence of one or more persons. It shall maintain the contacts closed in the presence of continued changes (due to human presence) at similar intensity and rate. It shall open the contacts at a nominal time after the changes cease.
- B. Passive Sensor System: Sensor(s) shall react to changes of radiated infrared energy, indicating the activity of one or more human bodies in the area covered:
1. Range of detection: The sensor(s) shall provide effective coverage of a room, sensing the presence of one or more people in the room in order to turn the lights on. The ceiling mounted sensor's area of coverage shall be approximately a 4200 mm (14 feet) diameter circle at 1800 mm (6 feet) away. Provide sufficient units to give full coverage as measured 750 mm (30 inches) above the floor. A field-of-view adjustment feature shall be provided to allow orientation to various room operating conditions.
 2. Sensor placement: Locate the sensor(s) in accordance with the manufacturer's recommendations to maximize energy savings by avoiding nuisance activation due to sudden temperature or air flow changes. Locate the units within 1800 mm (6 feet) horizontally of work stations or major points of activity, including the center of room entrance doors.
- C. Active Sensor System: Sensor(s) shall react to reflective changes to generated ultrasonic radiation (crystal controlled, 24 to 42kHz), indicating the activity of one or more persons in the area covered.
1. Range of detection: On ceilings below 3600 mm (twelve feet) in height, a single direction sensor shall cover approximately a 9 x 9 m (30 feet x 30 feet) area; a two directional unit a 18 x 9 m (60 feet x 30 feet) area; and a two-way corridor unit a total distance of 27 m (90 feet). The sensors shall be equipped with a concealed but accessible sensitivity control to tune the unit to specific room conditions.
 2. Sensor placement: Locate the sensor(s) in accordance with the manufacturer's recommendations to maximize energy savings by avoiding nuisance activation due to predictable non-human motion activities.

Give particular attention to work station or major areas of activity and the coverage of room entrance doors.

- D. Timing/Function: Shall not be user adjustable. Lighting shall remain on with one or more persons within the covered area. The system shall be factory set to maintain lights on for a minimum of 8 minutes and not longer than 12 minutes after the area of coverage is vacated. For testing purposes, there shall be a means to change the pre-set time delay to 30 seconds or less.
- E. Control Unit: The system shall have a switching relay(s) capable of switching the fluorescent or incandescent loads as required. Contacts shall be rated at a minimum of 15 Amps at voltages to 277, with expected cycles of operation in excess of 100K. Power derived from a current limiting 24 volt transformer shall power the system and the unit must be packaged for installation on a standard 200 mm x 200 mm (4 inch x 4 inch) NEMA box enclosure. The unit shall be wired through a conventional wall switch to provide an over-ride system "Off" and active "Off-On" functioning.
- F. Field Wiring: The wiring between the control unit and sensor(s) shall be an insulated multi-conductor, #22 gauge Poly Vinyl Chloride (PVC) jacketed cable.

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 cast or extruded aluminum, or rolled steel.
 - 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. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous red 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; maximum of 3.5 watts for single face and 7 watts for double-faced fixtures that do not use diffuser panels in front of the LEDs. LED exit light fixtures that use diffuser

panels shall require a maximum of 1.0 watt per fixture for single or double face fixtures.

2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltages: Fixtures shall be wired for 277-volt operation.

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. Avoid interference with and provide clearance for equipment. Where the indicated locations for the lighting fixtures conflict with the locations for equipment, change the locations for the lighting fixtures by the minimum distances necessary as approved by the CO/COR.
- D. For suspended lighting fixtures, the mounting heights shall provide the clearances between the bottoms of the fixtures and the finished floors as shown on the drawings.
- E. Fluorescent bed light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable.
- F. 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.
 - a. In addition to the above, the following is required for fixtures exceeding 9 kg (20 pounds) in weight. Note: Ceiling types are defined in ASTM Standard C635-69.
 - 1) Where fixtures mounted in "Intermediate" and "Heavy Duty" ceilings weigh between 9 kg and 25 kg (20 pounds and 56 pounds) provide two 12 gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.
 - 2) Where fixtures weigh over 25 kg (56 pounds) 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.
- 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.
4. 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 6 mm (1/4-20) 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 25 kg (56 pounds) 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 6.8 kg (15 pounds) in weight and occupying less than 600 mm x 600 mm (two square feet) 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.
5. Single or double pendent-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.
6. 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.
- G. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.
 - H. 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.
 - I. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
 - J. At completion of project, relamp all fixtures which have failed/burned-out lamps. Clean all fixtures, lenses, diffusers and louvers that have accumulated dust/dirt during construction.

END OF SECTION

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SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of exterior luminaries, controls, poles and supports.
- B. All exterior lighting fixtures are in place. This section addresses the re-lamping on exterior lighting fixture as indicated in the contract documents.

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. All exterior lighting fixtures are in place so not lighting submittals are required.

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):
AAH35.1-2006Alloy and Temper Designation Systems for
Aluminum
- B. American Association of State Highway and Transportation Officials
(AASHTO):
LTS-4-2003Structural Supports for Highway Signs,
Luminaries and Traffic Signals
- C. American Concrete Institute (ACI):

- 318-2005Building Code Requirements for Structural
Concrete
- D. American National Standards Institute (ANSI):
 - C57.12-2000.....General Requirements For Liquid-Immersed
Distribution, Power, and Regulating
Transformers
 - C81.61-2005Electrical Lamp Bases
- E. American Society for Testing and Materials (ASTM):
 - A123/A123M-2002Zinc (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 -2003Aluminum-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):
 - ICS 2-2005Industrial Control and Systems Controllers,
Contactors and Overload Relays Rated 600 Volts
 - ICS 6-2001Industrial Control and Systems Enclosures
- I. National Fire Protection Association (NFPA):
 - 70-2005National Electrical Code (NEC)
- J. Underwriters Laboratories, Inc. (UL):
 - 496-2004Edison-Base Lamp holders
 - 773-1995.....Plug-in, Locking Type Photo controls, for Use
with Area Lighting
 - 773A-2006Non-industrial Photoelectric Switches for
Lighting Control
 - 1598-2004Luminaries

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 LAMPS

- A. Install the proper lamps in every luminaire installed and every luminaire relocated or reinstalled.
- B. Lamps to be general-service, outdoor lighting types.

2.3 LIGHTING CONTACTORS

NEMA ICS 2, mechanically 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 selector switch.

2.4 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. A time clock to act as the pilot device.
 - c. A combination, photocell-time clock to act as dual pilot devices connected in series. The photocell shall provide the "on" function at dusk and the time clock(s) shall control specific circuit "off" functions during dark hours.
 - d. A time clock to act as the pilot device for a circuit (or circuits) when luminaries are individually photocell controlled.
 - e. The pilot devices shall control the power circuit through the contractor or relay as shown on the drawings.
 - 2. Mount and connect photocells and time clocks 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. Time clocks shall have the following features:
 - a. A 24-hour astronomic dial, motor-driven.
 - b. A spring-actuated, reserve power mechanism for operating the timer during electrical power failures and that automatically winds the spring when the electrical power is restored.
5. The arrangement and method of control and the control devices shall be as shown on the drawings.

2.5 EXISTING LIGHTING SYSTEMS

- A. For modifications or additions to existing lighting systems, the new components shall be compatible with the existing systems.
- B. New poles and luminaries shall have approximately the same configurations and dimensions as the existing poles and luminaries except where otherwise shown on the drawings.

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. Photocell Switch Aiming: Aim switch according to manufacturer's recommendations.

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.

END OF SECTION

SECTION 27 05 11
REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section, Requirements for Communications Installations, applies to all sections of Division 27.
- B. Furnish and install communications cabling, systems, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable, and other items and arrangements for the specified items are shown on drawings as indicated.

1.2 MINIMUM REQUIREMENTS

- A. References to industry and trade association standards and codes are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.3 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. **Manufacturers Qualifications:** The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. **Product Qualification:**
 - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
 - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. **Service Qualifications:** There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within 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 Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the CO/COR a minimum of 15 working days prior to the manufacturers making the factory tests.
 2. Four copies of certified test reports containing all test data shall be furnished to the CO/COR prior to final inspection and not more than 90 days after completion of the tests.
 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.5 EQUIPMENT REQUIREMENTS

- A. Where variations from the contract requirements are requested in accordance with 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 CO/COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
 3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.

4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.7 WORK PERFORMANCE

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure communications service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and pathways with other trades to minimize interferences.

1.8 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Inaccessible Equipment:
 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.9 EQUIPMENT IDENTIFICATION

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

1.10 SUBMITTALS

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

- B. The CO/COR approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION _____".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- E. The submittals shall include the following:
 - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 - 2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 - 3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- F. Manuals:
 - 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 CO/COR 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.

1.11 SINGULAR NUMBER

- A. 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 CO/COR at least 30 days prior to the planned training.

END OF SECTION

SECTION 27 10 00
NETWORK CABLING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of the network cabling system.

1.2 RELATED WORK

A. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

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 CO/COR 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):

70-08.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-02.....Thermoset-Insulated Wires and Cables
83-03.....Thermoplastic-Insulated Wires and Cables
486C-02.....Splicing Wire Connectors
486E-00.....Equipment Wiring Terminals for Use with Aluminum
and/or Copper Conductors
514B-02.....Fittings for Cable and Conduit

1479-03.....Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 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 CODES OF PRACTICE

- A. Adherence to the VA/NCA Network Cable Specifications by cabling installation contractors is a condition of contract. In the event the cabling installation is sub-contracted by the prime contractor, the prime contractor will supply a copy of these specifications to the sub-contractor. This requirement shall cover all levels of sub-contracting.
- B. Any variations to the issued job specification shall be referred for approval to the CO/COR. VA Quantico Regional Processing Center also must approve these variations.
- C. Contractors shall install all cable and cabling products with a proven track record for data network cabling installations. Such installations shall also meet all requirements as set out in this specification.
- D. Un-terminated "future capacity" cables are not permitted. All installed cables shall be terminated at each end and documentation, labeling and

(where applicable) test results provided. This applies to all permanently installed cable types.

3.2 DOCUMENTATION

- A. At least two copies of documents describing the data cable installation shall be provided. A copy shall be supplied to:
 - 1. Director, VA National Cemetery for which the work is being performed.

3.3 NETWORK EQUIPMENT

- A. VA Quantico Regional Processing Center must approve the installation or removal of network hardware equipment. Non-VA/NCA staff shall carry out such work only with prior approval from the VA Quantico Regional Processing Center.

3.4 NETWORK EQUIPMENT ENVIRONMENT

- A. Punch down area(s) (location of the data communication rack(s)) will be determined by the building CO/COR and the VA Quantico Regional Processing Center.
- B. Contractor shall supply 100BaseT, Category 5e or Category 6 certified rack-mounted modular RJ45 punch down block/panel (24/48 ports) for jacks meeting the ANSI/EIA/TIA 568-B category 5e/6 standards.
- C. Each jack on the punch down block/panel will correspond with the jack at the wall device faceplate.

3.5 UNSHEILDLED TWISTED PAIR (UTP) CATEGORY 5E/6

- A. IEEE 802.3 100BaseT UTP Level 5e/6, 24 AWG plenum rated cable grade.

3.6 NETWORK CONFIGURATION RESTRAINTS

- A. Each segment comprises a four pair Category 5e/6 cable.
- B. Pin all 8 conductors.
- C. Maximum link length - 90 meters
- D. Maximum channel length - 100 meters
- E. Maximum number of stations per segment - 1.

3.7 INSTALLATION CONSTRAINTS

3.7.1 INSTALLATION STANDARDS

- A. Cable and connecting hardware meeting or exceeding the Category 5e/6 specifications shall be used throughout, with pairs terminated according to the T568B wiring scheme.

3.7.2 GENERAL REQUIREMENTS

- A. The cabling system shall include all horizontal cables, vertical cabling, modular jacks, system cables, patch cables, cable management, and a comprehensive labeling system.

3.7.3 DATA OUTLETS

- A. The following information represents a minimum requirement for the number of UTP outlets that shall be installed in each type of workspace.

- B. If the construction at the location of the data outlet is drywall, provide flush-mounted single-gang outlet boxes with two-port base plates and applicable wall device faceplates (cable to be installed behind drywall).
- C. If the construction at the location of the data outlet is a solid wall, provide surface-mounted single-gang outlet boxes with two-port base plates and applicable wall device faceplates (cable to be installed in plastic wall mold equipped with protective insulator or sleeve).
- D. Where modular furniture is used, the location of the data outlet will be in the baseboard of the furniture, where the networked equipment (computers, printers, etc) will be located. Provide flush-mounted single gang outlet boxes with two-port base plates and applicable wall device faceplates. If flush-mounted single-gang outlet boxes cannot be used, then modular surface mount boxes will be used with two-port inserts. All cable runs in modular furniture will be through furniture wire baseboard ducts/conduit.

3.7.4 HORIZONTAL CABLING

- A. The horizontal wiring shall be a star topology connecting each network outlet jack to a jack on a patch panel rack in a communications enclosure/room.
- B. The cable used shall be 4-pair 100-ohm high performance, 24 AWG solid conductor, unshielded twisted pair cable, meeting or exceeding the Category 5e/6 specification.

3.7.5 NETWORK OUTLET AND LABELING

- A. Each network outlet faceplate shall incorporate one or more modular, universal RJ45 IDC jack sockets meeting or exceeding the Category 5e/6 specification. Label each jack at this wall device faceplate to correspond with the label on the patch panel jack (N1, N2, etc.). All numbering should be readily visible.

3.7.6 CABLE INSTALLATION

- A. The cable interconnecting a network outlet to the patch panel shall be one continuous length with no intermediate joins, splices or taps.
- B. Cable termination onto a horizontal distribution panel or patch panel shall be undertaken in a manner that permits additional cables to be terminated without unduly disturbing previously installed cables.
- C. Each data outlet / device location will have two (2) cable runs that will terminate in the punch down block/panel at the punch down area. No more than 24 cables shall be cable tied in a bunch.
- D. A 2-meter loop of cable shall be left within or on the approach to each communications room/enclosure to facilitate re-termination of the cable

in the future, should this be required. Such cable slack shall be coiled and supported in a neat and practical manner.

- E. A 0.5-meter loop of cable shall be left in the trunking on the approach to each network outlet to facilitate re-termination of the cable in the future, should this be required. The amount of untwisting in a pair as a result of termination to connecting hardware shall be no greater than 13mm, and less than this if possible.
- F. Cable bend radii shall be no less than eight times the cable diameter or as specified by the cable manufacturer; whichever is greater. Precautions shall be observed to eliminate cable stress caused by tension in suspended cable runs and tightly strapped bundles.
- G. Cable bundles shall not rub on, or be unduly compressed against any building infrastructure, building equipment, cable tray, equipment racking, or other cable support.
- H. Cable bundles shall not obstruct the installation and removal of equipment in equipment racks.
- I. Where UTP cables are run parallel with electrical cables the following minimum separation rules shall be observed:

Circuit rating	Unshielded power/data	Shielded power/data
< 1 KVA	300mm	25mm
> 1 < 2 KVA	450mm	50mm
> 2 < 5 KVA	600mm	150mm
5 KVA	1500mm	300mm

- J. Where UTP cables are run in the proximity of electrical motors or transformers the minimum separation shall be 1 meter.
- K. In situations where the above minimum distances cannot be applied due to a lack of available space, data cables shall be enclosed in rigid and/or flexible steel conduit. Conduit shall be bonded to a protective ground at one point in the installation. No steel cabling enclosure medium shall be installed without having continuity to a protective ground.

3.7.7 PATCH CABLES

- A. The cable to be used for copper patch shall be 4 pair 100-ohm high performance, stranded conductor, unshielded twisted pair cable, meeting or exceeding the Category 5e/6 specifications.
- B. The cable to be used for fiber patch shall be of the same type (multi-mode or single mode - see specifications in section 4 below) of what is used to connect the buildings.

- C. Each patch lead shall be terminated in RJ45 connectors (male) meeting or exceeding the Category 5e/6 specification.
- D. Contractor will supply one (1) 6' category 5e/6 patch cable with RJ45 connectors (male) for every cable run installed into the patch panel. This will allow connectivity between the patch panel and VA supplied switch.
- E. Contractor will supply one (1) 25' category 5e/6 patch cable with RJ45 connectors (male) for every cable run terminated at the user/device work location. This will allow connectivity from the networked device (computer, printer, etc) to the wall jack.

3.8 INTER-BUILDING CABLING

3.8.1 WIRING MAINTENANCE OR OTHER LOCAL BUILDINGS:

If local network connectivity for Maintenance or other local building is required, follow all specifications as stated in this document.

3.8.2 CONNECTING MAINTENANCE OR OTHER LOCAL BUILDINGS WITH THE ADMINISTRATION BUILDING:

- A. If the distance between the punch down area in the Administration Building to the punch down area in the Maintenance Building does not exceed 100m or 328' (maximum length of the cable run), then 100BaseT UTP Level 5e/6 24AWG plenum 4 pair cable may be used. Two cables will be required and must be installed in conduit that will connect the two buildings.

3.9 TESTING

- A. Testing shall be carried out with building electrical services operating (lighting, power, air conditioning plant and lift services where applicable).
- B. Wiring shall be tested to verify the continuity, integrity and polarity of the cable according to the specified pin and pair grouping assignments.

3.9.1 DOCUMENTATION

- A. The contractor shall provide installation documentation at the completion of the cabling system installation.
- B. The contractor shall certify that the cabling system meets the UTP cabling system requirements for Category 5e/6 performance levels.

4.0 EXISTING WIRING

- A. 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.

END OF SECTION

SECTION 28 16 11
INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section refers to an Intrusion Detection System, hereinafter referred to as IDS, as specified in this section.
- B. An existing Intrusion Detection System is in place. This section addresses the finishing and testing of the system.

1.2 RELATED WORK

- A. For door installation, Section 08 71 00, DOOR HARDWARE.
- B. For electrical installation, Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- C. For power 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 underground installation of wiring, Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.
- G. For Warranty Construction, see GENERAL CONDITIONS.
- H. For General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

1.3 QUALITY ASSURANCE

- A. The Contractor shall be responsible for finishing and the operation of the IDS 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 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.

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 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.

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):
 - PIR-01-00.....Passive Infrared Motion Detector Standard -
Features for Enhancing False Alarm Immunity
 - CP-01-00Control Panel Standard-Features for False Alarm
Reduction
- C. Department of Justice American Disability Act (ADA)
28 CFR Part 36-90.....ADA Standards for Accessible Design
- D. National Electrical Manufactures Association (NEMA):
 - 250-03.....Enclosures for Electrical Equipment (1000 Volts
Maximum)
- E. National Fire Protection Association (NFPA):
 - 70-05.....National Electrical Code
 - 731-06.....Standards for the Installation of Electric
Premises Security Systems
- F. Underwriters Laboratories, Inc. (UL):
 - 464-03.....Audible Signal Appliances
 - 609-96.....Local Burglar Alarm Units and Systems
 - 634-00.....Standards for Connectors with Burglar-Alarm
Systems
 - 639-97.....Standards for Intrusion Detection Units
 - 1037-99.....Standard for Anti-theft Alarms and Devices
 - 1635-96.....Digital Alarm Communicator System Units
- G. Uniform Federal Accessibility Standards (UFAS), 1984

1.6 WARRANTY OF CONSTRUCTION.

Warrant IDS work subject to the Article "Warranty of Construction" of FAR 52.246-21.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. General

1. All additional equipment associated within the IDS provided and installed for completion shall be 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.
2. 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 72 hours of run time in the event of a loss of primary power to the facility.
3. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
4. All equipment and materials for the system will be compatible to ensure functional operation in accordance with requirements.

2.2 EQUIPMENT ITEMS

A. General:

1. All requirements listed below are the minimum specifications that need to be met in order to comply with the IDS.

B. IDS Components: The IDS shall consist of, but not be limited to, the following components:

1. Control Panel
2. Interior Detection Devices (Sensors)
3. Power Supply
4. Enclosures

C. Power Supply

1. A power supply shall only be utilized if the control panel is unable to support the load requirements of the IDS system.
2. All power supplies shall be UL rated and able to adequately power two entry control devices on a continuous base without failure.

3.0 EXECUTION

3.1 INSTALLATION

- A. IDS installation shall be in accordance with Underwriters Laboratories (UL) 639 Standards for Intrusion Detection Units and UL 634 Standards

for Connectors with Burglar Alarm Systems, and appropriate manufacture's installation manuals for each type of IDS.

- 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 and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.
- D. The IDS 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 designed as a computer network.
- E. The IDS shall be able to be integrated with other security subsystems. Integration with these security subsystems shall be achieved by computer programming and the direct hardwiring of the systems. Determination for methodology shall be outlined when the system(s) is/are being designed and engineered. For installation purposes, the IDS shall utilize an output module for integration with other security subsystems. The Contractor will ensure all connections are per the OEM and that any and all software upgrades required to integrate the systems are installed prior to system start-up.
- F. For programming purposes, the Contractor shall refer to the manufacturer's requirements and Contracting Officer instructions for correct system operations. This includes ensuring computers being utilized for system integration meet or exceeds the minimum system requirements outlined in the IDS software packages.
- G. The Contractor shall provide fail-safe gas tube type surge arresters on exposed IDS data circuits. In addition, transient protection shall protect against spikes up to 1000 volts peak voltage with a one-microsecond rise time and 100-microsecond decay time, without causing false alarms. The protective device shall be automatic and self-restoring. Also, circuits shall be designed or selected assuming a maximum of 25 ohms to ground.
- H. Cleaning and Adjustments:
 - 1. Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.

2. Prepare for system activation by following manufacturer's recommended procedures for adjustment, alignment, or synchronization. Prepare each component in accordance with appropriate provisions of the component's installation, operations, and maintenance instructions.

3.2 TESTS AND TRAINING

All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

END OF SECTION

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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:
 - 2. Buildings (Public Information Building & Storage Building) shall have a general evacuation fire alarm signal in accordance with ASA S3.41 to notify all occupants in the respective building 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 Public Information Building.
- E. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using a 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.

B. Basic Performance:

1. Alarm and trouble signals from each 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 C 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 08 71 00, DOOR HARDWARE: Combination Closer-Holder.
- D. Section 09 91 00, PAINTING: Painting for equipment and existing surfaces.
- E. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements for items which are common to other Division 26 sections.
- F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and boxes for cables/wiring.
- G. 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 software and include all contractors information. Layering shall be by VA criteria as provided by the CO/COR. 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. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.
3. Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, HVAC shutdown 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 CO/COR one (1) set of reproducible, as-built drawings, two blue-line copies and one (1) set of the as-built drawing computer files using AutoCAD Release 14 or later. 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. Complete listing of all digitized voice messages.
 - f. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
 - g. Include information indicating who will provide emergency service and perform post contract maintenance.
 - h. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
 - i. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VA facility and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.
 - j. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.
 - k. A print out for all devices proposed on each signaling line circuit with spare capacity indicated.
2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manual to the CO/COR.
- a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.

- b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
- c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
- d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.
- e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.

D. Certifications:

- 1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.
- 2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
- 3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

1.5 WARRANTY

- A. Warrant all work performed and all material and equipment furnished under this contract subject to the terms of "Warranty of Construction", FAR clause 52.246-21 except that warranty period is five (5) years

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only.
- B. National Fire Protection Association (NFPA):
 - 70-2011.....National Electrical Code (NEC).
 - 72-2010.....National Fire Alarm and Signaling Code.

90A-2009.....Installation of Air Conditioning and Ventilating
Systems.

101-2012.....Life Safety Code

C. Underwriters Laboratories, Inc. (UL):

2000-2011.....Fire Protection Equipment Directory

D. Factory Mutual Research Corp (FM): Approval Guide, 2009 Edition

E. American National Standards Institute (ANSI):

S3.41-2008.....Audible Emergency Evacuation Signal

F. International Code Council, International Building Code (IBC) 2012
Edition

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

B. 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 and reused conduit shall be installed in accordance with NFPA 70.
2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
3. All new conduit shall be 19 mm (3/4 inch) minimum.

B. Wire:

1. All existing wiring shall be removed and new wiring 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 excepted by the fire alarm equipment manufacturer in writing.

4. Any fire alarm system wiring that extends outside of a 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 new and reused boxes shall be sized and installed in accordance with NFPA 70.
 3. New and existing covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 19 mm (3/4 inch) high.
 4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
 5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the CO/COR.

2.3 FIRE ALARM CONTROL UNIT

- A. General:
1. Each building shall be provided with a fire alarm control unit and shall operate as a supervised zoned 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.
- 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. 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.

F. 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.
- G. 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.
- H. Remote Control Capability: Each 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
- I. 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 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, 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. Annunciators shall display information for all buildings connected to the system. Local building annunciators, for general evacuation

system buildings, shall be permitted when shown on the drawings and approved by the CO/COR.

2.5 ALARM NOTIFICATION APPLIANCES

A. Bells:

1. Shall be electric, single-stroke or vibrating, heavy-duty, under-dome, solenoid type.
2. Unless otherwise shown on the drawings, shall be 150 mm (6 inches) diameter and have a minimum nominal rating of 80 dBA at 3000 mm (10 feet).
3. Mount on removable adapter plates on outlet boxes.
4. Bells located outdoors shall be weatherproof type with metal housing and protective grille.
5. Each bell circuit shall have a minimum of twenty percent spare capacity.

B. 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.

C. 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.

2.6 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 of single 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.

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 other areas.
4. Provide a remote indicator lamp, key test station and identification nameplate (e.g. "Heat Detector - Elevator P-") for each elevator

group. Locate key test station in plain view on elevator machine room wall.

2.7 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.

2.8 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.

2.9 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 CO/COR.

2.10 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 - 2
 4. Fire alarm bells - 1

5. Fire alarm speakers - 2
 6. Smoke detectors - 4
 8. Control equipment utility locksets - 5
 9. Control equipment keys - 10
 10. 2.5 oz containers aerosol smoke - 6
 13. Monitor modules - 2
 14. Control modules - 2
 15. Fire alarm SLC cable (same as installed) - 152 m (500 feet)
- B. Spare and replacement parts shall be in original packaging and submitted to the CO/COR.
- 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 CO/COR.
- 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.

2.11 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 CO/COR 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.
- B. All new conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. All existing accessible fire alarm conduit not reused shall be removed.

- C. All new or reused exposed conduit shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.
- D. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.
- E. 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 CO/COR.
- F. 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.
- G. 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.

3.2 TYPICAL OPERATION

- A. Activation of any manual pull station, heat detector, or smoke detector shall cause the following operations to occur:
 - 1. Operate the emergency system in Buildings. For buildings without sprinkler protection throughout, flash strobes continuously only on the floor 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 Buildings.
 - 3. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
 - 4. Unlock the electrically locked exit doors within the zone of alarm.
- B. 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.

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 CO/COR.

- 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 CO/COR. 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 CO/COR, 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. Open each alarm initiating and notification circuit to see if trouble signal actuates.
 4. 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.

END OF SECTION

**SECTION 31 20 11
EARTH MOVING (SHORT FORM)**

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the requirements for furnishing all equipment, materials, labor and techniques for earthwork including site demolition and clearing, excavation, fill, backfill and site restoration.

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 materials, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
2. Existing Subgrade (except footings): Same materials as above paragraph, that are not capable of direct support of slabs, pavement, and similar items, with the possible exception of improvement by compaction, proof rolling, or similar methods of improvement.
3. Existing Subgrade (footings only): Same as Paragraph 1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to CO/COR approval.

B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for auxiliary structures and buildings and sewer and other trench work throughout the job site.

C. Degree of Compaction: Degree of compaction is expressed as a percentage of maximum density obtained by the test procedure presented in ASTM D698 or D1557.

D. The term fill means fill or backfill as appropriate.

1.3 RELATED WORK

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.

C. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

D. Erosion control: Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS

1.4 CLASSIFICATION OF EXCAVATION

A. Classified Excavation: Removal and disposal of all material except that material not defined as Rock. No additional compensation will be given for excavation of any material not defined as rock.

B. Rock Excavation:

1. Trenches and Pits: Removal and disposal of solid, homogenous, interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be excavated with a late-model, track-mounted hydraulic excavator; equipped with a 1050 mm (42 inch) wide, short-tip-radius rock bucket; rated at not less than 103 kW (138 hp) flywheel power with bucket-curling force of not less than 125 kN (28,090 lbf) and stick-crowd force of not less than 84.5 kN (19,000 lbf); measured according to SAE J-1179.
2. Other types of materials classified as rock are unstratified masses, conglomerated deposits and boulders of rock material exceeding 3/4 cubic yard that cannot be removed by rock excavating equipment equivalent to the above in size and performance ratings, without systematic drilling, ram hammering, or ripping.
3. Blasting: Not permitted.
4. Guidelines for equipment are presented for general information purposes only. The Contractor shall be responsible for the means and methods for rock excavation and shall plan the work in accordance with geotechnical information provided by the Government.

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. Unit price for rock excavation shall include replacement of excavated rock materials with suitable bedding and backfill as indicated for the type of construction. 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).
 5. 36 inches below proposed finish grade of in-ground cremains areas.
- B. Payment: No separate payment shall be made for rock excavation quantities shown. Contract price and time will be adjusted for overruns or underruns 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 elevations.

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 Nursery and Landscape Association (ANLA):
2004.....American Standard for Nursery Stock
- C. American Association of State Highway and Transportation Officials (AASHTO):
T99-01 (R2004).....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
- D. American Society for Testing and Materials (ASTM):
D698-07.....Laboratory Compaction Characteristics of Soil Using Standard Effort
D1557-07.....Laboratory Compaction Characteristics of Soil Using Modified Effort
- E. New Mexico Department of Transportation, Standard Specifications for Highway and Bridge Construction, latest revision.

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 in 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- μ m (No. 200) sieve, per ASTM D2940;.
- D. Bedding: Naturally or artificially graded mixture of natural or crushed sand meeting ASTM C33.
- E. Granular Fill bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No. 4).
- F. Drainage Aggregate (Drainage Course): Washed, narrowly graded mixture of crushed stone, or crushed 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.
- G. Aggregate base course for pavements: provide base course crushed aggregate material in compliance with Section 304 of the NMDOT Standard Specifications, latest edition.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Tree Protection: See 01 57 19 Temporary Environmental Controls. All existing trees not indicated to be removed shall be protected from damage to their above and below ground structures. Trenches within tree driplines shall be hand dug to locate roots and address any conflicts. Do not cut roots over one inch diameter without approval from CO/COR.
- B. Grubbing: For trees indicated to be removed ONLY, remove stumps and roots 75 mm (3 inches) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inches) diameter, and nonperishable solid objects which will be a minimum of 900 mm (3 feet) below subgrade may be left.
- D. Stripping Topsoil: Unless otherwise indicated on the drawings, the limits of earthwork operations shall extend anywhere the existing grade is filled or cut or where construction operations have compacted or otherwise disturbed the existing grade or turf.
 - 1. Strip topsoil as defined herein from within the limits of earthwork operations as specified above unless specifically indicated or specified elsewhere in the specifications or shown on the drawings.
 - a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.

2. Topsoil shall be fertile, friable, natural topsoil of loamy character and characteristic of the locality. Topsoil shall be capable of growing healthy horticultural crops of grasses.
 3. Eliminate foreign material, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials, larger than 1/2 cubic foot in volume, from soil as it is stockpiled. Retain topsoil on Cemetery property. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading.
 4. Topsoil work, such as stripping, stockpiling, and similar topsoil work, shall not, under any circumstances, be carried out when the soil is wet so that the tilth of the soil will be destroyed.
 5. Stockpile topsoil in storage piles in storage area in Section E or elsewhere on site as approved by CO/COR. Construct storage piles to provide free drainage of surface water. Cover storage piles to prevent wind erosion in accordance with the Erosion and Sedimentation Control Plan and/or Storm Water Pollution Prevention Plan. Refer to Division 32 Section 32 90 00, "Planting" for soil amendments.
 - a. Stockpile shall be contained with erosion and sediment controls and stabilized if undisturbed.
 6. Dispose of unsuitable or excess topsoil as specified for disposal of waste material only after approval of the CO/COR.
- 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 the Cemetery Property.
- F. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all demolition and removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION

- A. Existing Utilities: Locations of existing underground utilities shown on plans are approximate. Verify locations and use extreme caution when digging. Damage to existing utilities shall be repaired at no expense to the government.

- B. Shoring, Sheet piling and Bracing: Shore, brace, or slope to its angle of repose banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities, in compliance with OSHA requirements.
1. Extend shoring and bracing to the bottom of the excavation. Shore excavations that are carried below the elevations of adjacent existing foundations.
 2. If the bearing of any foundation is disturbed by excavating, improper shoring or removal of shoring, placing of backfill, and similar operations, provide a concrete fill support under disturbed foundations, as directed by CO/COR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by CO/COR.
- C. Excavation Drainage: Operate pumping equipment as required, to keep excavations free of water and subgrades dry, firm, and undisturbed until approval of permanent work has been received from CO/COR. Approval by the CO/COR is also required before placement of the permanent work on all subgrades. When subgrade for foundations has been disturbed by water, remove the disturbed material to firm undisturbed material after the water is brought under control. Replace disturbed subgrade in trenches by mechanically tamped sand or gravel. When removed disturbed material is located where it is not possible to install and properly compact disturbed subgrade material with mechanically compacted sand or gravel, the CO/COR should be contacted to consider the use of flowable fill.
- D. Blasting: Blasting shall not be permitted.
- E. Earthwork for Structures:
1. Excavation shall be accomplished as required by drawings and specifications.
 2. Excavate foundation excavations to solid undisturbed subgrade.
 3. Remove loose or soft material to solid bottom.
 4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete, poured separately from the footings.
 5. Compact subgrades for footings to 95% of the soil's maximum dry density as determined by ASTM D 1557.
- F. Trench Earthwork:
1. Water Utility trenches:
 - a. Excavate to a width as necessary for sheet piling 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 4 inches of bedding consisting of ASTM C-33 concrete sand.
 - d. Place and compact as specified to not less than 4 inches above the top of pipe using ASTM C-33 concrete sand.
 - e. Fill remainder of trench to proposed grade using suitable on-site materials to backfill in accordance with CO/COR approval. When suitable material is not available on-site, backfill using Engineered Fill. Do not use unsuitable materials.
 - f. The length of open trench in advance of pipe laying shall not be greater than work that can be completed and stabilized in a single working day.
2. Sanitary and storm sewer trenches:
- a. Trench width below a point 150 mm (6 inches) above top of the pipe shall be 600 mm (24 inches) for 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. The bottom quadrant of the pipe shall be bedded on 6 inches of granular fill. Place and tamp fill material by hand.
 - c. Place and compact as specified to not less than 4 inches above the top of pipe using granular fill.
 - d. Fill remainder of trench to proposed grade using suitable on-site materials to backfill in accordance with CO/COR approval. When suitable material is not available on-site, backfill using Engineered Fill. Do not use unsuitable materials.
 - e. Use granular fill for bedding where rock or rocky materials are excavated.
- G. Site Earthwork: Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials, that are determined by the CO/COR or inspector 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 CO/COR, 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, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL REQUIREMENTS as applicable. Adjustments to be based on meters (yardage) in cut section only.

H. Finished elevation of subgrade shall be as follows:

1. Pavement Areas - bottom of the pavement or base course as applicable.
2. Lawn Areas - 3 inches below the finished grade when the subgrade is soil, unless otherwise specified or indicated on the drawings. Rock shall be removed to 12 inches below finished grade in lawn areas and 36 inches below finished grade in burial sections.
3. Planting Areas - as shown on drawings.
4. Rain Garden areas - as shown on drawings.

3.3 FILLING AND BACKFILLING

- A. General: Do not fill or backfill until all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from the excavation. Proof-roll exposed subgrades with a fully loaded dump truck. Use excavated materials or borrow for fill and backfill, as applicable. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, and pipes coming in contact with backfill have been installed, and inspected and approved by CO/COR.
- B. Proof-rolling Existing Subgrade: Proof-roll with a fully loaded dump truck. Make a minimum of one pass in each direction. Remove unstable uncompactable material and replace with suitable material as directed by a qualified geotechnical technician.
- C. Placing: Place material in horizontal layers not exceeding 200 mm (8 inches) in loose depth and then compacted. Do not place material on surfaces that are muddy, frozen, or contain frost.
- D. 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 CO/COR. 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 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 compact to 95 percent.
 - b. Under curbs, curbs and gutters: 95 percent.

- c. Under Sidewalks, scarify and recompact top 150 mm (6 inches) below subgrade and compact each layer of backfill or fill material compact to 95 percent.
 - d. Landscaped areas including lawns, top 400 mm (16 inches) compact to 85 percent.
 - e. Landscaped areas, below 400 mm (16 inches) of finished grade, compact to 90 percent.
2. Natural Ground (Cut or Existing)
- a. Under building slabs, steps and paved areas, top 150 mm (6 inches), compact to 95 percent.
 - b. Under Curbs, curbs and gutters, top 150 mm (6 inches), compact to 95 percent.
 - c. Under sidewalks, top 150 mm (6 inches), compact to 95 percent.
- E. Use of heavy equipment is restricted near pre-placed crypt sections. No vehicles over 6,000 lb wheel load, 12,000 lb axle load, or equivalent pressure per square inch to operate within 30 feet to crypt field boundary. Use extreme caution during earthwork activities.**

3.4 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 unfinished areas fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside the building away from the building walls for a minimum distance of 1800 mm (6 feet).
- D. The finished grade shall be 150 mm (6 inches) below bottom line of windows or other building wall openings unless greater depth is shown.
- E. Place crushed stone or gravel fill under concrete slabs on grade tamped and leveled. The thickness of the fill shall be 150 mm (6 inches), unless otherwise indicated.
- F. Finish subgrade in a condition acceptable to the CO/COR at least one day in advance of the paving operations. Maintain finished subgrade in a smooth and compacted condition until the succeeding operation has been accomplished. Scarify, compact, and grade the subgrade prior to further construction when approved compacted subgrade is disturbed by contractor's subsequent operations or adverse weather.

- G. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 LAWN AREAS

- A. General: Harrow and till to a depth of 6 inches, new or existing lawn areas to remain, which are disturbed during construction. Do not till lawn areas within tree drip lines. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed.
- B. Place topsoil and/or soil amendments and perform finish grading and soil testing in accordance with 32 90 00 PLANTING.
- C. Perform seeding and/or sodding as shown on plans and in accordance with 32 90 00 PLANTING.

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 Cemetery property except as noted.
- B. Place excess excavated materials suitable for fill and/or backfill on site where directed.
- C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- D. Segregate all excavated contaminated soil designated by the CO/COR 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.
- F. Excess gravel materials produced by road resurfacing on the Cemetery site may be spread to an even thickness in Cemetery Section E parking area (south of the Committal Shelter) as approved by the CO/COR. Other soil materials shall be removed from the site and disposed of legally.
- E. Provide erosion and sedimentation control for on- and off-site soil stockpiles as required by law.

3.6 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 debris, rubbish, and excess material from the Cemetery Property.

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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. Pedestrian Pavement: Walks, flower/water stations, plaza areas, curbs, miscellaneous flatwork.

1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation and subbase materials: Section 31 20 11, EARTH MOVING (Short Form).
- C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.
- D. Joint Sealants: Section 07 92 00, JOINT SEALANTS.

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 3.4D and 3.4E of Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.

1.5 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. Joint sealant and backer rod
 - 3. Reinforcement
 - 4. Curing materials
 - 5. Protective coating
 - 6. Integral color.
- C. See 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE for additional submittal requirements.
- D. Samples: sealant colors, integral color samples from manufacturer for color selection.

E. Mockups:

1. Mow curb: Provide mockup for concrete mow curb to demonstrate compliance with requirements, including dimensions, integral color, edges, joints, and surface. Mockup shall include one expansion joint with backer rod and sealant. Mockup size: 6 feet long by full width and depth.
2. Gutter: Provide mockup for concrete gutter to demonstrate compliance with requirements, including dimensions, integral color, edges, joints, and surface. Mockup shall include one expansion joint with backer rod and sealant. Mockup size: 4 feet long by full width and depth.
3. Integrally colored paving: Provide mockup for concrete paving at Rostrum to demonstrate compliance with requirements, including dimensions, integral color, edges, joints, and surface (Alternate #2). Mockup size: 3 feet by 3 feet by full depth.
4. Coordinate locations for mockups with the CO/COR; mockups cannot become part of the final project work.
5. Approved mockups shall serve as the basis for determining the acceptance or rejection of the finished work.

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. Refer to the latest edition of all referenced Standards and codes.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - M31-07.....Deformed and Plain Billet Steel Bars for Concrete Reinforcement (ASTM A615/A615M-96A)
 - M55M/55M-09.....Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A185)
 - M147-04.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 1996)
 - M148-05.....Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309A)
 - M171-05.....Sheet Materials for Curing Concrete (ASTM C171)
 - M182-05.....Burlap Cloth Made from Jute or Kenaf
 - M213-05.....Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction

- (Non-extruding and Resilient Bituminous Type)
(ASTM D1751)
- T99-09.....Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop
- T180-09.....Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
- C. American Society for Testing and Materials (ASTM):
- C94/C94M-09.....Ready-Mixed Concrete
- C143/C143M-08.....Slump of Hydraulic Cement Concrete
- C1116/C1116M-08.....Fiber Reinforced Concrete

PART 2 - PRODUCTS

2.1 GENERAL

Concrete shall be 4,000 psi air-entrained as specified in Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE, with the following requirements:

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: Max slump 4" 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.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.3 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.

2.4 INTEGRAL COLOR

- A. Colored Admixture: Davis Colors manufactured by Davis Colors, or approved equal; phone 800-356-4848, e-mail info@daviscolors.com, or internet www.daviscolors.com. Color additives shall contain pure, concentrated mineral pigments specially processed for mixing into concrete and complying with ASTM C979. Color additives containing carbon black are not acceptable.
 - a. Mow curb: "Sunset Rose" or per approved mockup.
 - b. Concrete gutter: "Sunset Rose" or per approved mockup.
 - c. Flagpole sleeves: "Sunset Rose" or per approved mockup.
 - d. Rostrum concrete (Alternate #2): Match existing concrete; "Spanish Gold" or per approved mockup.
- B. Add color admixture to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

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. Liquid Membrane Curing Compound conforming to ASTM 1315, Type I, Class A. Curing compound solids shall be 100% acrylic.
 - 3. For integrally colored concrete, curing compound shall be pigmented type approved by coloring admixture manufacturer. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B, manufactured for colored concrete and approved by color additive manufacturer for use with colored concrete. W-1000 Clear Cure & Seal manufactured by Davis Colors or approved equal. For concrete indicated to be sealed, curing compound shall be compatible with sealer.
 - 4. Curing materials shall be compatible with specified finishes. Curing materials for integral color concrete shall not cause mottling of the surface color.

2.6 EXPANSION JOINT FILLERS

Material shall conform to AASHTO M213.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 11, EARTH MOVING (Short Form) and as specified in this Section.
- B. Shape to line and grade and compact with self-propelled rollers.
- C. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- D. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- E. Compact subgrade to 98% of the maximum density per AASHTO T-180.
- F. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- G. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 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 01 00 00, GENERAL REQUIREMENTS, shall establish and control the alignment and the grade elevations of the forms.
 - 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 CO/COR 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 CO/COR 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 CO/COR before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the CO/COR 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 that 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. Construction joints shall not be visible in the finished work. All jointing shall conform to the jointing plans.
- 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 PAVEMENTS, 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/areas without approval by the CO/COR.

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 PEDESTRIAN PAVEMENT

- A. Walks, flower/water stations, equipment pads, curbs, and plaza areas:
 1. Finish the surfaces to grade and cross section with a metal float, troweled smooth and finished with a broom moistened with clear water.
 2. Brooming shall be transverse to the line of traffic.
 3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
 4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the

- surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 2 mm (1/16 inch) in depth.
5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
 6. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
 7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

3.11 JOINTS - GENERAL

- A. Place joints, where shown on plans, 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.

3.12 CONTROL (CONTRACTION) JOINTS

- A. Tool joints to depth as shown with a jointing tool to depth shown. Joints may be sawed after tooling to achieve the proper depth. Sawing shall be performed prior to initial shrinkage of concrete. Ravelling at edges of joints due to sawing is unacceptable. Joints should be sawed as soon as the concrete will withstand the energy of sawing without raveling or dislodging aggregate particles.

3.13 EXPANSION (ISOLATION) 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. Provide expansion joints as follows:
 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction (isolation joints).
 2. Using slip dowels where indicated.
 3. Using joint filler of the type, thickness, and width as shown.
 4. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.14 CONSTRUCTION JOINTS

- A. Place construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.
- B. Use a butt-type joint with slip dowels if the joint occurs at the location of a planned control joint.
- C. Finish edges of construction joint to look the same as control joints.

3.15 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.
- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.16 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions, specified finish condition, 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 CO/COR. The finished concrete shall be of a uniform color and texture. Curing method shall not cause mottling or staining in the finished concrete surface.
- 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. Liquid Membrane Curing:
 - 1. Apply membrane-forming curing compound in two coats at right angles to each other at a rate of 5 m²/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.
5. Curing compound shall be compatible with concrete finish and shall not create mottled or uneven color or texture in the finished work.

3.17 CLEANING

- A. After completion of the curing period:
 1. Remove the curing material (other than liquid membrane).
 2. Sweep the concrete clean.
 3. After removal of all foreign matter from the joints, seal joints as specified.
 4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.18 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the CO/COR, 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 CO/COR.

3.19 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the construction site.

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SECTION 32 30 00
SITE FURNISHINGS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.2 DESCRIPTION

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Gravesite Layout Markers
 2. Flower-watering stations, including trash receptacles, water spigot, and flower vase container and complete any required work necessary to make the water supply equipment operate using the water supply source indicated.
 3. Decorative Post and Chain
 4. Flag Sleeves

1.3 RELATED WORK

- A. The following items are not included in this Section and will be performed under the designated Sections:
1. Section 033053: CAST-IN-PLACE-CONCRETE (Short form)
 2. Water spigot precast post: Section 10 14 00 Exterior Signage.

1.4 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:
1. General: For each item specified in description of work or Part 2 - Products, provide information showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors. Mark items requiring field assembly for erection identification and furnish erection drawings and instruction.
 2. Provide templates and rough-in measurements as required.
 3. Provide samples of full range of colors and finishes available for review and approval, prior to ordering.
 4. Provide mockup of flag pole sleeve for verification that existing flags will fit properly, prior to installing all the flag pole sleeves.

1.5 REFERENCE STANDARDS

The publications listed below form a part of this specification and the work shall comply with pertinent standards of the latest editions as specified below or by industry standards unless designated otherwise herein.

- A. American Society for Testing and Materials (ASTM):
B221-08Aluminum and Aluminum-Alloy Extruded Bars, Rods,
Wire, Shapes, and Tubes
- B. American Welding Society (AWS):
D1.2-97..... Structural Welding Code Aluminum
- C. National Association of Architectural Metal Manufacturers (NAAMM)

PART 2 - PRODUCTS

2.1 GRAVESITE LAYOUT MARKERS

- A. General: Gravesite layout markers for this project shall consist of Gravesite Grid Monuments.
 - 1. Gravesite grid monuments shall be comprised of an aluminum survey marker (monument marker) set into a cast-in-place concrete base as shown in the Contract Drawings.
- B. Text and Cross-hairs: Text of top as shown on Contract Drawings; text all caps with height to be 4.75 mm (3/16"). Cross hairs shall be field engraved as shown on the Contract Drawings, aligned with the gravesite grid and engraved based upon Contractor-surveyed location data.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, those manufacturers that can demonstrate, during the submittal process, that they have provided these products as part of successful installations matching the specifications and drawings, at a minimum of three VA National Cemeteries.

2.2 FLOWER WATERING STATIONS: GENERAL

- A. Flower watering station materials, finishes and colors shall fully comply with the specifications and Contract Drawings or be deemed as approved equal. Trash receptacle and flower vase receptacle will be furnished by Owner, installed by Contractor. Water spigot assemblies, including post, shall be provided by the Contractor.

2.3 WATER SPIGOT ASSEMBLIES

- A. Water spigots shall be constructed as indicated on the drawings. The water spigot indicated on the drawings shall be an ADA compliant spigot operated with a paddle that allows the water to flow when pushed either right or left, with 2 Kg (5 lbs) of force or less. The assembly shall be installed with a pressure regulating valve and isolation valve

installed in the meter box and the assembly is to be (blown out) if located in a region where the temperatures seasonally go below freezing. The spigot assembly shall contain all pipes, fittings, attachments, mounting base, and any other ancillary materials or equipment to produce a fully functional water spigot assembly, as indicated on the drawings, from the connection to the irrigation water system at the isolation valve for the spigot.

2.4 DECORATIVE POST AND CHAIN

- A. Provide decorative post and chain as depicted on Contract Drawings. Install in locations and as shown on Contract Drawings.
- B. Where shown on Contract Drawings, posts shall include provisions for chain attachment.
 - 1. Chain: Provide zinc plated, powder coated, proof coil chain, 1180 Kg (2,600 pound) working load limit, length as shown on Contract Drawings.
 - 2. Provide enlarged quick link on the ends of the chains to allow the chain to be attached to eyehooks.

2.5 BENCHES

- A. All mounting hardware shall be stainless steel. Use of acorn nuts is required; exposed bolt ends or flat bolt heads are not acceptable.

2.6 FLAG SLEEVES

- A. For new facilities, furnish flag sleeves at the locations and following the details in the Contract Drawings.
- B. Flag sleeves shall be furnished and installed as indicated and shall support the flag pole style selected for this facility as determined by the Operations staff.
- C. Flag sleeve locations shall be marked along the adjoining roadway, by painting a dot on the edge of the pavement perpendicular to the road centerline at the flag sleeve location. The flag sleeve locations shall be also be located on the "Record Drawings" for the project and shall be annotated using swing tie measurements from prominent features, at approximate 90 degree angles.
- D. Flag sleeve concrete shall have integral color per Section 32 05 23 CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Prior to installation of any of the work in this section, contractor shall inspect the planned installation locations to insure that conditions are not significantly different from those indicated on the contract drawings. All materials shall be inspected prior to

installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, contractor should immediately notify the CO/COR.

3.2 PREPARATION

- A. Stake alignment and locations for all site furnishings for review and approval by CO/COR. Verify that all elements in this section "fit" within location provided.
- B. Install items rigid, plumb and true to lines and levels shown.
- C. Assemble (if required) and install items as per manufacturer's printed instructions, or approved shop drawings, unless otherwise specified or shown.

3.3 INSTALLATION

- A. Gravesite Grid Monuments and Markers:
 - 1. All material must be checked upon receipt at the job site prior to installation to check for any damage that may have occurred during transport. Units will be installed in complete accordance with manufacturers' recommendations and as shown the Contract Drawings.
 - 2. Cross-hairs on monuments and marker shall be field inscribed, based upon accurate Contractor-survey: refer to Contract Drawings.
- B. Flower Watering Stations:
 - 1. Stake location of flower watering stations and obtain approval from Owner's Representative prior to forming concrete pad.
 - 2. Anchor trash receptacle and flower vase containers as shown on the Contract Drawings and following the manufacturer's recommended installation instructions. Following installation of water spigot, install washed stone for splash area.
 - 3. Install water spigot assemblies according to manufacturer's recommendations, including pipe, isolation valve, fittings, pressure reducing valve and valve boxes. All anchoring hardware shall be stainless steel. Coordinate all work with other trades.
- C. Decorative post and chain:
 - 1. Install posts in concrete footings conforming to dimensions as indicated in Contract Drawings.
 - 2. Backfill and compact excavation around post.
 - 3. Ensure that all posts are plumb and aligned within a maximum one-fourth inch tolerance of indicated location on plans or by requirement of regulatory requirements, whichever is more stringent.
 - 4. Furnish and install the chain.
- D. Benches:

1. Mount benches as recommended by the manufacturer and as specified herein. All mounting hardware shall be stainless steel. Use of acorn nuts is required; exposed bolt ends or flat bolt heads are unacceptable.

E. Flag Sleeves:

1. Install flag sleeves as indicated on the Contract Drawings at the locations indicated. Install the flag sleeves so the flag poles set in them are plumb and insure that the top of the sleeves are set at the correct elevation, based upon finished grade, so as to not interfere with the mowing operations.

3.4 CLEAN UP

- A. Clean up area of excess material and debris. Clean above ground portions of all receptacles and other site improvements.

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**SECTION 32 84 00
PLANTING IRRIGATION**

PART 1 - GENERAL

1.1 DESCRIPTION

A. Contractor is responsible for providing a programmable fully automatic system with full and complete coverage within the areas indicated on the drawings. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the fully functional irrigation system, and warranty as shown on the drawings, the installation details, and as specified. Other items of work specifically included are:

1. Procurement of all applicable licenses, permits, and payment of required fees.
2. Coordination of Utility Locates ("Call Before You Dig").
3. Maintenance period services.
4. Sleeving for irrigation pipes and wires as indicated, and/or beneath all hardscape surfaces.

1.2 DEFINITIONS

- A. Lateral Piping: Piping located downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Mainline Piping: Located downstream from point of connection to water distribution piping to, and including, control valves. Piping is under system pressure.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- D. Hardscape: Site roads, walks, walls, or any other surface improvements for which removal for excavation to perform maintenance or replacement of the irrigation system pipes, or wires will require disturbance of other than landscape materials.

1.3 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Submittals: SECTION 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- C. Concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).

D. Excavation, Backfill: Section 31 20 11, EARTH MOVING.

E. Division 26, Electrical

F. Section 32 90 00, PLANTING

1.4 QUALITY ASSURANCE

A. Irrigation Contractor:

1. Irrigation Contractor must have demonstrated, using persons directly employed by the Contractor, experience with the construction of at least five (5) irrigation systems having large diameter gasketed pipe (4-inch and larger), centralized control systems with hardwired or radio communication, electrically operated remote control valves, large radius rotary sprinklers (minimum 1-inch inlet with swing joint).
2. Irrigation Contractor must be licensed in the State of New Mexico.

B. Equipment Manufacturer:

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 24 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.

C. 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 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.

D. System Requirements:

1. Full (head to head plus 10%) and complete coverage of the irrigated areas is required. Contractor shall, at no additional cost to the Government, make necessary adjustments to head locations as required to achieve full coverage of irrigated areas.
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. Diagrammatic also refers to the location of the pipelines and valves, which may have been adjusted for clarity of the drawings. Lines are to be common trenched wherever possible. Irrigation heads along roadways shall be placed between 12" to 18" from back of curb, unless otherwise specified.
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. Remote control valves shall be located individually or in groups of two, to minimize tripping hazards. Where the exact location for the valves has not been set, or there are any conflicts, the location shall be coordinated with the CO/COR before installation.
4. Irrigation lines and control wire shall run at boundaries of graves, thru designated utility lanes or beside roadways so that any gravesite may be opened in the future without disruption of the irrigation system.
5. Irrigation lines, control wires and power wires shall be run in trenches as indicated on the drawings or as typical for industry standards, if not indicated.
6. Disconnect and abandon existing irrigation system. Remove all sprinklers, valves and valve boxes located in Section F (reference the drawings). Fill all voids created by removals with compacted soil.
7. Unless noted otherwise, all irrigation lines, power wires and control wires shall be run in sleeves or conduit where installed beneath any site hardscape materials.

- E. 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.
- G. Follow manufacturer's instructions for installation.

1.5 SUBMITTALS

- A. Make submittals and provide number of copies per Specifications Section 01 33 23. Unless otherwise noted, provide four (4) copies of irrigation information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, "DO NOT DRINK" sign and all other irrigation equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the CO/COR. Incomplete submittals will be returned without review. Sequentially number each page of the submittal for ease in referencing during submittal review. Pages within a letter or number identified Tab section may be numbered sequentially as long as the process is consistent and provides unique page identification for each page of the submittal.
- B. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, valves, mainline components, water filtration components, electrical components and control system components. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts and specifications for equipment to be included in the project work. For rotary sprinklers include Center for Irrigation Technology Space Pro Single Leg Profile showing the Distribution Uniformity and Scheduling Coefficient for the nozzles being used at the specified spacing.
- D. Shop Drawings: Complete detailed layout shop drawings covering complete wiring diagram showing routing of decoder cable and manufacturer required surge protection at minimum 500 feet intervals along two wire path. Submittal shall also show source of current and connections to existing services. Do not start work before final shop drawing approval.
- E. Testing: Submit a proof of testing report following completion of each test listed in Part 1 of these specifications. Unless otherwise noted,

include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.

- F. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.
- G. Record Drawings: Submit information listed in Parts 1 and 3 of these specifications.
- H. Name and address of a permanent service organization maintained or trained by the manufacturers that will as a result of determined warranty work, or after warranty period following execution of a service contract for this facility, render satisfactory service within 24 hours of receipt of notification that service is requested.
- I. Reproducible "as-built" drawings. Submit information indicating the "as-built" conditions for the irrigation system to the CO/COR as marked-up copies of the full sized bid documents posted with all addendum, clarification and approved modifications. Upon approval by the CO/COR the Contractor produced marked-up "as-built" irrigation drawings shall be submitted to the A/E for preparation of the electronic "as-built" drawing(s) for the irrigation system. After electronic "as-built" drawing(s) have been approved, the Contractor shall utilize them to prepare an overall irrigation system drawing of a size suitable for display proximate to the irrigation central control computer.
- J. 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 submitted and 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 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.

1.6 SUBSTITUTIONS

- A. Unless otherwise noted, use specified equipment to match existing equipment. CO/COR must approve equipment prior to construction. Changes and associated design costs to accommodate alternative equipment are Contractor's responsibility. "As-Built" information shall show the sizes installed.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

1.7 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressures shall be as specified on the drawings.

1.8 CODES AND REGULATIONS

- A. Work and materials will be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

1.9 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the Contractor from existing outlets and supplies except as follows. Upon completion of the new irrigation system for this project or completion of portions thereof, the contractor through the permanent connection of the new irrigation system to the existing fully functional irrigation water source of supply constructed as part of this project, shall be provided water at available flow and pressure, for use by the Contractor, with Contractor provided additional facilities and/or equipment as required to perform the required flushing and testing of the new irrigation

system. Contractor shall coordinate the construction of the new irrigation water source of supply with the irrigation system construction to insure that water is available for irrigation purposes, or shall provide for irrigation water by other means at no cost to the Government. Once the irrigation system is deemed operable and approved, and prior to the final inspection, the contractor may use water at no cost through the irrigation system for establishing turf and maintaining plant material. No other expressed or implied uses of government furnished water exist.

1.10 TESTING

- A. Notify the CO/COR three days in advance of testing.
- B. Newly installed irrigation pipelines jointed with rubber gaskets or threaded connections shall be subject to pressure and leakage testing after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the CO/COR.
- D. Furnish clean, clear water, pumps, labor, fittings, power and equipment necessary to conduct tests or retests.
- E. Volumetric Leakage Test - Gasketed Mainline Pipe:
 1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 2. Purge all air from the pipeline before test.
 3. Provide all necessary pumps, bypass piping, storage tanks, meters, (3-inch) test gauge, supply piping, and fittings in order to properly perform testing. Testing pump must provide a continuous (100 psi) pressure to the mainline pipe. Where main lines are installed with significant elevation change, perform the test at the mid elevation of the segment being tested. Main lines may be tested in segments where the terrain makes it difficult to maintain the test pressure throughout. The test pressure is the minimum pressure on the line at the highest point of the line segment being tested.
 4. Allowable deviation in test pressure is (5 psi) during test period. Average pressure during the test shall be (100 psi) therefore the pressure shall start at 5 psi above and be re-pressurized when the

- pressure is 5 psi below the test pressure. Restore test pressure to (100 psi) at end of test. Water added to mainline pipe must be measured volumetrically to nearest (0.025 gallons).
5. Subject mainline pipe to the anticipated operating pressure of (100 psi) for two hours. The amount of additional water pumped in during the test will not exceed the value in the table, or the calculated value using the formula below, based upon differing number of joints, duration or pressure of the test:

Leakage Allowable (Gallons per (100 Joints) / Hour)

PIPE SIZE mm (INCHES)	Test Pressure (PSI)								
	60	70	80	90	100	110	120	130	140
63mm (2 ½")	0.26	0.28	0.30	0.32	0.34	0.35	0.37	0.39	0.40
75mm (3")	0.31	0.34	0.36	0.38	0.41	0.43	0.44	0.46	0.48
100 mm (4")	0.42	0.45	0.48	0.51	0.54	0.57	0.59	0.62	0.64
150 mm (6")	0.63	0.68	0.73	0.77	0.81	0.85	0.89	0.92	0.96
200 mm (8")	0.84	0.90	0.97	1.03	1.08	1.13	1.18	1.23	1.28
250 mm (10")	1.05	1.13	1.21	1.28	1.35	1.42	1.48	1.54	1.60
300 mm (12")	1.26	1.36	1.45	1.54	1.62	1.70	1.78	1.85	1.92

Note: Allowable Leakage calculated using $L = (ND\sqrt{P})/7400$

Where: L = Allowable Leakage (gph)

N = Number of Joints

D = Nominal Diameter of Pipe (inches)

P = Average Test Pressure (psi)

Volumetric leakage exceeding the amounts indicated above, adjusted for system test pressure, number of joints and shall be a failure of the test. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.

6. Cement or caulking to seal leaks is prohibited.
7. Contractor may sub-contract testing to pipeline testing company approved by CO/COR.

F. Hydrostatic Pressure Test - Solvent Weld Lateral Pipe:

1. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure of (80 psi) for 30 minutes.
2. Cap all sprinkler risers.
3. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
4. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
5. Cement or caulking to seal leaks is prohibited.
6. After lateral passes test and prior to operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.

G. Operational Test - Remote Control Valves, Lateral Piping and Sprinklers:

1. Activate each remote control valve in sequence from each new controller manually at the controller, and via any handheld units through their stand alone communication system. Manual operation on the valves from the bleed valve on the remote control valve is not an acceptable method of activation. The CO/COR will visually observe operation, water application patterns, and leakage.
2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
3. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.
6. The backflow prevention device shall be tested by a certified tester prior to project acceptance.

H. Distribution Uniformity (DU):

1. Perform a DU Test on one zone of burial section rotors and one zone of tree lawn rotors per each controller. Verify that DU meets submittal 1.5C.

2. In conjunction with the CO/COR, select the zones of sprinklers that are representative of the area being irrigated by the controller.
3. Perform a catch can test using procedures recommended by the Irrigation Association.
4. Where DU test fails adjust zone pressures and/or nozzle sizes to meet required Distribution Uniformity.
5. Calculate and provide a written documentation of the DU for each zone tested.
6. An Irrigation Association Certified Landscape Irrigation Auditor must perform the test. Provide written evidence of certification prior to conducting test.

I. Control System Grounding:

1. Test all new controllers for proper grounding of control system with installed grounding equipment that creates grounding resistance readings of 5 ohms or less or higher levels not to exceed 15 ohms, if acceptable by equipment manufacturer without equipment warranty invalidation. Test results must meet or exceed control system manufacturer's requirements for acceptance, while maintaining equipment warranty.
2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer's requirements are met. Add grounding rods as needed, bond all rods together.
3. If the test is acceptable, the individual completing the test must document the results of the grounding test on the inside of each satellite controller pedestal door and via a written report submitted to the CO/COR. Documentation should include controller name or number, date of test, name or initials of the individual completing the test, and the ohms resistance to ground. The test results should be marked on the inside of each controller pedestal door using a permanent marker.
4. A written report of the test data listing controller name or number, date of test, name of the individual completing the test, name of the company completing the test and the ohms resistance to the local ground for each satellite must be submitted to the CO/COR

J. Irrigation System Acceptance Test (Burn in) Prior to Final Inspection:

1. Upon completion of construction and prior to Final Inspection, an Acceptance Test(Burn in) must be passed.

2. Coordinate start of Test with CO/COR.
3. During the Test, the irrigation system must be fully operational from the controller. The irrigation system, must operate with no faults for 14 consecutive days. If at any time during the 14 day test period, a system fault occurs, the source of the fault must be determined and corrected and the 14 day evaluation period will start again. If a system fault occurs, make repairs within 24 hours of notification from CO/COR. Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.
4. When the system has operated for 14 days without fault, contact the CO/COR to schedule Final Inspection.
5. If the system is designed to detect flow and shut down and this condition happens during test, this is considered a success and test continues; if it does not shut down the test starts over

1.11 WARRANTY AND REPLACEMENT

- A. The purpose of the warranty is to insure that the Government receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.
 1. Warranty irrigation materials, equipment, and workmanship against defects for a period of one year from Final Acceptance by CO/COR. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item. Make repairs within 24 hours of notification from CO/COR.
 2. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
 3. Warranty applies to originally installed materials and equipment and replacements made during the Warranty period.

1.12 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with CO/COR or Cemetery Staff. Disturbance to cemetery operations must be minimized. See irrigation plans and installation details and Specifications Sections for required coordination efforts related to the installation of specific irrigation components.

- B. Install irrigation mainline and control and power wiring in sleeves under new roads prior to installation of road base, and under all other concrete or asphalt, either existing or new for this project.
- C. Install irrigation components in landscaped areas unless specifically indicated otherwise.
- D. Construction cannot proceed unless staking of irrigation mainline, remote control valve locations, and sprinkler locations are reviewed and accepted by the CO/COR.

1.13 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):
B40.1-05.....Gauges-Pressure Indicating Dial Type-Elastic
Element
- C. American Society of Sanitary Engineers (ASSE):
1013-2005.....Reduced Pressure Principle Backflow Preventers
- D. American Society for Testing and Materials (ASTM):
A242/A242M-04 (2009)....High Strength Low-Alloy Structural Steel
A536-84 (2009).....Ductile Iron Castings
B61-08.....Steam or Valve Bronze Castings
B62-09.....Composition Bronze or Ounce Metal Castings
D1785-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe,
Schedule 40, 80, and 120
D1238-04c..... Standard Test Method for Melt Flow Rates of
Thermoplastics by Extrusion Plastometer
D1784-08.....Rigid Poly(Vinyl Chloride) (PVC) Compounds and
Chlorinated Poly(Vinyl Chloride) (CPVC)
Compounds
D1785-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe,
Schedules 40, 80, 120
D1894-08.....Standard Test Method for Static and Kinetic
Coefficients of Friction of Plastic Film and
Sheeting
D2241-05.....Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe
(SDR Series)

- D2464-06.....Threaded Poly (Vinyl Chloride) (PVC) Plastic
Pipe Fittings, Schedule 80
- D2466-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe
Fittings, Schedule 40
- D2564-04e1.....Solvent Cements for Poly (Vinyl Chloride) (PVC)
Plastic Piping Systems
- D2657-07.....Standard Practice for Heat Fusion Joining of
Polyolefin Pipe and Fittings
- D3139-98 (2005).....Joints for Plastic Pressure Pipes Using
Flexible Elastomeric Seals
- D3350-10Standard Specification for PE Pipe & Fittings
Materials
- F477-08.....Elastomeric Seals (Gaskets) for Joining Plastic
Pipe
- E. American Water Works Association (AWWA):
 - C110/A21.10-08.....Ductile-Iron and Gray-Iron Fittings, 3-Inch
Through 48-Inch for Water
 - C111/A21.11-06.....Rubber-Gasket Joints for Ductile-Iron Pressure
Pipe and Fittings.
 - C115/A21.15-05.....Flanged Ductile-Iron Pipe with Ductile-Iron or
Gray-Iron Threaded Flanges
 - C151/A21.51-09.....Ductile-Iron Pipe, Centrifugally Cast, for
Water C153/A21.53-00 Ductile-Iron Compact
Fittings for Water Service
 - C504-06.....Rubber Seated Butterfly Valves
 - C509-09.....Resilient-Seated Gate Valves for Water Supply
Service
 - C901-08.....AWWA Standard for Polyethylene (PE) Pressure
Pipe and Tubing, 13 mm ($\frac{1}{2}$ In.) through 76 mm
(3 In.), for Water Service
- F. Manufacturers Standardization Society (MSS):
 - SP70-2006.....Cast Iron gate Valves, Flanged and Thread Ends
- G. National Electrical Manufacturers Association (NEMA):
 - 250-2008.....Enclosures for Electrical Equipment (1000 Volts
Maximum);

PART 2 - PRODUCTS

2.1 QUALITY

- A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

- A. Unless noted otherwise, use specified equipment. CO/COR must approve equipment prior to construction. The Contactor through written request prior to purchase or installation may request substitutions to the approved equals listed herein. Changes and associated design costs to accommodate alternative equipment are Contractor's.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

2.3 SLEEVING

- A. Provide sleeves beneath all hardscape for irrigation pipe and all wiring. Provide separate sleeves beneath hardscape for wiring.
- B. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
- C. Use Class 200, SDR-21, rated at (200 psi), conforming to dimensions and tolerances established by ASTM Standard D2241 or AWWA C905, DR-25 rated at (165 psi) conforming to AWWA Standard C905, or use C-900 PVC pipe, rated at (200 psi).
- E. Sleeve sizes are to be as shown on the drawings or twice the nominal diameter of pipe if not shown. The wiring bundle area may not exceed more than 40% of the sleeve cross sectional area, per NEC recommendations.

2.4 PIPE AND FITTINGS

- A. Irrigation Mains:
 - 1. Mainline pipe 2 1/2" and larger shall be polyvinyl chloride (PVC) Pressure Pipe, Class 200, SDR-21, rated at (200 psi), conforming to dimensions and tolerances established by ASTM Standard D2241.
 - 2. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use push-on rubber-gasketed ductile iron fittings with joint restraints according to 2.4.E.

B. Lateral Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
2. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Threaded Pipe:

1. Polyvinyl Chloride, ASTM D1785, PVC 1120, Schedule 80, for threaded connections, risers and swing joints.

E. Fittings:

1. Irrigation Mains:

a. Ductile Iron and PVC Pipe:

Mainline joints for bends (changes in direction), reducers and end caps shall be Leemco gasketed, push on, ductile iron fittings with joint restraints, or approved equal. Joints shall be installed in compliance with the manufacturer's directions and detail F6/I-107 in the Drawings. All joints in straight runs of pipe at both sides of bends, reducers and end caps shall receive Leemco joint restraints, or approved equal in accordance with manufacturer's directions and detail F6/I-107 in the Drawings.

2. Irrigation Laterals:

PVC, schedule 40, solvent welded socket type, ASTM D2466.

3. Threaded Pipe:

PVC, schedule 80, ASTM D2464.

4. Swing Joints:

Shall be a standard complete assembly by a manufacture, with elastomeric seals that allow 360 degree rotation, and are designed for minimum 1375 kPa (200 psig) working pressure.

F. Jointing Materials:

1. Irrigation Mains: Rubber gaskets, AWWA C111.

2. Irrigation Laterals: Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.
3. Threaded pipes: Use only Teflon-type tape or Teflon based paste pipe joint sealant on plastic threads. Use non-hardening, non-toxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

2.5 RESTRAINTS

- A. For all pipe 3" and larger, joints for bends (changes in direction), reducers and end caps shall be Leemco gasketed, push on, ductile iron fittings with joint restraints, or approved equal. Joints shall be installed in compliance with the manufacturer's directions and detail F6/I-107 in the drawings. All joints in straight runs of pipe at both sides of restrained bends, reducers and end caps shall receive Leemco joint restraints, or approved equal in accordance with manufacturer's directions and detail F6/I-107 in the drawings.

2.6 MAINLINE COMPONENTS

- A. Valves (Except remote control valves):
 1. General valve installation shall be as presented in the installation details. All valves shall meet or exceed any specified parameters identified herein.
 - a. Underground Shut-Off Valves shall be Matco "O" ring gasket iron body gate valve 10RT4 with 2" operating nut, or approved equal.
 - b. Air-Vacuum Relief Valves shall be Crispin AL-20, size 2", or approved equal.
 - e. Isolation valves 2" and smaller:
Use a NIBCO TI-8 brass gate valve with hand wheel or approved equal.
 - f. Quick Coupling Valve Assembly shall be Rain Bird 44 LRC or approved equal.
- B. Flower Water Station Spigot Connection Assembly:
 1. As presented in the installation details.
 2. Flower Watering Station Spigot: Acceptable model is Haws self closing faucet Model #6252 brass finish - no chrome, or approved equal.
 3. Inline pressure regulator, acceptable model is Zurn-Wilkins 70XL or approved equal.

5. Brass Pipe: Use extra heavy solid brass pipe and fittings with brass straps and brass screws.
6. Valve Box: Shall be as presented in the installation details.
- C. Valve Boxes: Shall be as presented in the installation details or approved equal.
- D. Backflow Preventer shall be Febco 880V reduced pressure principle backflow preventer, or approved equal.
- E. Water Meter Assembly: Reference Civil Drawings.
- F. Master Valve Assembly shall be Superior Controls Inc. 3300300 Normally open 24 volt solenoid valve, or approved equal.
- G. Flow Sensing Assembly shall be Netafim Octave Ultrasonic Water Meter model LS36OCT03GAL0.1 with optional pulse output, or approved equal.

2.7 SPRINKLER IRRIGATION COMPONENTS

- A. Remote Control Valve Assembly:
 1. Swivel Saddle and Lateral isolation valve shall be Leemco 4" PVC x Ductile Iron female swivel saddle with Leemco 2" x 4" gasket x male swivel isolation valve, or approved equal.
 2. Remote Control Valves shall be Superior Controls Inc. 950 DWPRS pressure regulating valve, or approved equal.
 2. Gate Valve: Acceptable manufacturer is NIBCO TI-8 brass gate valve with hand wheel or approved equal.
 3. PVC Union: Use a Schedule 80 threaded union with O-ring seal. Acceptable manufacturer is Spears or approved equal.
 4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
 5. Wire connectors: Use 3M DBR/Y-6.
 6. Use plastic valve tags as presented in the installation details or approved equal.
- B. Pop-Up Gear-Driven Rotary Sprinkler Assemblies shall be Rain Bird 5000 Series with PRS Std. angle Rain Curtain nozzles, 4" pop-up with stainless steel riser and Rain Bird 8005 Series, 4" pop-up with stainless steel riser, or approved equals.
- C. Bubblers:
 1. Bubblers shall be pressure compensating with fixed GPM discharge rates. Acceptable models are Rain Bird 1400 Series pressure compensating bubbler or approved equal.

2. Root Watering Assemblies shall be Rain Bird RWS Root Watering Tube, or approved equal.
- E. Low Voltage Decoders and Decoder Control Valve Wire:
1. Decoders at master valve and all automatic spray and bubbler valves shall be Rain Bird FD-Turf Series Two Wire Decoders, or approved equal.
 2. Decoder at flow sensor shall be Rain Bird SD210TURF sensor decoder, or approved equal.
 3. Wiring between controller and field decoders at remote control valve assemblies shall be Rain Bird direct burial 14 gauge "Maxi-Cable" or approved equal. Installation shall be in strict accordance with the manufacturers directives.
 4. When more than one valve is connected to a single decoder use 14 AWG UF direct-burial control wire to connect decoder to solenoids.
 5. Splicing Materials: Use 3M DBR/Y-6 or approved equal.
 6. Provide PE-Decoder Cable Fuse Device (DCFD)[™], or approved equal, where two wire decoder cable splits in different directions and at long straight runs of cable as required to isolate cable for trouble shooting.
- F. Warning Tape:
1. Standard, 4-Mil polyethylene (3 inch) wide tape, detectable type blue with black letters, and imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW".
- G. Tracer Wires:
1. No. 14, Green, Type TW plastic-coated copper tracer wire shall be installed with non-metallic irrigation main lines.

2.8 CONTROL SYSTEM COMPONENTS

- A. Automatic central control equipment:
1. Overall Control Concept: The automatic controller install at the site shall be compatible with a central computer system which provides irrigation starting controls and overriding capabilities of field satellite units in turn operating individual remote control valves in accordance with timing schedules programmed into the field units. The central computer system will not be furnished or installed as part of the project.

- B. Automatic Control Equipment—Independent Satellite Controllers:
1. Overall Control Concept. The electric automatic control system shall consist of one independent satellite controller which operates individual remote control valves in accordance with timing schedules programmed into the independent unit. The installation and location of the controller is shown on the drawings.
 2. The Controller shall be a wall mounted, Rain Bird ESP-LXD, 50 Station two-wire decoder outdoor controller or approved equal.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

- A. Site Inspections:
1. The Contractor Shall verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the CO/COR prior to beginning work.
- B. Utility Locates ("Call Before You Dig"):
1. Arrange for and coordinate with local authorities the location of all underground utilities, and with cemetery maintenance personnel.
 2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.
- C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the CO/COR one week in advance of review. The CO/COR will identify and approve modifications during this review.

3.2 LAYOUT OF WORK

- A. Stake locations of aisles and sprinklers in existing burial sections using a licensed surveyor. Use aisles as identified on the drawings.
- B. Stake out the irrigation system. Items staked include: irrigation mainline pipe, thrust blocks, isolation gate valve assemblies, air/vacuum relief valve assemblies, quick coupling valves, remote control valves, lateral piping, and sprinklers.
- C. The locations of all sprinklers and valves shall be GPS mapped and GPS mapping shall be provided as a submittal in AutoCAD format. Locations of valves shall also be indicated by dimensions from existing fixed objects and included in the submittal.
- D. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with CO/COR.

3.3 EXCAVATION, TRENCHING AND BACKFILLING

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Do not lay pipe on unstable material, in wet trench or when, in the opinion of the Co/COR, trench or weather conditions are unsuitable for the work.
- C. Install ductile Iron fittings and joint restraints as specified elsewhere in these specifications.
- D. Allow a minimum of (3 inches) between parallel pipes in the same trench.
- E. Hold pipe securely in place while joint is being made.
- F. Do not work over, or walk on, pipe in trenches until covered by layers of earth well tamped in place to a depth of (12 inches) over pipe.
- G. 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.
- H. Install sprinkler lines to avoid electric ducts, storm and sanitary sewer lines, water and gas mains, all of which have right of way.
- I. 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.
- J. Minimum cover:
 - 1. (36-inches) over irrigation mainline pipe in landscaped areas and to bottom of road base. (distance from top of pipe to finish grade)
 - 2. (18-inches) over irrigation lateral pipe to sprinklers. (distance from top of pipe to finish grade)
 - 3. (18-inches) over control wire when not in common trench with mainline or lateral piping. (distance from top of control wire to finish grade)
 - 4. (18-inches) vertical separation between lateral and mainline pipe installed in a common trench.
 - 5. (3-inches) minimum horizontal separation between pipes and wiring in a common trench.
 - 6. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.

7. Tops of remote control valves shall never be less than (3 inches) below lid of valve box.
- K. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the CO/COR.
- L. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.
- M. If trenching operation restricts access to a burial section, provide plywood and safety fencing across open trench to allow access to burial section. Provide access to the satisfaction of the CO/COR.
- N. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.
- O. Enclose pipe and wiring beneath roadways, walks, curbs, etc in sleeves. Backfill sleeves in the following manner:
 1. Backfill trench using excavated material in (6-inch to 8-inch) layers. Minimum compaction of backfill for sleeves shall be a minimum 95% Standard Proctor Density, ASTM D698-78. Backfill to bottom of road base under roads or to finish grade under walks and curbs.
- P. Backfill mainline pipe, lateral pipe and wiring in turf areas in the following manner:
 1. Backfill the trench by depositing the backfill material equally on both sides of the pipe or wire in (6-inch) layers and compacting to the density of surrounding soil.
- Q. Dress backfilled areas to original grade. Dispose of excess backfill and/or unsuitable backfill in a legal disposal area off-site.
- R. Where utilities conflict with irrigation trenching and pipe work, contact the CO/COR for trench depth adjustments.
- S. 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.
- T. 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.

- U. Warning tape shall be continuously placed above sprinkler system water mains at a depth of (8-10 inches).
- V. Survey monuments:
 - a. Protect markers during construction.
 - b. If a survey marker is disturbed during construction, the Contractor is responsible for replacing the marker. The Contractor must hire a licensed surveyor to resurvey the location of the marker and replace it in the proper location.

3.4 SLEEVING AND BORING

- A. Furnish and install where pipe and control wires pass under walks, paving, walls, and other similar areas.
- B. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.
- C. Extend sleeve ends a minimum of (12-inches) beyond the edge of the paved surface. Cover pipe ends and mark edge of pavement with a chisel or saw.
- D. Verify that sleeve sizing is adequate prior to installation. Sleeving to be twice line size or greater to accommodate retrieval for repair of wiring or piping and shall extend (12-inches) beyond edges of paving or construction. Cover pipe ends and mark edge of pavement with a chisel or saw.
- E. Bed sleeves with a minimum of 100 mm (4 inches) of sand backfill above top of pipe.

3.5 ASSEMBLING PIPE AND FITTINGS

- A. General:
 - 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
 - 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
 - 3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per (20-foot) length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 6 m (20') LENGTH
38 mm (1 ½")	7.5 m (25')	2.3 m (7'-8")
50 mm (2")	7.5 m (25')	2.3 m (7'-8")
63 mm (2 ½")	30 m (100')	575 mm (1'-11")
75 mm (3")	30 m (100')	575 mm (1'-11")
100 mm (4")	30 m (100')	575 mm (1'-11")
150 mm (6")	45 m (150')	400 mm (1'-4")
200 mm (8")	60 m (200')	300 mm (1'-0")
250 mm (10")	75 m (250')	225 mm (9")
300 mm (12")	90 m (300')	200 mm (8")

B. Mainline Pipe and Fittings:

1. Plastic pipe:

a. Shall be snaked in trench at least (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.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:

- a. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
- b. Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
- c. Snake pipe from side to side within trench.
- d. In irrigation isles, coordinate with the location of the monuments to avoid conflicts.

2. Fittings: The use of cross type fittings is not permitted.

D. Specialized Pipe and Fittings:

1. Mechanical joint connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.

2. PVC Threaded Connections:

- a. Use only factory-formed threads. Field-cut threads are not permitted.
- b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
- c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.

F. Joint Restraint Harness:

1. Install joint restraints in the manner recommended by the manufacturer and in accordance with accepted industry practices.
2. Provide correct number and type of restraints per manufacturer's requirements.

3.6 INSTALLATION OF MAINLINE COMPONENTS

A. Setting of valves:

1. No valves shall be set under pavement or walks.
2. Clean interior of valves of foreign matter before installation.
3. Where pressure control valves are installed adjacent to remote control valve, they shall be housed in the same valve box.
4. Set valve box cover flush with finished grade.
5. Install as indicated in the installation details, per manufacturer's instructions.
6. Install where indicated on the irrigation plans.
7. Brand or cast "GV" in (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.

B. Air/Vacuum Relief Valve Assembly:

1. As presented in the installation details, per manufacture's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "AV" in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Quick Coupling Valve Assembly:

1. As presented in the installation details, per manufacture's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "QC" in 2-inch high by 3/16-inch deep letters on valve box lid.

D. Flower Watering Station Hydrant Connection Assembly:

1. As presented in the installation details, per manufacture's instructions.
2. Sequence of construction:
 - a. Coordinate exact location with CO/COR.
 - b. Components are to be installed before concrete pad. Coordinate installation with concrete contractor.
3. Location:

- a. Stations will be installed at locations indicated on drawings, centered between adjacent sprinkler locations.
- b. Route adjacent piping around stations. No mainline or lateral pipe is to be installed under Flower Watering Stations.
4. Brand "FW" in 2-inch high by 3/16-inch deep letters on valve box lid.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS AND QUICK COUPLERS

A. Remote Control Valve Assembly:

1. Mainline Flushing:
 - a. Thoroughly flush mainline before installation of Remote Control Valve Assemblies.
 - b. Identify remote control valve service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
 - c. Connect (2-inch) pipe to flushing service tee(s). Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations.
 - d. Use a volume of water such that the velocity in the largest pipe flushing to this point is (3 FPS).
 - e. Multiple points may be flushed simultaneously.
 - f. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
 - g. The CO/COR will review the flushing operation and clarity of water before stopping the flushing operation.
 - h. Disconnect pipe from service tee(s) and install remote control valve(s).
2. Install per manufacturer's recommendations where indicated on the drawings.
3. Adjust valve to regulate the downstream operating pressure to meet the pressure notated on the Drawings.
4. Wire connectors and waterproof sealant will be used to connect control wires to decoders and solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
5. Install only one remote control valve to a valve box. Where space allows, locate valve box (5-feet) from and align square with nearby

- edges of roadways. Where space does not allow for a 5-foot offset, align per the direction of the CO/COR.
6. Attach ID tag with controller station number to control wiring at solenoid.
 7. Brand controller and station number in 50 (2-inch) high by (3/16-inch) deep letters on valve box lid.
- B. Pop-Up Gear-Driven Rotary Sprinkler Assembly:
1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
 2. Install per the installation details at locations shown on the drawings.
 3. Locate rotary sprinklers (6-inches) from adjacent edges of curbs, paved areas, walls or fences.
 4. Install sprinklers perpendicular to the finish grade.
 5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
 6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
 7. Adjust the radius of throw of each sprinkler for best performance.
 8. Install (2-foot) square piece of sod around all rotary sprinklers in areas to be seeded.
- C. Bubbler Assembly:
1. Thoroughly flush lateral pipe before installing bubbler. Water must be clear of any debris before flushing operation stops.
 2. Install per the installation details at locations shown on the drawings.
 3. Install bubblers perpendicular to the finish grade.
 4. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
- D. Sprinkler Heads:
1. Shall be placed on temporary nipples extending at least (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 at ground surface as detailed.
 2. Place part-circle rotary sprinkler heads no more than (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.

3. Install all bubblers and quick couplers on swing joints as detailed on plans.

3.8 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Install controller at location shown in the drawings.
2. Install electrical connections per control system manufacturer's recommendations and is shown in the drawings.
3. Lightning protection: Drive grounding rod(s) into soil its full length. Furnish and install grounding plate(s) as indicated or as required to create the grounding connection with the field tested resistance value equal to or lower that the specified values identified in this specification. Connect (#6 AWG) copper grounding wire to rod and plate using CADWELD style connections. Brand "GR" in (2-inch) high by (3/16-inch) deep letters on valve box lid.
4. Connect control wire to the corresponding control unit terminal.
5. Install permanent receiver for hand held radio if not factory installed.

B. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a separate (12-inch) standard valve box. Coil (2 feet) of wire in valve box. Brand "WS" in (2-inch) high by (3/16-inch) deep letters on valve box lid.
2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
3. Green wire shall be used as the common ground wire from power source to all satellites. White shall be the common (neutral) wire. All wiring is to be NEC Code compliant.
4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
5. Unless noted on plans, install wire parallel with and below mainline pipe. Install wire a minimum (2-inches) below top of PVC mainline pipe.
6. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the

- backfill, (8-10 inches) below the ground surface, directly over the wiring.
7. Surface mount wire installed above grade in a professional manner with routing approved by the Contracting Officer.
 8. Connect wire to power source.
- C. Installation of Decoder System and Decoder Control Wire:
1. Installation of two-wire decoder based system shall be in strict compliance with manufacturer's directives and recommendations. Per the submittal section of these specifications, Contractor shall provide a shop drawing which identifies locations of decoder cable, decoders and Decoder Cable Fuse Devices, for review and approval by the COR prior to beginning work on the irrigation system.
 2. Provide a (24-inch) excess length of wire in an (8-inch) diameter loop at each 90 degree change of direction, at both ends of sleeves, and at (100-foot) intervals along continuous runs of wiring. Do not tie wiring loop. Coil (24-inch) length of wire within each remote control valve box.
 3. If a control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve assembly, or in a separate valve box. Use same procedure for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand "WS" in (2-inch) high by (3/16-inch) deep letters on valve box lid.
 4. Unless noted on plans, install wire parallel with and below mainline pipe.
 5. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill (6-inches) above the wiring.
 6. Cap all exposed wire ends with wire nuts.
 7. 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.
 8. Provide (12 inch) expansion loops in wiring at each wire connection or change in wire direction. Provide (24 inch) loop at remote control valves.

9. Power wiring for the operation of irrigation system shall not be run in same conduit as control wiring.

3.9 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.

3.10 INSTALLATION OF OTHER COMPONENTS

- A. Tools and Spare Parts:
 1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.
- B. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.11 TEST AND FLUSHING

- A. Test irrigation system per procedures listed in section 1.10.
- B. Flushing: After testing, flush system per procedures listed in section 3.7. 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.

3.12 MAINTENANCE AND OPERATION INSTRUCTIONS

- A. Maintenance and Operating Instructions: Prior to final acceptance, provide verbal instructions, for a period of not less than 8 hours, to the operating personnel. Provide Maintenance and Operating Instructions for the provided irrigation system in the form of manual(s) as follows:
1. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
 2. Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
 3. Manufacturer's Operation and Maintenance manuals.
 4. Manufacturer's Technical Service Bulletins.
 5. Manufacturer's Warranty Documentation.
 6. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
 7. Predictive schedule for component replacement.
 8. Listing of technical support contacts.
 9. Operation and maintenance submittal package must be complete prior to being reviewed by the CO/COR. Incomplete submittals will be returned without review.
 10. Provide video taping of the training for the equipment provided for the project. Training shall be produced on DVD or CD, whichever is compatible with the computer system provided for the central computer, where applicable. Training shall be suitable for refresher by the previously trained employees, or for use by new employees to learn the system equipment. Coordinate the final training presentation with the A/E and CO/COR in outline form prior to creation, to insure that the format and organization of the content is applicable for the facility staff utilization.

3.13 WINTERIZATION AND SPRING START-UP

- A. Winterize the new irrigation system in accordance with local practices in the first fall after completion of construction of the irrigation system and start up in the spring after completion of construction.

Repair any damage caused in improper winterization at no additional cost to the Owner. Coordinate the winterization and start-up with the cemetery landscape maintenance personnel.

3.14 TESTING, OPERATIONAL PERFORMANCE AND ACCEPTANCE

- A. Provide the testing as indicated in previous sections of the specifications.
- B. Demonstrate the operations of the systems as indicated in the project specifications.
- C. Acceptance shall be predicated upon a successful demonstration of the operation of the systems, as described, or demonstrating a fully functional system in automatic operation for a period of 7 days, whichever is more stringent.

3.15 MAINTENANCE

- A. Operate and maintain the irrigation system for a duration of 30 calendar days after Final Inspection. Make periodic examinations and adjustments to irrigation system components.

3.16 SPARE PARTS

- A. Upon completion of the work furnish the Owner the following for his maintenance stock.
 - 1. 2 - quick coupler keys with hose adapters
 - 2. 2 - valve keys for operating manual isolation valves with cross handle
 - 3. 1 - valve key for operating manual isolation valves with 2" square operating nut
 - 4. 5 - Rain Bird series 5004-PC-SAM-SS
 - 5. 5 - Rain Bird 8005-SS-SAM-06
 - 6. 10 each - Rain Bird 1401, 1402 and 1404 pressure compensating bubbler
 - 7. 2 each Rain Bird RWS complete root watering system
 - 8. 1 - Rain Bird DPU-210 Sensor Decoder Programming Unit
 - 9. 1 - Rain Bird Landscape Irrigation and Maintenance Remote 3.0 (LIMR)

3.16 CLEANUP

- A. Upon completion of work, remove from site all machinery, tools, excess materials, and rubbish. Restore site to normal or original condition.

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**SECTION 32 90 00
PLANTING**

PART 1 - GENERAL

1.1 DESCRIPTION AND REQUIREMENTS

- A. This work consists of furnishing and installing all planting materials required for landscaping at all NCA construction projects hereinafter specified in locations as shown. The landscape contractor shall be required to visit the site prior to submitting Bid Proposal to become familiar with all conditions affecting the proposed work. The contractor shall identify and review all underground utility locations prior to commencing work and shall exercise caution when working close to utilities and shall notify the (CO/COR) Contracting Officer/Contracting Officer's Representative of apparent conflicts with construction and utilities so that adjustment can be planned prior to installation.
- B. Agronomic consultation on the appropriateness of all plant materials proposed for installation during this project must be obtained from the MSN Agronomist and/or NCA Chief Agronomist via coordination through the CO/COR prior to project initiation and actual plant installation. In general, all plant material must be regionally adapted to the climate of the site, be of appropriate mature dimensions to fit the planting location and be low maintenance species. This requirement will generally exclude or severely limit the use of rose plants, wild flowers and ground covers.
- C. Any exceptions to these species exclusions must be approved by the MSN Agronomist and/or NCA Chief Agronomist via coordination through the CO/COR prior to project initiation.

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 11, EARTH MOVING, Stripping Topsoil and Stock Piling.
- B. Section 01 45 29, TESTING LABORATORY SERVICES, Topsoil Testing.
- C. Section 31 20 11, 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:

Inert Mulch	2.3 kg (5 pounds) of each type to be used.
Organic Mulch	2.3 kg (5 pounds) of each type to be used.

All pesticides required such as preemergence or post emergence herbicides, insecticides, or fungicides.	EPA approved labeling and MSDS sheet for each such product selected for use.
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- B. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the CO/COR for approval:
1. Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease).
 2. Fertilizers.
 3. Lime
 4. Peat
 5. Seed
 6. Sod
- C. Manufacturer's Literature and Data:
1. Antidesiccant
 2. Erosion control materials
 3. Hydro mulch
 4. Pre-emergent herbicide
- D. Soil laboratory testing results and any soil amendment recommendations from the Contractor. Submit soil test results for each variable soil type and condition that exists on the construction site. All soils and materials testing shall be the responsibility of the Contractor.
1. Organic Soil Amendment and Imported Topsoil: The Contractor shall provide a 5 pound representative sample from each proposed source for testing, analysis, and approval. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the CO/COR. Testing reports shall include the following tests and recommendations.
 - a. Mechanical gradation (sieve analysis) and chemical (pH soluble salts) shall be performed by public extension service agency or a certified private testing laboratory in accordance with the current standards of the Association of Official Agricultural Chemists. A hydrometer shall be used to determine percent of clay and silt.
 - b. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 110 °C, plus or minus 5°C.

- c. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Soluble Salts, and acidity (pH).
 - d. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for fertilizing and liming applications to support successful turfgrass growth.
 - e. All tests shall be performed in accordance with the current standards of the Association of Official Agricultural Chemists.
2. Amended soil (in place): Following the incorporation of amendments and additives, the Contractor shall provide a minimum of six (6) samples per forty thousand (40,000) square feet, six inch (6") depth by three inch (3") diameter core samples of amended soil taken from the site for testing, analysis, and approval. The location of each sample shall be as directed by the CO/COR from areas designated to receive turfgrass or be established to turfgrass on the Contract Drawings. No seeding or hydroseeding operations shall occur until acceptance of the amended soil samples has been obtained. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the CO/COR. Tests shall be as directed in paragraph 1.4 E.1.d. of this Section.
 3. Seed: Submit a manufacturer's Certificate of Compliance to the Specifications with each shipment of each type of seed. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.
 4. Fertilizer: Submit four (4) certificates of analysis for each type of fertilizer.
 5. Hydro Mulching: Prior to the start of hydro mulching, submit a certified statement for approval as to the number of pounds of materials to be used per gallon of water.

1.5 DELIVERY AND STORAGE

A. Delivery:

1. Notify the CO/COR 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 and lime to the site in the original, unopened containers bearing the manufacturer's warranted chemical analysis, name, trade name or trademark, and in conformance to state and federal law. In lieu of containers, fertilizer and lime may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.
 5. During delivery: Protect sod from drying out and seed from contamination.
- B. Storage:
1. Sprinkle sod with water and cover with moist burlap, straw or other approved covering, and protect from exposure to wind and direct sunlight. Covering should permit air circulation to alleviate heat development.
 2. Keep seed, lime, and fertilizer in dry storage away from contaminants.
 3. 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. 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.
 - c. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.

1.6 PLANTING AND TURFGRASS INSTALLATION SEASONS AND CONDITIONS

- A. Perform landscape planting operations within the following dates: From March 1st to October 31st, but not before irrigation system is installed, tested, and approved.
- B. Perform turfgrass installation operations within the following dates: From May 1st to August 15th, but not before irrigation system is installed, tested, and approved.
- C. 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 CO/COR stating the special conditions and proposal variance for approval.

1.7 LANDSCAPE PLANT AND TURF ESTABLISHMENT PERIOD

- A. The Establishment Period for landscape plants and turfgrass shall begin immediately after installation, with the approval of the CO/COR and continue for a period of time during the growing season sufficiently long (optimally a minimum of 3 months) for the turfgrass and landscape plant materials to achieve an establishment condition and appearance satisfactory to the MSN

Agronomist and NCA. These conditions and appearance are described as follows: Turfgrass shall have obtained a minimum of 98% surface cover that is generally weed-free and Landscape Plant Materials shall be fully rooted, actively growing and healthy and planting beds generally weed-free. The contractor shall be responsible for the health and maintenance of plants and turfgrass during the establishment period. Plants and turfgrass will not be accepted until after completion of an acceptable establishment period. During the Landscape Plant and TurfGRASS Establishment Period the Contractor shall:

1. Water all plants and turfgrass to maintain a moist soil surface at all times until the plants and turfgrass are well established. An adequate supply of moisture must also be maintained within the root zone. Apply water at a moderate rate so as not to displace the mulch, create any water ponding or runoff from the soil supporting the plants and turfgrass. The actual quantity of applied water required to achieve and maintain these conditions is best determined on site by the MSN Agronomist in consultation with the CO/COR and the Contractor.
2. Prune plants and replace mulch as required.
3. Replace and restore stakes, guy straps, 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 (3 inches). After all unwanted vegetation has been removed and proper mulch quantities have been placed/restored, treat all mulched areas with pre-emergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.
5. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the CO/COR in coordination with the MSN Agronomist.
6. Provide the following during turfgrass establishment:
 - a. Eradicate all weeds. Water, fertilize, overseed, and perform any other operation necessary to promote the growth of turfgrass.
 - b. Mow the turfgrasses as often as necessary to maintain the NCA specified mowing height for each type of turfgrass prior to final acceptance. For warm season turfgrasses mow at heights as appropriate for species and cultivar as directed by the CO/COR in consultation with the MSN Agronomist. Final mowing height is as appropriate for warm season turfgrasses and mow as often as necessary to maintain the proper height while never removing more than 1/3 of the total height of grass leaves in a single mowing. Mow any portion of the newly developing turfgrass

stand that requires mowing without waiting for other areas of slowly developing seedlings to catch-up.

7. Replace dead, missing or defective plant material during the establishment period and an active growing season. Immediately replace each plant with one of the same size and species.
8. Replant any areas void of turfgrass during an active growing season only.
 - a. Seeding shall be evaluated for species and health thirty (30) days after final planting and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from the seeding operation shall be 98% coverage uniform in color and leaf texture. Bare spots shall be a maximum of one-half (0.5) square foot. Unsatisfactory areas shall be reseeded within seven (7) days during an active growing season.
9. Complete remedial measures directed by the CO/COR in consultation with the MSN Agronomist to ensure plant and turfgrass survival.
10. Repair damage caused while making plant or turfgrass replacements.

1.8 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE.

- A. Landscape plant and turfgrass acceptance will occur after completion of the LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD. The Contractor shall have completed, located, and installed all plants and turfgrass according to the plans and specifications. All plants and turfgrass shall be living and in a healthy condition at the time of inspection and acceptance. The Contractor shall make a written request two weeks prior to final inspection of the landscape plants and turfgrass. Upon inspection when work is found to not meet the specifications, the PLANT AND TURFGRASS ESTABLISHMENT PERIOD shall be extended at no additional cost to the Government until work has been satisfactorily completed, inspected and accepted.
- B. Criteria for acceptance of landscape plants.
 1. Planter beds and earth mound water basins are properly mulched and free of weeds.
 2. Tree support stakes, guys, and turnbuckles are in good condition.
 3. Total plants on site as required by specifications and required number of replacements have been installed.
 4. Remedial measures directed by the CO/COR to ensure plant material survival and promote healthy growth have been completed.
- C. Criteria for acceptance of turfgrass shall be as follows:
 1. A satisfactory stand of turfgrass plants from the seeding operation shall be 98% coverage uniform in color and leaf texture. Bare spots shall be a maximum of one-half (0.5) square foot.

1.9 PLANT AND TURFGRASS WARRANTY

- A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of Section 00 72 00, GENERAL CONDITIONS, including the following supplements:
1. A One Year Plant and Turfgrass Warranty will begin on the date that the Government accepts the plants and turfgrass but not before the end of the Landscape Plant and Turfgrass Establishment Period.
 2. The Contractor will replace any dead plant material and any areas void of turfgrass immediately during the warranty period and during an active growing season. A one year warranty for the plants and turfgrass that are replaced will begin on the day the replacement work is completed and accepted.
 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 improper handling, care, or negligence requires replacement in kind and size.
 4. The Government will reinspect all replacement plants and turfgrass at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material and turfgrass immediately and during an active growing season. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification.
 5. The Contractor shall remove stakes, guy straps and any required tree wrappings from plants having been installed for one year, unless otherwise directed by the CO/COR in consultation with the MSN Agronomist.

1.10 APPLICABLE PUBLICATIONS

- A. NCA Handbook 3420 - Turfgrass Maintenance in VA National Cemeteries re-certified 2011. The Agronomic and Horticultural practices specified in this handbook shall serve as the contractor's official reference guide to all establishment and preliminary maintenance practices employed during this construction project.
- B. 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.
- C. 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
- D. Hortus Third, most current edition. A Concise Dictionary of Plants Cultivated in the U.S. and Canada.

- E. American Society for Testing and Materials (ASTM) Publications:
 - C136-06 Sieve Analysis of Fine and Coarse Aggregates
 - C516-08 Vermiculite Loose Fill Thermal Insulation
 - C549-06 Perlite Loose Fill Insulation
 - D977-05 Emulsified Asphalt (AASHTO M140)
 - D1557-09 Test Methods for Laboratory Compaction of Soil
 - D2028-97 (Rev. 2004) ... Cutback Asphalt (Rapid-curing Type)
 - D2103-08 Polyethylene Film and Sheeting
 - D5851 (Rev 2006) Planning and Implementing a Water Monitoring Program
- F. Turfgrass Producers International: Turfgrass Sodding.
- G. U. S. Department of Agriculture Federal Seed Act.
Amended July 2011 Rules and Regulations

PART 2 - PRODUCTS

2.1 GENERAL

All plant and turfgrass 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 ORGANIC SOIL AMENDMENT

- A. All areas to receive turfgrass seeding, may require an organic soil amendment to increase organic content and water retention as well as enhance turfgrass growth. If native topsoil has an organic matter content below 4% it should be amended in-place after grading activities are completed to effectively create a satisfactory topsoil horizon.
- B. Organic soil amendment will be spread and incorporated into the finished subgrade at the depths indicated on the Contract Drawings in order to raise the organic content of the soil to a minimum of four percent (4%) and a maximum of six percent (6%). Contractor will allow for additional depth of the organic soil amendment to bring all grades to the required finished grades as per the grading plans.
 - 1. Organic Soil Amendment shall be dark brown or black in color and capable of enhancing plant growth. Ninety-eight percent (98%) of the material should pass a one inch (1") screen. There shall be no admixture of refuse (i.e. noticeable inert contamination) or other materials toxic to plant growth.
 - 2. Acceptable types of Organic Soil Amendments include peat moss, humus or peat, well rotted manure, various mature composts, and commercially available combinations thereof. Acceptable compost may be derived from natural organic sources such as food or animal residuals, yard trimmings,

or biosolids. Organic Soil Amendment shall be free of all woody fibers, seeds, and leaf structures, plastic and other petroleum products, and free of toxic and non-organic matter. Unacceptable sole sources of organic matter include untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.

3. Organic Soil Amendment shall conform to the following minimum material requirements:

Test Parameter	Acceptable Ranges
Organic Matter	27% to 80%
pH	5.5-8.5
Ash	20-65%
Nitrogen	0.4%-3.5%
Phosphorus	0.2%-1.5%
Potassium	0.4%-1.5%
C:N Ratio	25-30:1
CEC	50-150 meq/100 g
Heavy Metals	Less than max. limits established by EPA 503
Inert Contents	< 1% by weight
Water-Holding Capacity	150-200%
Pathogen/Weed Seed Destruction	Proof of EPA minimum Heating requirements

4. Organic content to be determined by the loss of ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 110 °C, plus or minus 5°C.
5. Any topsoil stripped and stockpiled on the site may be used provided that, after testing and addition of necessary additives, it meets the above specification. The Contractor shall provide additional Organic Soil Amendment as required to complete the required work.
6. All Organic Soil Amendment proposed for use shall be tested for conformance to the specifications and results provided to the CO/COR and MSN Agronomist.

2.3 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.

- 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 CO/COR, 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, Grade 1, 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. Never pick-up or move tree species by grasping the trunk. Trees must be moved by lifting the root ball, box or container.
- 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. Bare-root (BR) plants shall not be used.
- G. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
- H. Make substitutions only when a plant (or its alternates as specified) is not obtainable and the CO/COR in consultation with the MSN Agronomist authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant having the same essential characteristics with no adjustment to the contract price.
- I. When existing plants are to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.

2.4 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.

2.5 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 (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 6.0 nor more than 7.0, and should be best suited to the region, climate and plant material specific to the project.
- B. 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 CO/COR 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.

2.6 LIME

Lime shall be agricultural limestone containing not less than 90 percent calcium and magnesium carbonates. Lime must be ground to such 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%.

2.7 SOIL CONDITIONERS

- A. Peat shall be a natural product of peat moss derived from a fresh-water site conforming to Fed. Spec. Q-P-166, except as otherwise specified. Peat shall be shredded and granulated to pass through a 1/2 inch mesh screen and conditioned in storage piles for at least six months after excavation.
- B. Coarse Sand: Coarse concrete sand, ASTM C-33 Fine Aggregate, shall be clean, sharp, and 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. Pine Bark shall be horticultural-grade milled pine bark, with 80 percent of the material by volume sized between (.004in. and .59in.).
1. Pine bark shall be aged sufficiently to break down all woody material.
Pine bark shall be screened
 2. pH shall range between 4.0 and 7.0.
 3. Submit manufacturer's literature for approval.

- F. 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.

2.8 PLANTING SOIL MIXTURE

The planting soil mixture shall be composed of 3 parts topsoil, and 1 part peat moss.

2.9 PLANT FERTILIZERS

- 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 a uniform free-flowing granular complete analysis fertilizer containing a minimum of 10% by weight of nitrogen, phosphoric acid and potash with a minimum of 50% of the nitrogen from a controlled release source such as sulfur coated urea.
- C. For existing trees, provide a uniform free-flowing granular fertilizer bearing the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 10% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea.), 10% available phosphoric acid, and 10% potash.

2.10 TURFGRASS FERTILIZER

Provide turfgrass fertilizer that is commercial grade, free flowing, uniform in composition, and conforms to applicable state and federal regulations. Granular fertilizer shall bear the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 20% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea), 5% available phosphoric acid, and 15% potash. Liquid starter fertilizer for use in the hydro mulch slurry will be commercial type with 50 percent of the nitrogen from a controlled release source.

2.11 MEMBRANES

- A. Landscape Fabric shall be as presented in the Drawings.

2.12 MULCH

- A. Mulch for hydro-seeding shall be Hydro Straw Original or approved equal applied at the rate of 2,000 pounds per acre. Mixing of water, seed and mulch shall be per manufacturer's recommendation.
- B. Inert mulch materials shall be as presented on the Drawings.

2.15 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 (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.

2.16 STAKES AND GUYING STRAPS

- A. Shall be as presented in the installation details.

2.17 EDGING

- A. Shall be as presented on the drawings.

2.18 WATER

Water shall not contain elements toxic to plant life. It shall be obtained as described in Section 32 84 00 Planting Irrigation.

2.19 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.

2.20 SEED

- A. Seed shall be state-certified seed of the latest season's crop and shall be delivered in original sealed packages bearing the producer's warranted analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Seed shall be labeled in conformance with U. S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. Seed that has become wet, moldy, or otherwise damaged will not be acceptable. Onsite seed mixing shall be done only in the presence of the CO/COR.
- B. Minimum Acceptable Seed Quality standards for all turfgrass seed utilized are as follows: Purity 95%, Germination 85%, Weed Seed Content less than 0.5%, Noxious Weeds 0.0%, Inert Material less than 3%, Germination Test Date no older than 6 months.
- C. Turfgrass seed mixture shall be Princess 77 Bermudagrass. Seeding rate shall be as indicated on the Drawings.

2.21 SOD

Sod shall be nursery grown, certified sod as classified in the TPI Guideline Specifications to Turfgrass Sodding. Sod must also conform to the turfgrass species limitations as outlined in seeding mixtures in 2.20C above in this spec.

2.22 HERBICIDES AND OTHER PESTICIDES

All herbicides and other pesticides shall be properly labeled and registered with the U.S. Environmental Protection Agency. Keep all pesticides in the original labeled containers indicating the analysis and method of use.

PART 3 - EXECUTION

3.1 LAYOUT

Stake plant material locations and bed outlines on project site for approval by the CO/COR before any plant pits or beds are dug. The CO/COR may approve adjustments to plant material locations to meet field conditions.

3.2 FINE GRADING AND ORGANIC SOIL AMENDMENT INCORPORATION

- A. Contractor shall obtain CO/COR written approval of previously completed rough grading work prior to commencing organic soil amendment incorporation work.
- B. Immediately prior to dumping and spreading the approved organic soil amendment, the subgrade shall be cleaned of all stones greater than two inches (2") and all debris or rubbish. Such material shall be removed from the site. Prior to spreading of the organic soil amendment, subgrades shall be tilled to a depth of 8" in two directions. Contractor shall then regrade surface.
- C. Organic soil amendment material shall be placed and uniformly spread over approved finish sub-grades to a depth sufficiently greater than the specified depth so that after natural settlement and light rolling, the specified minimum compacted depth will have been provided and the completed work will conform to the lines, grades and elevations indicated. Incorporate organic soil amendment by disc harrowing, rototilling or other means in a uniform manner. The depth of incorporation shall be based upon the organic content of the tested and approved organic soil amendment, so as to produce a finished soil with an organic matter content of between four (4%) and six percent (6%). Supply additional organic soil amendment material, after in-place testing and approval (see paragraph 1.4. E.1d), as may be needed to give the required organic matter content and finished grades under the Contract without additional cost to the Government.
- D. No subsoil or organic soil amendment material shall be handled in any way if it is in a wet or frozen condition.
- E. Sufficient grade stakes shall be set for checking the finished grades. Stakes must be set in the bottom of swales and at the top of slopes. Connect contours and spot elevations with an even slope.
- G. After organic soil amendment material has been incorporated into the subsoil, it shall be carefully prepared by scarifying or harrowing and hand raking. Remove all large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove all stones over one and one half inch (1-1/2") diameter from the amended soil bed. The amended soil shall also be free of smaller stones in excessive quantities as determined by the CO/COR.

3.3 EXCAVATION FOR PLANTING

- A. The whole surface shall then be compacted with a roller or other suitable means to achieve a maximum dry density of 88 to 90 percent in accordance with compaction standards of ASTM D1557 Method D. During the compaction process, all depressions caused by settlement or rolling shall be filled with additional organic soil amendment and the surface shall be regraded and rolled until presenting a smooth and even finish corresponding to the required grades. The acceptable condition of the finished soil grade for all areas that are to be established to turfgrass is best described as "fine textured and firm". The test for satisfactory firmness requires that the surface soil not be fluffy or powdery and will support the weight of an average adult person without creating a visible depression.
- B. 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 turfgrass before excavations are made in a manner that will protect turfgrass areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.
- C. 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 CO/COR may select other locations for plant material.
- D. 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.
- E. Where ground cover and planting beds occur in existing turfgrass areas, remove turfgrass to a depth that will ensure the removal of the entire root system, with additional bed preparation as specified in the next paragraph.
- F. Planting pits for trees, shrubs and groundcovers shall be shaped and amended in accordance with the planting details included in the drawings.
- 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.
- I. Treat plant saucers, shrub, and ground cover bed areas, after mulching, with preemergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.

3.4 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 in accordance with planting details included in the drawings.

- B. Backfill balled and burlapped and container-grown plants as described in the planting details included in the drawings. For balled and burlapped plants, carefully fold back the top half of the burlap and remove tying materials. Any wire caging or similar material, must be completely removed. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of backfill mixture; then form earth saucers or water basins around isolated plants with topsoil.

3.5 TRUNK WRAPPING

Wrap the trunks of deciduous trees immediately after planting. Wrap the trunks of deciduous trees, (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.

3.6 STAKING AND GUYING

- A. Stake and guy plants as shown on the drawings and as specified.
- B. Remove stakes and guy straps after one year.

3.9 PRUNING

- A. Prune new plant material and indicated existing plant material in the following manner: Remove dead, broken and crossing branches. 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. Do not use any type of wound dressing on pruning cuts.

3.10 FERTILIZATION OF EXISTING TREES

Apply fertilizer to existing trees shown on the drawings at the rate of (2 pounds per inch) caliper. Apply in (4 inch to 8 inch) deep holes 40 to (1-1/2 to 2 inches) in diameter, made by an earth auger, distributed evenly at not more than 2 feet) on center throughout the outer half of the branch spread zone of each tree. Fertilize to within (4 inches) of the surrounding grade. Use topsoil to bring the surface up to the surrounding grade. When using fertilizer in packet, tablet, or wedge form, apply in accordance with manufacturer's recommendations.

3.11 TILLAGE FOR TURFGRASS AREAS

Thoroughly till the soil to a depth of at least (6 inches) by scarifying, disking, harrowing, or other approved methods. This is particularly important in areas where heavy equipment has been used. Remove all debris and stones larger than (one inch) remaining on the surface after tillage in preparation for finish grading. To minimize erosion, do not till areas of 3:1 slope ratio or greater. Scarify these areas to a (one inch) depth and remove debris and stones.

3.12 FINISH GRADING

After tilling the soil for bonding of topsoil with the subsoil, spread the topsoil evenly to a minimum depth of (6 inches). Incorporate topsoil at least (2 to 3 inches) into the subsoil to avoid soil layering. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.13 APPLICATION OF FERTILIZER AND LIME FOR TURFGRASS AREAS

- A. Apply turfgrass fertilizer at a rate that will deliver 1 pound of nitrogen per 1000 sq.ft. In addition, adjust soil acidity as recommended by soil test results and add any soil conditioners as specified herein for suitable topsoil under PART 2, Paragraph 2.2AandB, and 2.5 TOPSOIL.
- B. Spread lime as recommended by the soil test results.
- C. Incorporate lime into the soil to a depth of at least (4 inches) as part of the finish grading operation. Starter fertilizer should be lightly mixed with the top ½ inch of soil. Immediately restore the soil to an even condition before any seeding or sod placement.

3.15 HYDRO-MULCHING

- A. When hydro-mulching, mix the slow release starter fertilizer, seed, approved wood cellulose mulch material in the required amount of water to produce a homogenous slurry and then uniformly apply slurry under pressure to deliver the recommended quantity of fertilizer and specified amount of mulch and seed per 1000 sq.ft.
- B. Care shall be taken to avoid spraying mulch on adjacent rock mulch surfaces, concrete edges, curbs and headstones and footstones. In the event that mulch is sprayed on adjacent surfaces, the surfaces shall be immediately cleaned of any and all mulch.

3.17 WATERING

- A. Apply water to the turfgrass areas immediately following installation at a rate sufficient to ensure thorough wetting of the soil to a depth of at

least (2 inches). Supervise watering operation to prevent run-off. Supply all pumps, hoses, pipelines, and sprinkling equipment. Repair all areas damaged by water operations. Keep soil surface constantly moist, not wet, until turfgrass plants are well established.

- B. Contractor shall deep water all trees twice each week during the Plant Establishment Period, providing water penetration throughout the root zone to the full depth of the planting pits, as verified in the field by the CO/COR.

3.18 PROTECTION OF TURFGRASS AREAS

Immediately after installation of the turfgrass areas, protect against traffic or other use by erecting barricades, as required, and placing approved signs at appropriate intervals until final acceptance.

3.20 RESTORATION AND CLEAN-UP

Where existing or new turfgrass 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 turfgrass work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas are completed. Remove all debris, rubbish and excess material from the station.

3.21 ENVIRONMENTAL PROTECTION

All work and Contractor operations shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

--END--

SECTION 33 10 00
WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Underground water service connection complete and ready for operation including piping, valves, meter pit, backflow preventer and connection to the existing main.

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 11, EARTH MOVING (SHORT FORM).
- C. Concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).

1.3 DEFINITIONS

- A. Water Distribution: Pipelines and appurtenances which are part of the distribution system to be installed by the contractor, beginning at the connection to the existing service pipeline near the property line. Being the same service that extends from the State maintained water tower. The distribution system comprises the network of piping located throughout the site, as applicable, including valves and other appurtenances used to supply water for domestic and irrigation purposes.
- B. Site Water Service Pipeline: Pipeline to be provided by the contractor installed from the existing stub at the property line to the existing PIC and maintenance buildings.

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 authority having jurisdiction over the connection to the site water service pipeline.
- C. 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):
 - 1. Ductile iron pipe, fittings, and appurtenances.
 - 2. Copper pipe, fittings, and appurtenances.
 - 3. Gate valves.
 - 4. Ball valves.
 - 5. Service saddles.
 - 6. Joint restraint.
 - 7. Precast concrete Meter Pit (including frame and lid)
 - 8. Adjustable pipe supports.
 - 9. Disinfection products.
 - 10. Backflow preventer.
 - 11. Meter.
- C. Testing Certifications:
 - 1. Hydrostatic Testing.
 - 2. 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):
 - B16.1-2005.....Cast Iron Pipe Flanges and Flanged Fittings,
Class 25, 125, 250 and 800
 - B16.18-2001.....Cast Copper Alloy Solder Joint Pressure Fittings
 - B16.26-2006.....Cast Copper Alloy Fittings for Flared Copper
Tubes
 - B40.100-2005.....Pressure Gauges and Gauge Attachments
- C. American Society of Mechanical Engineers (ASME):
 - B18.5.2.1M - 2006 Metric Round Head Short Square Neck Bolts
 - B18.5.2.2M - 1982 Metric Round Head Square Neck Bolts
 - B18.2.2 - 1987 Square and Hex Nuts
- D. American Society for Testing and Materials (ASTM):
 - A47/A47M - 99(2004).....Standard Specification for Ferritic Malleable
Iron Castings
 - A48/A48M - 03(2008).....Standard Specification for Gray Iron Castings
 - A123/A123M-08.....Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
 - A148M/A148M-08.....Standard Specifications for Steel Castings

- A242/A242M-04e1.....Standard Specifications for High Strength Low Alloy Structural Steel AASHTO No. M161
- A307/A307-07b.....Standard Specifications for Carbon Steel Bolts and Studs, 415 MPa (60,000 psi) Tensile Strength
- A536-84 (2004)e1.....Standard Specifications for Ductile Iron Castings
- A563M - 07.....Standard Specification for Carbon and Alloy Steel Nuts [Metric]
- B42-02e1.....Standard Specification for Seamless Copper Pipe, Standard Sizes
- B61-08.....Standard Specifications for Steam or Valve Bronze Castings
- B62-02.....Standard Specifications for Composition Bronze or Ounce Metal Castings
- B88-03.....Standard Specifications for Seamless Copper Water Tube
- B-633-07.....Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- B828-02.....Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
- C94/C94M-09.....Standard Specification for Ready-Mixed Concrete
- C443-05a.....Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- D2000-08.....Standard Classification System for Rubber Products in Automotive Applications
- F477-08.....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F593-02 (2008).....Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- F1674-05.....Standard Test Method for Joint Restraint Products for Use With PVC Pipe
- E. American Water Works Association (AWWA):
 - B300-04.....Hypochlorites
 - B301-04.....Liquid Chlorine
 - C104/A21.4-08.....Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
 - C105/A21.5-05.....Polyethylene Encasement for Gray and Ductile C.I. Piping for Water and Other Liquids

- C110/A21.10-08.....Ductile-Iron and Gray-Iron Fittings, 80 mm Through 1200 mm (3 Inches Through 48 Inches) for Water and Other Liquids
- C111/A21.11-07.....Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
- C115/A21.15-05.....Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
- C150/A21.50-08.....American National Standard for Thickness Design of Ductile Iron Pipe
- C151/A21.51-02.....Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
- C153/A21.53-06.....Ductile-Iron Compact Fittings, 80 mm Through 300 mm (3 inches Through 12 inches) for Water and Other Liquids
- C509-01.....Resilient Seated Gate Valve for Water Supply Service
- C550-05.....Standard for Protective Interior Coatings for Valves and Hydrants
- C600-05.....Installation of Ductile-Iron Water Mains and Their Appurtenances
- C651-05.....Standard for Disinfecting Water Mains
- D2000-08.....Standard Classification System for Rubber Products in Automotive Applications
- F593-02 (2008).....Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- M11-04.....Manual: Steel Pipe: A Guide for Design and Installation
- M23-02.....Manual: PVC Pipe - Design and Installation
- F. NSF International:
 - 61-02.....Drinking Water System Components-Health Effects (Sections 1-9)
- G. American Welding Society (AWS):
 - A5.8-04.....Braze Filler Metal
- H. Copper Development Association's Copper Tube Handbook-2009

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS (PIPES 4" AND GREATER)

- A. Ductile iron pipe, direct buried:
 - 1. Ductile iron pipe conforming to the requirements of AWWA C151, Special Thickness Class 51 for 100 mm through 300 mm (4 inches through 12 inches) in diameter with interior double thickness cement

- mortar lining and asphaltic seal coat, and exterior asphaltic coating in accordance with AWWA and ANSI Standards.
2. Below Grade: Supply pipe in lengths not in excess of a nominal 6 m (20 feet) with rubber ring type push-on joints, mechanical joint or approved restrained joint. Provide mechanical and restrained joint pipe with sufficient quantities of accessories as required for each joint. All hardware shall be type 304 stainless steel.
 3. Provide polyethylene encasement over pipe, fittings, and valves in accordance with AWWA C105. Make provisions to keep the polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.
- B. Ductile Iron Pipe Above Grade or in Below Ground Concrete Pits:
1. Flanged ductile iron pipe, AWWA C115, with factory applied screwed long hub flanges except as otherwise specified hereinafter. Face and drill flanges after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and flush with end of pipe, ANSI B16.1, 850 kPa (125 psi) or 1725 kPa (250 psi) standard, for the purpose intended.
 2. Wall Pipe Castings: Size and types shown on the drawings. For wall pipe with mechanical joint or flange ends flush with face of wall, provide mechanical joint and flanged ends tapped for studs.
 3. Pipe Thickness Class: Minimum of Class 53 as defined in AWWA C150 for all sizes of flanged pipe.
 4. Rubber Ring Gaskets: Full face type, AWWA C111, 2 mm (1/16 inch) rubber ring gaskets and of approved composition suitable for the required service.
 5. Bolts and Nuts on Flanged Fittings: Grade B, ASTM A307. Low alloy, high strength steel in accordance with AWWA C111.
- C. All Pipe Fittings: Ductile iron with a minimum pressure rating of 2400 kPa (350 psi). Fittings shall meet the requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 850 kPa (125 psi) or 1725 kPa (250 psi) template in accordance with ANSI B16.1 with full faced gaskets.
- D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior for buried fittings, and shop prime epoxy for exposed fittings.

- E. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for all pipe in accordance with AWWA C151.

2.2 COPPER PIPE AND FITTINGS (PIPES LESS THAN 4")

- A. Copper Piping: ASTM B88, Type K, or Type L with flared fittings in accordance with AWWA C800, with sweat cast brass fittings per ANSI B16.18. Use brazing alloy, AWS A5.8, Classification BCuP. Fittings for compression-type joint, ASME B16.26, flared tube type.

2.3 MECHANICAL JOINT RESTRAINT GLANDS

- A. Restraint devices for mechanical joint fittings and appurtenances conforming to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53, shall conform to the following:
1. Restraint devices for nominal pipe sizes 75 mm (3 inch) through 900 mm (36 inch) shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
 2. The devices shall have a working pressure rating equal to that of the pipe on which it is used. Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.
 3. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.
 4. An identification number consisting of year, day, plant and shift (YYDDD) (plant designation) (Shift number), shall be cast into each gland body. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. All components shall be manufactured in the United States.
 5. Mechanical Joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
 6. MJ restraints shall be listed by Underwriters Laboratories, and approved by Factory Mutual in the 75 mm (3 inch) through 300 mm (12 inch) sizes.
 7. All casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance.
- B. Concrete buttresses (3,000 PSI minimum) are required at all underground bends (vertical and horizontal).

2.4 VALVES

A. Gate:

1. Conform to AWWA C509. Mechanical joint ends for buried locations and flanged ends for exposed and interior (in vaults and pits) locations. Valves 75 mm (3 inches) and larger shall be resilient seated, ductile iron body, bronze mounted inclined seats, non-rising stem type (except for outside screw and yoke), with a minimum 1375 kPa (200 pound) WOG. Valves shall open right. 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. Stuffing boxes shall have O-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. Asbestos packing is not allowed.
2. Operator:
 - a. Underground: Except for use with post indicators, furnish valves with 50 mm (2 inch) nut for socket wrench operation.
 - b. Above Ground and in Pits: Outside screw and yoke with hand wheel.
3. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.

B. Ball:

1. MSS SP-72, SP-110, Type II, Class 125, Style 1, rated for 1035 kPa at 176 Celsius (150 psig at 350 Fahrenheit), two piece, full port, chrome plated brass ball, end entry body style, 15% glass reinforced PTFE seats, PTFE packing and blow-out proof stem, vinyl covered steel handle, with solder-joint end connections or threaded ends with adapters are acceptable, SWP Rating 1035 kPa (150 PSIG), CWP Rating 4140 kPa (600 PSIG).

2.5 PRECAST CONCRETE OR CMU METER PIT

A. Precast reinforced concrete:

1. Concrete: 4,000 psi at 28 days for precast units and 3,000 psi at 28 days for CMU construction.
2. Entrained Air: 5% to 9%
3. Reinforcing Steel: ASTM A496-A615 Grade 60
4. Design Loading: AASHTO HS-20-44 with 30% impact and equivalent soil pressure of 130 psf. Flotation forces not accounted for.

B. Access Hatch

1. Design Loading: AASHTO HS-20-44
2. Material: Aluminum
3. Dimensions: 48" x 72"

4. Manufacturer: Bilco Type JD, or equal.

C. Steps: Plastic coated, pressure-molded to the steel. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Spacing shall be 12" on center.

2.6 PIPE SUPPORTS

A. Adjustable pipe support shall consist of adjustable pipe saddle and stanchion with integral base plate.

B. All materials shall be hot-dipped galvanized steel.

C. Stanchion shall be minimum 3-inch diameter schedule 40 steel pipe.

D. Pipe saddle shall be as manufactured by Anvil Figure 264, or approved equal.

E. Pipe stanchion shall be as manufactured by Anvil Figure 63, or approved equal.

D. Anchor bolts shall be type 304 stainless steel.

2.7 POTABLE WATER

Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.8 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 tablets and shall contain 65 percent chlorine by weight.

PART 3 - EXECUTION

3.1 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 recommended by the manufacturer to maintain the product performance as if it were undamaged.

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, and bends installed on underground pipe shall be anchored. See Section 3.4 "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.

3.2 DUCTILE IRON PIPE

- A. Installing Pipe: Lay pipe in accordance with AWWA C600 with polyethylene encasement in accordance with AWWA C105. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.
- B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by machine leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Perform cutting following manufacturer's recommendations for field cutting of pipe. Repair damaged cement mortar lining in accordance with manufacturer's recommendations.
- D. Jointing Ductile-Iron Pipe:
 - 1. Push-on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking

- ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home following industry standard procedures or manufacturer's approved means.
2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening the bolts. Bolts shall be tightened to the specified torque. For new construction, all mechanical joints at valves and fittings shall be secured with an approved mechanical joint retainer glands suitable for the pipe.
 3. Ball Joints: Install in strict accordance with the manufacturer's instructions. Where ball joint assemblies occur at the face of structures, the socket end shall be at the structure and ball end assembled to the socket.
 4. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

3.3 COPPER PIPE

- A. Copper piping shall be installed in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations. Copper piping shall be bedded in 101.6 mm (4 inches) of sand and then back filled as specified in Section 31 20 11, EARTH MOVING.

3.4 PIPE SUPPORTS

- A. Supports:
 1. All piping shall be properly and adequately supported.
 2. Install adjustable pipe supports as shown on the drawings and in accordance with manufacturer's recommendations.

3.5 RESTRAINED JOINTS WITH CONCRETE BUTTRESSES

- 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 as specified herein in Paragraph 2.3 or approved equal.
- D. Thrust blocks shall be required, unless otherwise noted.
- E. 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.
- F. Concrete buttresses shall be minimum 3,000 psi concrete and are required for all bends underground (vertical and horizontal).
- F. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained with the specified Mechanical Joint Restrainer Gland, or approved equal.

3.6 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 water 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).

3.7 VALVES

- A. Clean valve interior before installation.
- B. Valves shall be installed plumb and level and in accordance with manufacturer's recommendations.

3.8 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 275kPa (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 76 cm/sec (2.5 ft/sec) (approx.) Velocity in Main		Number of Hydrant Outlets			
				Size of Tap. mm (in.)			
				25 (1)	38 (1 ½)	51 (2)	64 (2 1/2-in)
mm	(In)	L/sec	(gpm)	Number of taps on pipe			
100	(4)	6.3	(100)	1	--	--	1
150	(6)	12.6	(200)	--	1	--	1
200	(8)	25.2	(400)	--	2	1	1
250	(10)	37.9	(600)	--	3	2	1
300	(12)	56.8	(900)	--	--	3	2
400	(16)	100.9	(1600)	--	--	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 authority having jurisdiction. 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.

3.9 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 (150 psi) or 1.5 times the normal working pressure, whichever is greater. Leakage shall not exceed the following requirements.
 - 1. Ductile Iron Pipe: AWWA C600. Provide to COR.

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SECTION 33 30 00
SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

Work includes adjustment of sanitary sewer cleanouts to accommodate the installation of cast iron covers surrounding all exposed cleanouts and commissioning of the septic system.

1.2 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.

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.
 - 4. Frames and Covers.

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
 - A625/A625M-08.....Tin Mill Products, Black Plate, Single Reduced

- C150-07.....Portland Cement
 - D698-07ae1.....Laboratory Compaction Characteristics of Soil
Using Standard Effort (12,400 ft-lbf/ft³ (600
kN-m/m³))
 - D1784-08.....Standard Specifications for Rigid PVC Compounds
and CPVC Compounds
 - D1785-06.....Standard Specification for Poly Vinyl Chloride
(PVC) Plastic Pipe, Schedules 40, 80, and 120
 - D2241-05.....Standard Specification for Poly(Vinyl Chloride)
(PVC) Pressure-Rated Pipe (SDR Series)
 - D2464-06.....Standard Specifications for Threaded PVC Pipe
Fittings, Schedule 80
 - D2466-06.....Standard Specification for Poly Vinyl Chloride
(PVC) Plastic Pipe Fittings, Schedule 40
 - D2467-06.....Standard Specifications for Poly Vinyl Chloride
(PVC) Plastic Pipe Fittings, Schedule 80
 - D2564-04e1.....Standard Specification for Solvent Cements for
Poly(Vinyl Chloride) (PVC) Plastic Piping
Systems
 - D2855-96(2002).....Standard Practice for Making Solvent-Cemented
Joints with Poly(Vinyl Chloride) (PVC) Pipe and
Fittings
 - D2412-02(2008).....Determination of External Loading
Characteristics of Plastic Pipe by Parallel-
Plate Loading
 - D3034-08a.....Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe
and Fittings
 - D3212-07.....Joints for Drain and Sewer Plastic Pipes Using
Flexible Elastomeric Seals
 - D3350-08.....Polyethylene Plastics Pipe and Fittings
Materials
 - F477-08.....Elastomeric Seals (Gaskets) for Joining Plastic
Pipe
 - F679-08.....Poly (vinyl chloride) (PVC) Large-Diameter
Plastic Gravity Sewer Pipe and Fittings
- C. American Society of Mechanical Engineers (ASME):
- A112.36.2M.....Cleanouts

PART 2 - PRODUCTS

2.1 PIPING

- A. Cleanout pipe and fittings shall conform to ASTM D1785 Schedule 40
PVC. Solvent weld all joints.

2.2 CLEANOUT FRAMES AND COVERS

- A. Cast-Iron Frame and Cover: ASME A112.36.2M; with round, bottom-flanged, cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover.
- B. PVC Cleanouts: ASTM D 3034, PVC cleanout threaded plug and threaded pipe hub.

PART 3 - EXECUTION

3.1 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.

3.2 CLEANOUTS

- A. 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.
- B. 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.
- C. Adjust piping to allow for installation of cast iron cleanout frame and cover. Cut piping to depth required and install new cleanout plug on existing piping.

3.3 SEPTIC SYSTEM COMMISSIONING

- A. The contractor shall engage the services of a qualified septic inspector to perform a visual inspection of accessible piping and appurtenances associated with the septic system and survey for deficiencies. Any noted deficiencies shall be documented and delivered to the CO/COR.
- B. Introduce 777.5 gallons of water into the system through continuous application until the design demand is reached. After introduction of the specified amount, perform a visual inspection of the cleanouts within the field and the distribution box and record the total time associated with dewatering.
- C. The contractor shall compile findings and observations and recommendations for correcting deficiencies in a report and submit to the CO/COR.

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SECTION 33 46 00
SUBDRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall address materials and installation requirements for surface and subsurface drainage systems that will convey stormwater to an outfall as well as underdrains for gravel trenches within raingardens.

1.2 DEFINITIONS

- A. HDPE: High-density polyethylene plastic.
B. RCP: Reinforced Concrete Pipe.
C. Subdrainage: Drainage system that collects and removes subsurface or seepage water.

1.3 SUBMITTALS

- A. See Section 01 33 23 - Submittal Procedures
B. Product Data: For the following:
1. 4" and 6" diameter PVC Schedule 40 Perforated-wall pipe and fittings.
2. 4" and 10" diameter PVC Schedule 40 Solid-wall pipe and fittings.
3. 12" N-12 HDPE Solid-wall pipe and fittings.
4. 15" Reinforced Concrete Pipe.
5. Trench drain systems.
6. Storm drain frames and grates
7. Pre cast manholes and boxes
8. Geotextile filter fabrics.
9. Subdrainage structures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified or approved equal.

2.2 PIPING MATERIALS

- A. Refer to the "Piping Applications" Article in Part 3 for applications of pipe, fitting, and joining materials.

2.3 PERFORATED-WALL PIPES AND FITTINGS

- A. Perforated Pipe and Fittings:
1. 4" and 6" diameter Schedule 40 PVC perforated drain pipe meeting ASTM D 1785 with 2 rows of holes, 120 degrees apart. Holes are ½ inches in diameter spaced 5" on center.
2. Couplings: use schedule 40 PVC couplings solvent weld meeting ASTM D 2665.

2.4 SOLID-WALL PIPES AND FITTINGS

- A. 4" and 10" Diameter Solid Pipe:
 - 1. 4" and 10" diameter Schedule 40 PVC pipe meeting ASTM D 1784.
 - 2. Couplings: use schedule 40 PVC couplings solvent weld meeting ASTM D 2665.
- B. 12" and 15" Diameter N-12 Solid-wall Pipe:
 - 1. 12" and 15" diameter ADS N-12 pipe with soiltight connections (or equal).
 - 2. Couplings: Manufacturer's standard soiltight couplings or Mission Flex Seal Adjustable Repair Couplings (with full width stainless steel sleeve).
- C. 15" Diameter Reinforced Concrete Pipe:
 - 1. 15" Diameter Reinforced Concrete Pipe meeting ASTM C 76.
 - 2. Joints for RCP meeting ASTM C 443.

2.5 SOLVENTS

- A. Solvents for PVC pipe shall include a two-step process with primer conforming to ASTM F 656 and solvent cement conforming to ASTM D 2564.

2.6 CLEANOUTS

- A. Cast-Iron Frame and Cover with concrete collar: ASME A112.36.2M; with round, bottom-flanged, cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover.
- B. PVC Cleanouts: ASTM D 3034, PVC cleanout threaded plug and threaded pipe hub.

2.7 DRAINAGE CONDUITS

- A. Single-Pipe Drainage Conduits: Perforated PVC Schedule 40 complying with ASTM D 1785 and wrapped in geotextile filter fabric.
 - 1. Available Manufacturers:
 - a. Charlotte Pipe
 - b. JM Eagle
 - c. GF Harvel
 - 2. Size: Nominal size 4 and 6 inch diameter.
 - 3. Filter Fabric: Nonwoven, PP geotextile.
 - 4. Fittings: PVC Schedule 40.
 - 5. Couplings: PVC Schedule 40.
 - 6. Filter Fabric: Specified in Part 2 "Geotextile Filter Fabrics"

2.8 CONVEYANCE CONDUITS

- A. Single-Pipe Conveyance Conduits: Solid Wall PVC Schedule 40 complying with ASTM D 1785, HDPE complying with ASTM F 405, or RCP complying with ASTM C 76.
 - 1. Available Manufacturers:
 - a. Charlotte Pipe
 - b. JM Eagle
 - c. GF Harvel
 - d. Advanced Drainage Systems
 - e. Rinker Pipe
 - f. Cemex
 - 2. Size: Nominal size 4, 10, 12 and 15 inch diameter.
 - 3. Fittings: PVC Schedule 40, HDPE snap type and Reinforced Concrete Pipe.
 - 4. Couplings: PVC Schedule 40, corrugated HDPE snap type and RCP joints.

2.9 TRENCH DRAIN SYSTEMS

- A. Trench drain channel:
1. Trench drain flumes (flow channel) shall be cast in place and constructed of Class B (4,000 psi) Portland Cement Concrete or Aco Drain KlassikDrain K300 or approved equal. Trench drain shall be installed in accordance with the dimensions shown on the Storm Drainage Details Plan. Contractor shall submit a work plan in conjunction with the trench drain submittal identifying the type of trench drain system that is intended for use along with details regarding pipe connections and materials. The work plan will require approval of the CO/COR.
- B. Trench drain frame and grate:
1. Frames shall be provided in accordance with manufacturer's recommendations.
 2. Grates shall be manufactured in the United States of America. All manufacturers shall be approved suppliers and be able to demonstrate that there is an acceptable quality control program at the producing plant, prior to supplying castings. Grates shall be Irving X-Bar Type AA or approved equal.
 - a. Design: Traffic rated (H-20), ADA Compliant.
 3. Fasteners shall be provided in accordance with manufacturer's recommendations.

2.10 SOIL MATERIALS

- A. Fills, Engineered Fill, Bedding, Granular Fill, Drainage Aggregate, Aggregates, and satisfactory soil materials are specified in Division 31 Section 31 20 11 "Earth Moving (Short Form)."

2.11 GEOTEXTILE FILTER FABRICS

- A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.
1. Structure Type: Nonwoven, needle-punched continuous filament.
 2. Style(s): Flat and sock.

2.12 SUBDRAINAGE STRUCTURES

- A. Subdrainage Inlets:
1. Existing inlets shall be lowered (by sawcutting) to match proposed grades. Install new Irving X-Bar Type AA frames and grates or approved equal. All material to be hot dipped galvanized. Use hydraulic cement for water tight seal around piping as needed.
 2. Connection stubs shall be manufactured from PVC or HDPE pipe stock and formed to provide a watertight connection with the specified pipe system.
 3. Joint tightness shall conform to ASTM D3212 Joints For Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals, and the flexible elastomeric seals shall conform to ASTM F477.
- B. Subdrainage Manholes:
1. Pre-cast concrete drainage structures with frame and manhole cover in accordance with local specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section 31 20 00 "Earth Moving."

3.3 PIPING APPLICATIONS

- A. Roadside Swale Subdrainage Piping:
 - 1. Perforated PVC Schedule 40 pipe and fittings, couplings, and coupled joints within the stone bed (6" diameter).
- B. Rain Garden Subdrainage Piping:
 - 1. Perforated PVC Schedule 40 pipe and fittings, couplings, and coupled joints within the stone trench (4" diameter).
 - 2. Solid Wall PVC Schedule 40 pipe and fittings, couplings, and coupled joints to connect to existing structure (4" diameter).
- C. Conveyance Piping:
 - 1. Solid Wall N12 HDPE pipe and fittings, couplings, and coupled joints beneath sidewalk section and connecting trench drain and subdrainage structures (12" and 15" diameter).
 - 2. Solid Wall PVC Schedule 40 pipe and fittings (10" diameter).
 - 3. Solid Wall RCP pipe and joints (15" diameter).

3.4 CLEANOUT APPLICATIONS

- A. Roadside Swale Subdrainage Piping:
 - 1. At grade at end of pipe run: PVC cleanout with cast iron frame and cover. Frame and cover to be surrounded by a concrete collar.

3.5 ROADSIDE SWALE AND RAIN GARDEN DRAINAGE INSTALLATION

- A. Place 2" of drainage course in rain garden and 4" of drainage course in roadside swale trench on subgrade along trench bottom. Place and lightly compact to dimensions indicated.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.
- D. Install drainage piping as indicated in Part 3 "Piping Installation" Article for subdrainage.
- E. Add 3/4" clean, washed drainage course to width of 4 inches on each side and to top of pipe to perform tests.
- F. After satisfactory testing, cover drainage piping with remaining drainage course. Apply 2" in rain garden and 8" in roadside swale.

3.6 CONVEYANCE PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals,

sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Lay perforated pipe with perforations down.
 2. Excavate recesses in trench bottom for bell ends of pipe and/or fittings. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- C. Install PVC piping according to ASTM D 2321 and ASTM F 1668.
- D. Install HDPE piping in accordance with ASTM D 2321 and manufacturer's recommendations.
- E. Install RCP piping according to ASTM C 1479.

3.7 PIPE JOINT CONSTRUCTION

- A. Join solid wall PVC pipe and fittings according to ASTM F 656 and ASTM D 2564 with a two-step primer and solvent application.
- B. Join perforated PVC pipe and fittings according to ASTM F 656 and ASTM D 2564 with a two-step primer and solvent application.
- C. Join solid wall HDPE pipe and fittings according to ASTM F 405 or ASTM F 667 using external snap couplers.
- D. Join RCP pipe and fittings according to ASTM C 443.
- E. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes. Mission Flex Seal adjustable repair couplings (with full width stainless steel band) or equal.

3.8 CLEANOUT INSTALLATION

- A. Cleanouts for Subdrainage Systems:
1. Install cleanouts from piping to grade.
 2. In grassed areas, set cleanout frames and covers on a cast-in-place concrete anchor 6 inches in depth.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Make all connections to both new and existing concrete structures using hydraulic cement to achieve a water tight connection.
1. When connecting new pipes to existing concrete structures, core the opening 3 inches wider than the pipe diameter. Use brick as appropriate to fill voids and place hydraulic cement around both sides of the wall to provide a smooth and water tight finish.
 2. When placing new structures within existing pipe networks, clip back piping as shown on the drawings to allow for insertion of the structure and replace pipe segment with the bell in an upstream direction. Use brick as appropriate to fill voids and place hydraulic cement around both sides of the wall to provide a smooth and water tight finish.
 3. When abandoning existing piping within existing structures, remove piping as shown on the drawings and brick up the openings using hydraulic cement. Parge both sides of the wall to provide a smooth and water tight finish.

3.10 FIELD QUALITY CONTROL

- A. Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.

Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.11 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.
- B. Contractor shall be responsible for cleaning existing trench drain systems and delivering them clear and free of dirt and other superfluous material upon completion of the work.

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