# Project Number 912-M&R18-07

# Electrical and Roof Work at the Maintenance Building

# at the

# West Virginia National Cemetery

# TECHNICAL SPECIFICATIONS AND DRAWINGS - TABLE OF CONTENTS

SPECIFICATION SECTIONS:



DRAWINGS:

**SECTION 01 00 02**

**GENERAL REQUIREMENTS**

## 1.1 GENERAL INTENTION

A. Contractor shall furnish all tools, labor, materials, equipment, services, and professional design services to perform work at the **West Virginia National Cemetery** as required by the work scope, drawings and specifications.

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

C. All Testing Laboratory services will be retained and paid for by the Contractor. Contractor shall submit testing lab certifications for approval. Agency must be certified in the testing they are to perform. However, the Department of Veterans Affairs may elect to retain its own Testing Laboratory for any purpose. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the COR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the COR.

D. All employees of general contractor and subcontractors shall comply with security requirements as established by the COR. They shall be restricted from unauthorized access.

E. 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.

F. Training:

1. All employees of general contractor or subcontractors shall, at the minimum, have successfully completed the 10-hour OSHA certified Construction Safety course and/or other relevant competency training, as determined by VA COR.
2. Submit OSHA training records of all employees for approval before the start of work.

## 1.2 STATEMENT OF BID ITEM(S) AND SCOPE OF WORK

A. General

1. Contractor is strongly encouraged to survey the project area prior to bidding to adequately understand the full scope of work and all requirements. Contractor is required to submit any questions or clarifications prior to bid. A bid submitted will be taken as agreement that the work shall be performed to meet the requirements herein based on the existing conditions in the field.

2. This numbered requirement only applies to work items specifically noted as design build elements below. The contractor shall engage the services of a professional design firm which specializes in the work contained in this project. Contractor shall submit this firm for approval complete with qualifications prior to the start of construction. Contractor and this professional design firm shall submit design drawings. Design drawings shall be: scaled drawings, Final construction documents, stamped and sealed by a professional engineer in the state where the work is to take place, submitted full size (30x42″) and in electronic format (pdf) to both the Project Engineer and the Cemetery Director.

3. This numbered requirement only applies to work items specifically noted as design build elements below. Where a work item is noted as a design build element, a professional engineer’s review shall be performed prior to submission. Prior to submission to the COR, contractor shall have all submittals reviewed, signed and sealed by a professional engineer in the state where work is to take place, and stamped approved by this professional design firm.

4. The contractor shall submit submittals including shop drawings and any other specification requirements to the COR for review and approval prior to fabrication/installation. Submittals approved by the owner (VA/NCA) are required prior to starting on the corresponding work.

5. The contractor shall submit a draft invoice/payment request concurrently to the field COR and the Project Engineer for dual approval. Only when the field COR and the Project Engineer approve of the draft invoice may it then be submitted for formal payment.

B. Specific work items:

1. Design Build Element: Provide professional design service to design and submit construction drawings and details to install a replacement metal roof on the Maintenance Building (also typically referred to as

Cold Storage Building on drawings). The specific requirements herein and on the drawings shall be the minimum requirements. Demolish existing metal roof, sheathing, and underlayment. Install new metal roof, sheathing and underlayment per specifications.

2. Install two (2) new LED exit and emergency lighting fixtures, one at each exit door over the door. Fixtures shall meet specification requirements and be wired into the existing electrical panel. Install new circuit in rigid metal conduit for these fixtures.

3. Install four (4) new LED exterior wallpack light fixtures. Fixtures shall be minimum: 55W consumption, 375W equivalent output, 5000K temperature, 6500 Lumens, outdoor rated, waterproof, and UL listed. See drawing for approximate locations for fixtures and existing panels. Install new fixtures as close to the top of the building as is practical, and within manufacturer's requirements. Install new circuit in rigid metal conduit for these fixtures. Install new photocell on this circuit such that the new fixtures only run when it is dark.

4. Install three (3) new safety yellow heavy duty solid plastic parking bumpers, truck sized. Sizes to be 8′ long, 10″ deep, and 7″ high with a standard front and back bevel. Provide method of securing to ground which shall provide for long term durability. Submit locations in coordination with the COR to ensure protection of the existing building from vehicle damage. Submit for approval.

**1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR**

A. Contractor is responsible to download and produce copies of drawings for their use.

**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 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 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 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 COR.

C. Guards: NOT USED

D. Key Control: NOT USED

E. Document Control:

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of “sensitive information”.
2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Certain documents, sketches, videos or photographs and drawings may be marked “Law Enforcement Sensitive” or “Sensitive Unclassified”. Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the COR upon request.
4. These security documents shall not be removed or transmitted from the project site without the written approval of COR.
5. All paper waste or electronic media such as CD’s and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify COR immediately when there is a loss or compromise of “sensitive information”.

7. All electronic information shall be stored in a specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
   a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
   b. “Sensitive information” including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

F. Motor Vehicle Restrictions
   1. Vehicle authorization request shall be required for any vehicle entering the site and such request shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies.

**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. Safety Plan: Establish and maintain a safety program in accordance with 29 CFR 1926. Prior to start of work, prepare a safety plan detailing project-specific safety measures, including periodic status reports, and submit to 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, fire safety, locations of restrooms, use of NCA equipment, etc. Contractor's shall anticipate providing temporary portable restrooms. Documentation shall be provided to the 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 Construction Partitions: NOT USED

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

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

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

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

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

K. 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 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 COR.

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

M. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR.

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

O. 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.

P. Dispose of waste and debris in accordance with NFPA 241. Remove from the site weekly.

Q. 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 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 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 COR, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the 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.

D. Working space and space available for storing materials shall be as determined by the COR with agreement of the Cemetery. Contractor

parking will be only in areas and on roadways designated and agreed to by the 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. Contractor shall work concurrent with the normal working hours of the cemetery, which are 8:00am to 4:30pm, Monday through Friday excluding federal holidays.

1. Do not store materials and equipment in other than assigned areas.
2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by the Cemetery in quantities sufficient for not more than two work days. Provide unobstructed access to the Cemetery areas required to remain in operation.
3. Where access by Cemetery personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements. All such actions shall be coordinated with the Utility Company involved:
   a. 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.

G. Phasing: To insure such executions, the Contractor shall furnish the 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 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, COR and Contractor.

H. 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 are not affected.

K. Utilities Services: Maintain existing utility services for the Cemetery at all times.

L. Abandoned Lines: NOT USED

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 COR.

N. Coordinate the work for this contract with other construction operations as directed by 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 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.

P. Dignity Clause:

1. Every action by contractor personnel at a national cemetery must be performed with the special care, reverence, dignity, and respect that acknowledges the cemetery as the final resting place that commemorates the service and sacrifice that service members,

Veterans and their families made for our Nation. Critically important is the awareness required of the Contractor employees of the remains buried in the grounds where the work is performed. The utmost care must be given to these remains and the headstones and flat grave markers that mark those gravesites and memorialize the service of individuals.

2. Contractors cannot walk, stand, lean, sit or jump on headstones or markers. Nor can they drive over them. Contractor personnel should use tools approved by the Contracting Officer Representative (COR), such as shovels, pry bars or pinch bars to lift flat markers out of the ground; pick axes are not an acceptable tool.

**1.7 ALTERATIONS**

A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR of buildings, areas in which alterations occur, areas which are anticipated routes of access, and furnish a signed report, to the Contracting Officer. This report shall list:
   1. Shall note any discrepancies between drawings and existing conditions at site.
   2. 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 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 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 COR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions present 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 flooring and other surfaces, 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:

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

**1.8 ENVIRONMENTAL CONTROLS**

NOT USED

**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 described as such in the scope of work above. 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 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 the COR.

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 COR may have the necessary work performed and charge the cost to the Contractor.

**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 COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the 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 installations and improvements.

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**

NOT USED

**1.13 PROFESSIONAL SURVEYING SERVICES**

NOT USED

**1.14 LAYOUT OF WORK**

A. The Contractor shall lay out the work 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 COR. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the 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 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 center lines for each building and/or addition to each existing building, 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 developed by the professional surveying company discussed above.

**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 COR's review, as often as requested.

C. The Contractor shall deliver two approved completed sets of hard copy as-built drawings (full size 42x30”) to the field COR within 15 calendar days after acceptance of the project by the COR.

D. Paragraphs A, B, & C shall also apply to all shop drawings. If the project includes design-build elements, the contractor shall submit any design-build drawings upon completion of the project to the field COR and Project Engineer, to include all revisions, and to include a revision stating “as-built”, the date, and an updated signed/sealed professional engineering stamp/seal.

**1.16 USE OF ROADWAYS**

A. For hauling, use only established public roads and designated permanent roads on Cemetery property and, or where authorized by the 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.

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

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

**1.17 COR'S FIELD OFFICE**

NOT USED

**1.18 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT**

NOT USED

**1.19 TEMPORARY TOILETS**

A. Provide for use of all Contractor's workers ample temporary sanitary toilet accommodations with suitable sewer and water connections, or when approved by 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.

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

**1.21 NEW TELEPHONE EQUIPMENT**

NOT USED

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

**1.25 RELOCATED EQUIPMENT AND ITEMS**

A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated by symbol "R", stated herein these specifications, or otherwise shown 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 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.

**1.29 FINAL ELEVATION PHOTOGRAPHS (NOT USED)**

**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 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
11. Fire Safety Plan per OSHA 29 CFR 1926
12. Employee certifications of the 10-hr OSHA safety training compliance

**1.4 FAR/VAAR CLAUSES INCLUDED BY REFERENCE**

Unless specifically noted otherwise, the below FAR and VAAR clauses are included by reference in this contract:

FAR 52.225-10 NOTICE OF BUY AMERICAN REQUIREMENT—CONSTRUCTION MATERIALS (MAY 2014)
VAAR 852.252-70 SOLICITATION PROVISIONS OR CLAUSES INCORPORATED BY REFERENCE (JAN 2008)
FAR 52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)
FAR 52.225-9 BUY AMERICAN—CONSTRUCTION MATERIALS (MAY 2014)
FAR 52.225-11 BUY AMERICAN—CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (OCT 2016)
FAR 52.236-27 SITE VISIT (CONSTRUCTION) (FEB 1995) ALTERNATE I (FEB 1995)
VAAR 852.232-72 ELECTRONIC SUBMISSION OF PAYMENT REQUESTS (NOV 2012)
VAAR 852.236-71 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (JUL 2002)
VAAR 852.236-72 PERFORMANCE OF WORK BY THE CONTRACTOR (JUL 2002)
VAAR 852.236-74 INSPECTION OF CONSTRUCTION (JUL 2002)
VAAR 852.236-76 CORRESPONDENCE (APR 1984)
VAAR 852.236-77 REFERENCE TO "STANDARDS" (JUL 2002)
VAAR 852.236-78 GOVERNMENT SUPERVISION (APR 1984)
VAAR 852.236-79 DAILY REPORT OF WORKERS AND MATERIAL (APR 1984)
VAAR 852.236-80 SUBCONTRACTS AND WORK COORDINATION (APR 1984)
VAAR 852.236-82 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (WITHOUT NAS) (APR 1984)
VAAR 852.236-84 SCHEDULE OF WORK PROGRESS (NOV 1984)
VAAR 852.236-85 SUPPLEMENTARY LABOR STANDARDS PROVISIONS (APR 1984)
VAAR 852.236-88 CONTRACT CHANGES--SUPPLEMENT (JUL 2002)

VAAR 852.236-89 BUY AMERICAN ACT (JAN 2008)

- - - E N D - - -

**SECTION 01 33 23**
**SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES**

1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.

1-2. For the purposes of this contract, samples including laboratory samples to be tested, test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.

1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:

A. Satisfactory written evidence is presented to, and approved by 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 including any laboratory samples to be tested will not serve as a basis for extending contract time for completion.

1-5. Submittals shall be reviewed for compliance with contract requirements by Architect-Engineer (hired by contractor), and action thereon will be taken by COR on behalf of the Contracting Officer.

1-6. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall

refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.

1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.

1-8. 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 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 (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
4. Contractor shall send a copy of transmittal letter to both COR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
4b. Contractor shall forward a copy of transmittal letter to COR simultaneously with submission to a commercial testing laboratory.
5. Laboratory test reports shall be sent directly to 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 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 the

contractor’s hired Architect-Engineering firm (also discussed in these specifications as Professional Design firm).

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 COR.

1-12. Samples for approval shall be sent to COR. Coordinate address for shipment with the COR.

- - - E N D - - -

# 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. The reference standards herein are included in this contract and work performed shall be in compliance with them. For example, concrete work on this project shall be performed in compliance with ACI standards.

### 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.<br>http://www.aluminum.org |
| AABC | Associated Air Balance Council<br>http://www.aabchq.com |
| AADM | American Association of Automatic Door Manufacturers<br>http://www.aaadm.com |
| AATC | American Association of Textile Chemists and Colorist<br>http://www.aatcc.org |
| AAMA | American Architectural Manufacturer's Association<br>http://www.aamanet.org |
| AAN | American Nursery and Landscape Association<br>http://www.anla.org |
| AASHTO | American Association of State Highway and Transportation Officials<br>http://www.transportation.org/Pages/default.aspx |
| ACGIH | American Conference of Governmental Industrial Hygienists<br>http://www.acgih.org |
| ACI | American Concrete Institute<br>http://www.aci-int.net |
| ACPA | American Concrete Pipe Association<br>http://www.concrete-pipe.org |
| ACPPA | American Concrete Pressure Pipe Association<br>http://www.acppa.org |
| ADA | American with Disabilities Act<br>http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag |
| ADC | Air Diffusion Council<br>http://flexibleduct.org |
| AGA | American Gas Association<br>http://www.aga.org |
| AGC | Associated General Contractors of America<br>http://www.agc.org |
| AHA | American Hardboard Association<br>http://www.domensino.com/AHA/ |
| AIHA | American National Standards Institute/American Industrial Hygiene Association<br>http://www.aiha.org/Pages/default.aspx |

| | |
|---|---|
| AISC | American Institute of Steel Construction<br>http://www.aisc.org |
| AISI | American Iron and Steel Institute<br>http://www.steel.org |
| AITC | American Institute of Timber Construction<br>http://www.aitc-glulam.org |
| ALI | Automotive Lift Institute<br>http://www.autolift.org/ |
| AMCA | Air Movement and Control Association<br>http://www.amca.org/ |
| ANLA | American Nursery & Landscape Association<br>http://www.anla.org |
| ANSI | American National Standards Institute, Inc.<br>http://www.ansi.org |
| APA | Architectural Precast Association<br>http://www.archprecast.org/ |
| APA | The Engineered Wood Association<br>http://www.apawood.org |
| ARI | Air-Conditioning and Refrigeration Institute<br>http://www.lightindustries.com/ARI/ |
| ARMA | Asphalt Roofing Manufacturers Association<br>http://www.asphaltroofing.org/ |
| ASAE | American Society of Agricultural Engineers<br>http://www.asabe.org |
| ASCE | American Society of Civil Engineers<br>http://www.asce.org |
| ASHRAE | American Society of Heating, Refrigerating, and Air-Conditioning Engineers<br>http://www.ashrae.org |
| ASME | American Society of Mechanical Engineers<br>http://www.asme.org |
| ASSE | American Society of Sanitary Engineering<br>http://www.asse-plumbing.org |
| ASTM | American Society for Testing and Materials<br>http://www.astm.org |
| AWI | Architectural Woodwork Institute<br>http://www.awinet.org |

| | |
|---|---|
| AWS | American Welding Society<br>http://www.aws.org |
| AWPA | American Wood Protection Association<br>http://www.awpa.com |
| AWWA | American Water Works Association<br>http://www.awwa.org |
| BHMA | Builders Hardware Manufacturers Association<br>http://www.buildershardware.com |
| BIA | The Brick Industry Association<br>http://www.bia.org |
| CAGI | Compressed Air and Gas Institute<br>http://www.cagi.org |
| CARB | California Environmental Protection Agency Air Resources Board<br>http://arb.ca.gov/hompage.html/ |
| CFR | Code of Federal Regulations<br>http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR |
| CGA | Compressed Gas Association, Inc.<br>http://www.cganet.com |
| CID | Commercial Item Description<br>http://www.gsa.gov/portal/content/100847 |
| CISCA | Ceilings and Interior Systems Construction Association<br>http://www.cisca.org |
| CISPI | Cast Iron Soil Pipe Institute<br>http://www.cispi.org |
| CLFMI | Chain Link Fence Manufacturers Institute<br>http://www.chainlinkinfo.org |
| CPA | Composite Panel Association<br>http://www.compositepanel.org/ |
| CRA | California Redwood Association<br>http://www.calredwood.org |
| CRI | Carpet and Rug Institute<br>http://www.carpet-rug.com |
| CRRC | Cool Roof Rating System<br>http://coolroofs.org/ |
| CRSI | Concrete Reinforcing Steel Institute<br>http://www.crsi.org |

| | |
|---|---|
| CSI | Cast Stone Institute<br>http://www.caststone.org |
| DASMA | Door and Access Systems Manufacturers Association<br>http://www.dasma.com/ |
| DHI | Door and Hardware Institute<br>http://www.dhi.org |
| DOE | U.S. Department of Energy<br>http://www.energy.gov/ |
| EEI | Edison Electric Institute<br>http://www.eei.org |
| EGSA | Electrical Generating Systems Association<br>http://www.egsa.org |
| EIMA | Exterior Insulation Manufacturers Association<br>http://www.eima.com/ |
| EPA | Environmental Protection Agency<br>http://www.epa.gov |
| ETL | ETL Testing Laboratories, Inc.<br>http://www.envirotestinglabs.com/ |
| FCC | Federal Communications Commission<br>http://www.fcc.gov |
| FHA | Federal Highway Administration<br>http://www.fhwa.dot.gov/ |
| FM | FM Global<br>http://www.fmglobal.com |
| FPS | The Forest Products Society<br>http://www.forestprod.org |
| FSC | Forest Stewardship Council<br>http://www.fscus.org |
| GA | Gypsum Association<br>http://www.gypsum.org |
| GANA | Glass Association of North America<br>http://www.glasswebsite.com |
| GBI | Green Building Initiative<br>http://www.thegbi.org/ |
| GS | Green Seal<br>http://www.greenseal.org |
| GSA | General Services Administration<br>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.<br>http://www.porcelainenamel.com |
| PTI | Post-Tensioning Institute<br>http://www.post-tensioning.org |
| RCSC | Research Council of Structural Connections<br>http://www.boltcouncil.org/ |
| RFCI | The Resilient Floor Covering Institute<br>http://www.rfci.com |
| RIS | Redwood Inspection Service<br>See - CRA |
| RMA | Rubber Manufacturers Association, Inc.<br>http://www.rma.org |
| SCAQMD | South Coast Air Quality Management District<br>http://www.aqmd.gov |
| SCMA | Southern Cypress Manufacturers Association<br>http://www.cypressinfo.org |
| SDI | Steel Deck Institute<br>http://www.sdi.org |
| SDI | Steel Door Institute<br>http://www.steeldoor.org |
| SEI | Structural Engineering Institute<br>http://www.asce.org/SEI/ |
| SJI | Steel Joist Institute<br>http://www.steeljoist.org |
| SMACNA | Sheet Metal and Air-Conditioning Contractors National Association, Inc.<br>http://www.smacna.org |
| SPRI | Single Ply Roofing Industry<br>http://www.spri.org |
| SSPC | The Society for Protective Coatings<br>http://www.sspc.org |
| STI | Steel Tank Institute<br>http://www.steeltank.com |
| SWI | Steel Window Institute<br>http://www.steelwindows.com |
| SWRI | Sealant Waterproofing and Restoration Institute<br>http://www.swrionline.org/ |

| | |
|---|---|
| TCNA | Tile Council of North America, Inc.<br>http://www.tileusa.com |
| TPI | Truss Plate Institute, Inc.<br>http://www.tpinst.org/ |
| UL | Underwriters' Laboratories Incorporated<br>http://www.ul.com |
| ULC | Underwriters' Laboratories of Canada<br>http://www.ulc.ca |
| USDA | U.S. Department of Agriculture<br>http://www.usda.gov |
| USGBC | U.S. Green Building Council<br>http://www.usgbc.org |
| WCLIB | West Coast Lumber Inspection Bureau<br>http://www.wclib.org/ |
| WDMA | Window and Door Manufacturers Association<br>https://www.wdma.com/ |
| WH | Warnock Hersey<br>http://www.intertek.com/marks/wh/ |
| WRCLA | Western Red Cedar Lumber Association<br>http://www.wrcla.org/ |
| WWPA | Western Wood Products Association<br>http://www2.wwpa.org/ |

- - - E N D - - -

**SECTION 01 74 19**
**CONSTRUCTION WASTE MANAGEMENT**

## PART 1 – GENERAL

### 1.1 DESCRIPTION

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

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

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

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

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

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

### 1.3 QUALITY ASSURANCE

A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed

to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:

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

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

C. Contractor shall develop and implement procedures to recycle construction and demolition waste to a minimum of 50 percent.

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

E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website http://www.wbdg.org/tools/cwm.php provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.

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

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

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

**1.4 TERMINOLOGY**

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

B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.

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

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

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

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

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

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

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

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

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

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

1. On-site Recycling – Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
2. Off-site Recycling – Materials hauled to a location and used in an altered form in the manufacture of new products.

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

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

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

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

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

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

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

**1.5 SUBMITTALS**

A. Prior to final invoice, location of facility where concrete materials were taken for recycling; along with weight tickets indicating amount of material recycled.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

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

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

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

## PART 3 - EXECUTION

### 3.1 COLLECTION

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

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

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

### 3.2 DISPOSAL

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

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

### 3.3 REPORT

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

B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.

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

- - - E N D - - -

# SECTION 02 41 10
# DEMOLITION AND SITE CLEARING

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies all site preparation work, demolition and removal of buildings, portions of buildings, utilities, other structures and debris.

### 1.2 RELATED WORK

A. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.

**B**. Disconnecting utility services prior to demolition: Section 01 00 02, GENERAL REQUIREMENTS.

C. Reserved items that are to remain the property of the Government: Section 01 00 02, GENERAL REQUIREMENTS.

### 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 02, GENERAL REQUIREMENTS.

C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.

D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.

E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:

1. No wall or part of wall shall be permitted to fall outwardly from structures.
2. Maintain at least one stairway in each structure in usable condition to highest remaining floor. Keep stairway free of obstructions and debris until that level of structure has been removed.
3. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
4. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.

G. Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Cemetery; any damaged items shall be repaired or replaced as approved by the Project Engineer/Contracting Officer's Representative (PROJECT ENGINEER / COR). Coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. 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 PROJECT ENGINEER / COR's approval.

**1.4 UTILITY SERVICES**

A. Demolish and remove outside utility service lines shown to be removed.

B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

C. Assume for bidding purposes that all buried (underground) pressurized piping is installed with concrete thrust blocks, which shall be demolished by the contractor as necessary for work required.

**PART 2 – GENERAL NOTES**

**2.1 DEMOLITION GENERAL NOTES**

A. Referenced standards contained herein and in other specification sections dictate the requirements for new work, and are not to be taken as assurance that existing work to be demolished meets these reference standards or specifications.

**PART 3 – EXECUTION**

**3.1 SITE CLEARING**

A. General: Remove trees, shrubs, grass, and other vegetation, pavements, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.

1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

B. Erosion Control: Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways. Install silt fence and inlet protection as shown and as per requirements of the SWPPP, prior to any soil disturbance activities. Provide temporary seeding as required by the SWPPP.

C. Maintain site controls in accordance with Storm Water Pollution Prevention Plan and repair as directed by COTR to sustain compliance with SPDES permit. Maintain all records as required by the SWPPP. Perform inspections as required by the SWPPP.

D. Topsoil - On-site: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 150 mm (6 inches). Satisfactory topsoil is reasonably free and/or screened of subsoil, clay lumps, stones, and other objects over 25 mm (1 inch) in diameter, and without weeds, roots, and other objectionable material.

1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.

a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.

2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles to prevent wind erosion in accordance with the Storm Water Pollution Prevention Plan.
   a. Stockpile shall be contained with erosion and sediment controls (silt fence) and stabilized if undisturbed in accordance with the Storm Water Pollution Prevention Plan.
3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material only after approval of the Architect.

E. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
   1. Completely remove stumps, roots, and other debris protruding through ground surface.
   2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
   3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
      a. Place fill material in horizontal layers not exceeding 150 mm (6 inches) loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.

F. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.

G. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings and is included under work of related Division 15 and 16 Sections. Removing abandoned underground piping or conduits interfering with construction is included under this Section, except as indicated to be abandoned in-place.

H. Continue maintenance of erosion controls in compliance with the Storm Water Pollution Prevention Plan until the work is completed and the threat of erosion is gone by either around surface stabilizer or lawn “grow-in” is at 85% complete. Temporary erosion control devices shall not be removed until the area is certified as being stabilized by the Qualified Inspector.

**3.2 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 Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the PROJECT ENGINEER / 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. In removing buildings and structures of more than two stories, demolish work story by story starting at highest level and progressing down to third floor level. Demolition of first and second stories may proceed simultaneously.

D. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500 mm (5 feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications. Burning is not permitted on the property.

E. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the PROJECT ENGINEER / COR. When Utility lines are encountered that are not indicated on the drawings, the PROJECT ENGINEER / COR shall be notified prior to further work in that area.

F. Where electrical, mechanical, plumbing, fire protection, fire alarm, or security components or equipment are shown to be demolished, contractor shall demolish all piping, conduit, cables, ductwork, outlets, switches, local panels back to their point of origin. Demolition shall be done such that all national, state and local codes are met both in the process of demolition but also the finished work. As an example, demolition of electrical components shall be taken back to the panel where the circuit originates. Coordinate with the COR as necessary.

**3.2 CLEAN-UP**

A. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to PROJECT ENGINEER / COR. Clean-up shall include off the 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.

- - - E N D - - -

# SECTION 06 10 00
# ROUGH CARPENTRY

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. Section specifies wood blocking, sheathing, furring, nailers, and rough hardware.

### 1.2 RELATED WORK

A. NA

### 1.3 PERFORMANCE REQUIREMENTS

B. Engineered Wood Products:

1. Provide products with no added urea formaldehyde; determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
2. Bio-based Content:
   a. Interior Panels: Engineered products designed specifically for interior applications and providing a surface that is impact-, scratch-, and wear-resistant and that does not absorb or retain moisture; provide minimum 55 percent bio-based content.
   b. Structural Interior Panels: Engineered products designed for use in structural construction applications; provide minimum 89 percent bio-based content.
   c. Structural Wall Panels: Engineered products designed for use in structural walls, curtain walls, floors and roofs; provide minimum 94 percent bio-based content.
3. VOC Emissions:
   a. Provide low VOC products with Green Seal Certification to GS-36 and description of the basis for certification

### 1.4 SUSTAINABILITY REQUIREMENTS

A. Materials in this section may contribute towards contract compliance with sustainability requirements.

B. Biobased Material: For products designated by the USDA’s BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit http://www.biopreferred.gov.

**1.5 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. Prepare shop drawings showing framing connection details, fasteners, connections and dimensions.

**1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING**

A. Protect lumber and other products from dampness both during and after delivery at site.

B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

C. Stack plywood and other board products so as to prevent warping.

D. Locate stacks on well drained areas, supported at least 150 mm (6 inches) above grade and cover with well-ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

**1.7 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 Forest and Paper Association (AF&PA):
Wood Structural Design Data

C. American Lumber Standard Committee, Incorporated (ALSC):
ALSC Board of Review

D. American National Standards Institute (ANSI):

| | |
|---|---|
| ANSI A190.1-2012 | Structural Glued Laminated Timber |

E. American Plywood Association (APA):

| | |
|---|---|
| E30-2011 | Engineered Wood Construction Guide |

F. American Society of Mechanical Engineers (ASME):

| | |
|---|---|
| B18.2.1-2012 | Square, Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws |
| B18.2.2-2010 | Hex Nuts for General Applications |
| B18.6.1-81 (R2008) | Wood Screws |
| B18.6.4-98(R2005) | Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws |

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

| | |
|---|---|
| A307-10 | Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength |
| 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 |
| D6007-02 | Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber |
| E1333-10 | Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber |
| F844-07a | Washers, Steel, Plan (Flat) Unhardened for General Use |
| F1667-11ae1 | Nails, Spikes, and Staples |

H. American Wood Protection Association (AWPA)

I. FM Global Group (FM):

| | |
|---|---|
| FM 4435 | Approval Standard for Edge Systems Used with Low Slope Roofing Systems |

J. Green Seal (GS):

| | |
|---|---|
| GS-36 | (2013) Commercial Adhesives |

K. South Coast Air Quality Management District (SCAQMD):

| | |
|---|---|
| SCAQMD Rule 1168 | (1989; R2005) Adhesive and Sealant Applications |

L. U.S. Department of Commerce/National Institute of Science and Technology:

| | |
|---|---|
| PS 1-09 | Structural Plywood |
| PS 20-10 | American Softwood Lumber Standard |

**PART 2 - PRODUCTS**

**2.1 LUMBER**

A. Unless otherwise specified, each piece of lumber to bear a grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.

1. Identifying marks in accordance with rule or standard under which material is produced, including requirements for qualifications and

authority of the inspection organization, usage of authorized identification, and information included in the identification.

2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.
3. Design members and fastenings to conform to AITC Timber Construction Manual. Coordinate to show structural properties on drawings of load bearing structural members.

B. Structural Members: Species and grade as listed in the AF&PA, National Design Specification for Wood Construction having design stresses as shown.

C. Lumber Other Than Structural:

1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
2. Framing lumber: Minimum extreme fiber stress in bending of 1100.
3. Furring, blocking, nailers and similar items 100 mm (4 inches) and narrower Standard Grade; and, members 150 mm (6 inches) and wider, Number 2 Grade.

D. Sizes:

1. Conforming to Prod. Std. PS20.
2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.

E. Moisture Content:

1. At time of delivery and maintained at the site.
2. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.
3. Lumber over 50 mm (2 inches) thick: 25 percent or less.

F. Preservative Treatment:

1. Do not treat Heart Redwood and Western Red Cedar.
2. Products containing chromium or arsenic will not be permitted.
3. Provide products with waterborne or boron-based preservatives.

G. Waterborne Wood Preservatives:

1. Treat wood products with waterborne wood preservatives listed in Section 4 of AWPA Standards U1, excluding those which contain arsenic and/or chromium.
2. Pressure treatment of wood products must conform to the requirements of AWPA Standards U1 and T1.

3. Retention of preservatives as prescribed in AWPA Standard U1 for the following Use Categories (material conforming to a higher AWPA Use Category may be specified):
   a. UC1: Interior construction - above ground, dry conditions.
   b. UC2: Interior construction - above ground, damp conditions.
   c. UC3A: Exterior construction - above ground, coated and with rapid water runoff.
   d. UC3B: Exterior construction - above ground, uncoated or poor water runoff.
   e. UC4A: General purpose soil or fresh water contact - heavy duty above ground.
   f. UC4B: Heavy duty soil or fresh water contact - critical or difficult to replace components.
   g. UC4C: Extreme duty soil or fresh water contact - critical structural components.

H. Boron-based Preservatives: Impregnate lumber with preservative treatment conforming to AWPA Standard U1.

I. Fire-retardant Treatment:
   1. Fire-retardant-treated wood products to be free of halogens, sulfates, ammonium phosphate and formaldehyde.
   2. Fire retardant treatment of wood products to conform to the requirements of AWPA Standard U1, Commodity Specification H and AWPA Standard T1, Section H.

**2.2 PLYWOOD**

A. Comply with Prod. Std. PS 1 and APA E30.

B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.

C. Sheathing:
   1. APA rated Exposure 1 or Exterior; panel grade CD or better.
   2. Wall Sheathing:
      a. Minimum 9 mm (11/32 inch) thick with supports 400 mm (16 inches) on center and 12 mm (15/32 inch) thick with supports 600 mm (24 inches) on center unless specified otherwise.
      b. Minimum 1200 mm (48 inches) wide at corners without corner bracing of framing.
   3. Roof Sheathing:

a. Minimum 15 mm (19/32 inch) thick or span rating of 40/20 or 18 mm (23/32 inch) thick or span rating of 48/24 for supports 600 mm (24 inches) on center.

**2.3 ROUGH HARDWARE**

A. Anchor Bolts: ASTM A307, size as indicated, complete with nuts and washers.

B. Washers:

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

C. Screws:

1. Wood to Wood: ANSI B18.6.1 or ASTM C1002.
2. Wood to Steel: ASTM C954, or ASTM C1002.

D. Nails:

1. ASTM F1667:
   a. Common: Type I, Style 10.
   b. Concrete: Type I, Style 11.
   c. Barbed: Type I, Style 26.
   d. Underlayment: Type I, Style 25.
   e. Masonry: Type I, Style 27.

**2.4 BLOCKING**

A. General: Provide miscellaneous lumber as indicated and lumber support or attachment for other construction, including the following:

1. Blocking.
2. Nailers.
3. Furring.

B. Provide Standard or No. 2 Grade lumber.

2.5 Rough Carpentry Products shall comply with following standards for biobased materials:

| Material Type | Percent by Weight |
|---|---|
| Lumber | 25 percent biobased material |
| plywood | 55 percent biobased material |

The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

**PART 3 - EXECUTION**

**3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS**

A. Conform to applicable requirements of the following:
   1. Comply with APA standards for installation of plywood.

B. Anchors in Masonry: Embed anchor bolts not less than 400 mm (15 inches) in masonry unit walls and provide each with a nut and a 50 mm (2 inch) diameter washer at bottom end. Fully grout bolts with mortar.

C. Anchors in Concrete:
   1. Embed anchor bolts not less than 200 mm (8 inches) in poured concrete walls and provide each with a nut and a 50 mm (2 inch) diameter washer at bottom end.
   2. A bent end may be substituted for the nut and washer; bend to be not less than 90 degrees.
   3. Powder-actuated fasteners spaced 900 mm (3 feet) o.c. may be provided instead of bolts for single thickness plates on concrete.

D. Sheathing:
   1. Lay panels with joints staggered, with edge and ends 3 mm (1/8 inch) apart and nailed over bearings as specified.
   2. Set nails not less than 9 mm (3/8 inch) from edges.
   3. Install 50 mm by 100 mm (2 inch by 4 inch) blocking spiked between studs to support edge or end joints of panels.

E. Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants: Provide sizes and configurations indicated or specified and anchored securely to continuous construction.
   1. Roof Edge Strips and Nailers: Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces.
   2. Except where indicated otherwise, nailers to be 150 mm (6 inches) wide and the same thickness as the insulation. Anchor nailers securely to underlying construction.
   3. Anchor perimeter nailers in accordance with FM 4435. Provide strips grooved for edge venting; install at walls, curbs, and other vertical surfaces with a 6 to 12 mm (1/4 to 1/2 inch) air space.
   4. Crickets, Cants, and Curbs: Provide wood saddles or crickets, cant strips, curbs for scuttles and ventilators, and wood nailers bolted to tops of concrete or masonry curbs and at expansion joints, and at lumber and exterior plywood.

F. Wood Blocking: Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

G. Wood Grounds: Provide for fastening wood trim, finish materials, and other items to plastered walls and ceilings. Install grounds in proper alignment and true with a 2400 mm (8 foot) straightedge.

H. Wood Furring:

1. Provide where shown and as necessary for facing materials specified.
2. Except as shown otherwise, furring strips to be nominal one by 3, continuous, and spaced 400 mm (16 inches) o.c. Erect furring vertically or horizontally as necessary.
3. Nail furring strips to masonry.
4. Do not use wood plugs.
5. Provide furring strips around openings, behind bases, and at angles and corners.
6. Furring to be plumb, rigid, and level and shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required.

**3.2 PROTECTION**

A. Protect rough carpentry from weather.

B. If rough carpentry becomes wet, apply EPA-registered borate treatment complying with EPA registered label.

- - - E N D - - -

# SECTION 07 01 50.19
# PREPARATION FOR RE-ROOFING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Complete roof removal for new roof system installation.
   2. Partial roof removal for new roof system installation.
   3. Roofing membrane and selective roofing system component removal for new roof membrane installation.
   4. Existing roofing membrane preparation for new roofing, membrane, and system installation.

B. Existing Roofing System: as described in the SOW and/or drawings. System components include:
   1. Pavers and paver supports.
   2. Aggregate ballast.
   3. Roof insulation and drainage board.
   4. Aggregate surfacing.
   5. Roofing membrane.
   6. Cover board.
   7. Roof insulation.
   8. Vapor retarder.
   9. Substrate board.

### 1.2 RELATED REQUIREMENTS

A. Replacement Roof Deck and Parapet Sheathing: Section 06 10 00, ROUGH CARPENTRY.

B. Sheet Metal Counterflashing: Section 07 60 00, SHEET METAL FLASHING AND TRIM.

### 1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):
   1. FX-1-01(R2006) Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.

C. American Society for Nondestructive Testing (ASNT):
   1. SNT-TC-1A - Personnel Qualification and Certification for Nondestructive Testing.

D. ASTM International (ASTM):

1. C208-12 - Cellulosic Fiber Insulating Board.
2. C578-17a - Rigid, Cellular Polystyrene Thermal Insulation.
3. C728-17a - Perlite Thermal Insulation Board.
4. C1177/C1177M-13 - Glass Mat Gypsum Substrate for Use as Sheathing.
5. C1153-10(2015) - Location of Wet Insulation in Roofing Systems Using Infrared Imaging.
6. C1278/C1278M-17 - Fiber-Reinforced Gypsum Panel.
7. D4263-83(2012) - Indicating Moisture in Concrete by the Plastic Sheet Method.

E. U.S. Department of Commerce National Institute of Standards and Technology (NIST):
1. DOC PS 1-09 - Structural Plywood.
2. DOC PS 2-04 - Performance Standard for Wood-Based Structural-Use Panels.

**1.4 PREINSTALLATION MEETINGS**

A. Conduct preinstallation meeting minimum 30 days before beginning Work of this section.
1. Required Participants:
a. Contracting Officer's Representative.
b. Design/build engineer (if re-roofing is design/build in the SOW).
c. Inspection and Testing Agency.
d. Contractor.
e. Installer.
f. Manufacturer's field representative.
g. Other installers responsible for adjacent and intersecting work, including mechanical and electrical equipment installers.
2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
a. Removal and installation schedule.
b. Removal and installation sequence.
c. Preparatory work.
d. Protection before, during, and after installation.
e. Removal and installation.
f. Temporary roofing including daily terminations.
g. Transitions and connections to other work.
h. Inspecting and testing.
i. Other items affecting successful completion.

3. Document and distribute meeting minutes to participants to record decisions affecting installation.

## 1.5 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:

1. Show size, configuration, and installation details.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Description of temporary roof system and components.
3. List of patching materials.
4. Recover board fastening requirements.
5. Temporary roofing installation instructions and removal instructions.

## 1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Same installer as the new roofing installer.

## 1.7 FIELD CONDITIONS

A. Building Occupancy: Perform work to minimize disruption to normal building operations.

1. Verify occupants are evacuated from affected building areas when working on structurally impaired roof decking above occupied areas.
2. Provide notice minimum 72 hours to COR before beginning activities affecting normal building operations.

B. Existing Roofing Available Information:

1. Examine available information before beginning work of this section.

C. Weather Limitations: Proceed with reroofing preparation only during dry weather conditions as specified for new roofing installation in its relevant specification section.

1. Remove only as much roofing in one day as can be made watertight in same day.

## 1.8 WARRANTY

A. See relevant roofing specification for required warranty.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Patching Materials: Match existing roofing system materials.

B. Plywood Sheathing: See Section 06 10 00, ROUGH CARPENTRY.

C. Metal Flashing: See Section 07 60 00, SHEET METAL FLASHING AND TRIM.

D. Temporary Protection Materials:

1. Expanded Polystyrene (EPS) Insulation: ASTM C578.
2. Plywood: NIST DOC PS 1, Grade CD Exposure 1.
3. Oriented Strand Board (OSB): NIST DOC PS 2, Exposure 1.

E. Temporary Roofing System Materials: Contractor's option.

F. Fasteners: Type and size required by roof membrane manufacturer to resist wind uplift.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Protect landscaping from damage.

D. Maintain access to existing walkways and adjacent occupied facilities.

E. Coordinate use of rooftop fresh air intakes with Contracting Officer's Representative to minimize effect on indoor air quality.

F. Ensure temporary protection materials are available for immediate use in case of unexpected rain.

G. Ensure roof drainage remains functional.

1. Keep drainage systems clear of debris.
2. Prevent water from entering building and existing roofing system.

H. Coordinate rooftop utilities remaining active during roofing work with Contacting Officer's Representative.

### 3.2 RE-ROOFING PREPARATION - GENERAL

A. Notify Contacting Officer's Representative of planned operations, daily.

1. Identify location and extent of roofing removal.
2. Request authorization to proceed.

### 3.3 OVERBURDEN REMOVAL

A. Remove aggregate ballast.

1. Store aggregate ballast for reuse.

B. Remove loose aggregate from bituminous membrane surface.

C. Remove pavers and paver support.
   1. Store undamaged pavers and paver supports for reuse.
   2. Dispose of damaged pavers.
D. Remove insulation, and drainage board from protected roofing membrane.

**3.4 COMPLETE ROOFING SYSTEM REMOVAL (ASSUME FOR BIDDING PURPOSES, BUT REFERENCE SOW AND/OR ANY DRAWINGS FOR FURTHER CLARIFICATION)**

A. Remove existing roofing system completely, exposing structural roof deck.
   1. Remove cover board, roof insulation, vapor retarder, and substrate board.
   2. Remove or cut-off roofing system fasteners.

**3.5 PARTIAL ROOFING SYSTEM REMOVAL (NOT APPLICABLE TO THIS PROJECT)**

A. Remove existing roofing completely, exposing structural roof deck at locations and to extent indicated on drawings.
   1. Remove cover board, roof insulation, vapor retarder, and substrate board.
   2. Remove or cut-off roofing system fasteners.

**3.6 ROOFING MEMBRANE AND SELECTIVE ROOFING SYSTEM COMPONENT REMOVAL (NOT APPLICABLE TO THIS PROJECT)**

A. Remove existing roofing membrane, only, in locations and to extent indicated on drawings.
B. Visually inspect cover board, roof insulation, vapor retarder, and substrate board for moisture immediately after roof membrane removal.
   1. Coordinate with Contracting Officer's Representative to observe inspections.
   2. Identify wet roofing system components required to be removed.
   3. Mark roofing system removal locations and extents.
C. Remove wet roofing system components.
   1. Remove or cut-off roofing system fasteners when removals expose structural roof deck.
D. Patch selective roofing system removals immediately after inspection and repair.
E. Install patching materials to match existing roofing system.
F. Patch roofing membrane to maintain building watertight, unless new roofing membrane is installed same day as removal and repair.

**3.7 DECK PREPARATION**

A. Inspect structural roof deck after roofing system removal.

1. Replace roof deck if stated as such in SOW and/or drawings.

B. Concrete Roof Decks:
   1. Visually confirm concrete roof deck is dry.
   2. Perform moisture test according to ASTM D4263 each day for each separate roof area.
      a. Proceed with roofing work only when moisture is not observed.

C. Steel Roof Decks:
   1. Visually inspect structural roof deck installation and fasteners.
      a. Notify Contracting Officer's Representative of unsuitable conditions and inadequate fastenings potentially affecting roof system performance.
   2. Secure roof deck with additional fastenings as recommended by roofing system manufacturer’s representative, manufacturer’s literature, and/or the design build engineer (if applicable).
   3. Replace roof deck if stated as such in SOW and/or drawings.
      a. Replacement Roof Deck: See Section 05 31 00, STEEL DECKING. Section 06 10 00, ROUGH CARPENTRY.

**3.8 TEMPORARY ROOFING**

A. Install temporary roofing to maintain building watertight.

B. Remove temporary roofing before installing new roofing.

**3.9 BASE FLASHING REMOVAL**

A. Expose base flashings to permit removal.
   1. Two-Piece Counterflashings: Remove cap flashing and store for reuse.
   2. Single Piece Counterflashings: Carefully bend counterflashing.
   3. Metal Copings: Remove decorative cap and store for reuse.

B. Remove existing base flashings.
   1. Clean substrates to receive new flashings.

C. Replace counterflashings damaged during removal.
   1. Counterflashings: See Section 07 60 00 SHEET METAL FLASHING AND TRIM.

D. Remove existing parapet sheathing and inspect parapet framing.
   1. Notify Contracting Officer's Representative of damaged framing.

E. Install pressure-preservative treated plywood sheathing, 15 mm (19/32 inch) thick.

**3.10 RECOVER BOARD INSTALLATION**

A. Install recover boards over existing roof insulation roofing membrane with butted joints. Stagger end joints in adjacent rows.

B. Fasten recover boards to resist wind-uplift.
   1. Fastening Requirements: See relevant specification section for new roofing type.
   2. Uplift Resistance: Base on pull out resistance determined by specified field testing.

**3.11 FIELD QUALITY CONTROL**

A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
   1. Fastener Pull Out Tests: ANSI/SPRI FX-1 and at recommended frequency.

B. Existing Roofing System Warrantor Services:
   1. Inspect reroofing preparation and roofing installation to verify compliance with existing warranty conditions.
   2. Submit reports of field inspections, and supplemental instructions issued during inspections.

**3.12 DISPOSAL**

A. Collect waste materials in containers.

B. Remove waste materials from project site, regularly, to prevent accumulation.

C. Legally dispose of waste materials.

- - E N D - -

# SECTION 07 41 13
# STANDING SEAM METAL ROOFING

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies the installation of pre-formed standing seam roofing panels with either double roll formed field seam or snap together seam. To be used for roofing sloped 1 in 4 (3 in/ft) or greater.

### 1.2 RELATED WORK

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

B. Fascia and Trim: Section 07 60 00, FLASHING AND SHEET METAL.

### 1.3 DESIGN REQUIREMENTS

A. Provide panels in continuous lengths up to manufacturer's standard longest lengths, with no joints or seams, except where indicated or specified. Ribs of adjoining sheets must be in continuous contact from eave to ridge.

B. There cannot be exposed or penetrating fasteners except where shown on approved shop drawings. Fasteners into steel must be stainless steel, zinc cast head, or cadmium plated steel screws inserted into predrilled holes.

C. Field-formed seam type system must be mechanically locked closed by the manufacturer's locking tool. Snap together type systems must have a capillary break and a positive side lap locking device. Include a continuous factory applied sealant within the seam.

D. Roof panel anchor clips must be concealed and designed to allow for longitudinal thermal movement of the panels, except where specific fixed points are indicated. Provide for lateral thermal movement in panel configuration or with clips designed for lateral and longitudinal movement.

E. Design metal roof panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E1592.

2. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class; design and size

components to withstand positive and negative wind loads, including increased loads at building corners as calculated according to local jurisdiction and ASCE 7.

3. Deflection: Provide panels capable of supporting design loads between unsupported spans with deflection of not greater than L/180 of the span.

F. Single Source: Roofing panels, clips, closures, and other accessories must be standard products of the same manufacturer; be the latest design by the manufacturer; and have been designed by the manufacturer to operate as a complete system for the intended use.

G. Energy Performance, Energy Star: Provide roofing finish system that is listed on DOE's ENERGY STAR "Roof Products Qualified Product List" or listed on Cool Roof Rating Council (CRRC) product list.

**1.4 INSTALLATION REQUIREMENTS**

A. 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 RE/COR and all parties whose work is effected or related to the work of this section.

B. Install in accordance with SMACNA Architectural Sheet Metal Manual except as otherwise shown or specified.

**1.5 SUBMITTALS**

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

B. Shop Drawings: Show design, details of construction, flashing, and fastenings.

C. Provide design calculations prepared by a professional engineer specializing in structural engineering verifying that system supplied and any additional framing meets design load criteria indicated. Coordinate calculations with manufacturer's test results. Include calculations for:

1. Wind load uplift design pressure at roof locations.
2. Clip spacing and allowable load per clip.
3. Fastening of clips to structure or intermediate supports.
4. Intermediate support spacing and framing and fastening to structure when required.

5. Allowable panel span at anchorage spacing indicated.
6. Safety factor used in design loading.
7. Governing code requirements or criteria.
8. Edge and termination details.

D. Installer Qualifications: Document installer is factory-trained, approved by the metal roofing system manufacturer to install the system, and has a minimum of three years' experience as an approved applicator with that manufacturer. The applicator must have applied five installations of similar size and scope as this project within the previous 3 years.

**1.6 SUSTAINABILITY REQUIREMENTS**

A. Materials in this section may contribute towards contract compliance with sustainability requirements.

**1.7 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT**

A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to http://www.epa.gov/wastes/conserve/tools/cpg/products/.
2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.

B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

**1.8 WARRANTY**

A. Roofing work subject to the terms of the Article "Warranty of Construction", FAR clause 52.246-21, except extend the warranty period to five years to include repair of leaks. In addition, contractor shall furnish a manufacturer's warranty for a period of twenty years.

**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 Architectural Manufacturer Association (AAMA):

| | |
|---|---|
| AAMA 621-02 | High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates |

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

| | |
|---|---|
| A463/A463M-15 | Steel Sheet, Cold-Rolled, Aluminum-Coated, by the Hot-Dip Process |
| C920-14a | Elastomeric Joint Sealants |
| E1514-98(2011) | Structural Standing Seam Steel Roof Panel Systems |
| E1592 | Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference |

D. American Society of Civil Engineers (ASCE):

| | |
|---|---|
| ASCE 7-10 | Minimum Design Loads for Buildings and Other Structures |

E. Cool Roof Rating Council (CRRC):

| | |
|---|---|
| CRRC-1-10 | Product Rating Program, www.coolroofs.org |

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual 2012

G. Underwriters Laboratory (UL):

| | |
|---|---|
| UL 580, 2006 Edition | Tests for Uplift Resistance of Roof Assemblies |

H. U.S. Department of Energy (DoE):

Roof Products Qualified Product List, www.energystar.gov

**PART 2 - PRODUCTS**

**2.1 METAL ROOF PANEL**

A. Aluminum-Zinc Alloy Coated Sheet Steel conforming to ASTM A463 and coated on both sides with 0.5 ounce of aluminum per square foot (0.15 Kg/sm); minimum 0.6 mm (24 gage) base metal thickness.

B. Conform to ASTM E1514.

C. Factory formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated, and mechanically attaching panels to supports

using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for a weathertight installation.

D. Vertical rib, snap joint, standing seam metal roof panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels and snapping panels together.

E. Panel Coverage: 304 mm (12 inches), 406 mm (16 inches), or 608 mm (24 inches). Match existing.

F. Seam Height: Minimum 44 mm (1-3/4 inch).

**2.2 SEALANTS**

A. Field-applied: ASTM C920.

B. Seam Cap Sealant: Factory applied hot melt, high viscosity, pressure sensitive adhesive with high heat resistance.

C. Type, Grade, and Class as recommended in writing by the manufacturer.

**2.3 SEALANT TAPE**

A. Pressure sensitive, 100 percent solids, Gray Polyisobutylene compound with release-paper backing.

B. 12 mm (1/2 inch) wide x 3 mm (1/8 inch) thick.

**2.4 UNDERLAYMENT**

A. Self-Adhering with reinforcing scrim, High-Temperature Sheet: Minimum 50 mil thick, consisting of slip-resisting top surface laminated to SBS-modified asphalt adhesive, with release-paper backing; cold applied.

**2.5 FASTENERS**

A. Self-drilling, or self-tapping zinc plated hex head carbon-steel screws with EPDM washer or stainless steel cap.

B. Concealed Standard Anchor Clips: Clips base must be minimum 1.2 mm (18 gauge) galvanized steel with 0.7 mm (22 gage) galvanized or stainless steel sliding top. Clips must be two (2) piece design; one-piece clips are not acceptable.

**2.6 FINISHES**

A. Factory finished complying with SMACNA’s recommendations for applying and designating finishes.

B. Exterior Finish:

1. 2-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.

2. Coating system must provide nominal 0.025 mm (1.0 mil) dry film thickness, consisting of primer and color coat.
3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.0125 mm (0.5 mil).

C. Color: Match existing, submit for approval.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.
1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.

B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Install fascia and trim.

**3.3 METAL ROOF PANEL INSTALLATION, GENERAL**

A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cutting of metal roof panels by torch is not permitted.
2. Install panels perpendicular to purlins.
3. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction; predrill panels.
4. Provide metal closures at peaks, rake walls and each side of ridge and hip caps.

5. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
6. Locate and space fastenings in uniform vertical and horizontal alignment.
7. Install ridge and hip caps as metal roof panel work proceeds.
8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
9. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:
1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.
1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.

**3.4 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION**

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

4. Form field-formed seam type system seams in the field with an automatic mechanical seamer approved by the manufacturer.

**3.5 ACCESSORY INSTALLATION**

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Details of installation which are not indicated must be in accordance with the SMACNA, panel manufacturer's approved printed instructions and details, or the approved shop drawings. Allow for expansion and contraction of flashing.

B. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

**3.6 ERECTION TOLERANCES**

A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 6 mm in 6 m (1/4 inch in 20 feet) on slope and location lines as indicated and within 3 mm (1/8 inch) offset of adjoining faces and of alignment of matching profiles.

**3.7 CLEANING AND PROTECTION**

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

- - - E N D - - -

# SECTION 07 92 00
# JOINT SEALANTS

## PART 1 - GENERAL

### 1.1 DESCRIPTION

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

### 1.2 RELATED WORK

A. Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.

C. Sealing joints in stone veneer: Section 04 43 00, NATURAL STONE VENEER.

D. Sealing joints in cast stone: Section 04 72 00, CAST STONE MASONRY.

### 1.3 QUALITY CONTROL

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
3. Test elastomeric joint sealants according to SWRI’s Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
5. Determine sealants will not stain joint substrates according to ASTM C1248.

D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates in accordance with sealant manufacturer’s recommendations:

1. Locate test joints where indicated or, if not indicated, as directed by Contracting Officer's Representative.
2. Conduct field tests for each application indicated below:
   a. Each type of elastomeric sealant and joint substrate indicated.
   b. Each type of non-elastomeric sealant and joint substrate indicated.
3. Notify RE/COR seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint sealant manufacturer's technical representative present. Provide written acceptance from manufacturer's technical representative that materials pass for adhesion and compatibility.

E. 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.

F. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution:
   1. Joints in mockups of assemblies specified in other sections, that are indicated to receive elastomeric joint sealants, which are specified by reference to this section.

**1.4 SUSTAINABILITY REQUIREMENTS**

A. Materials in this section may contribute towards contract compliance with sustainability requirements.

B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit http://www.biopreferred.gov.

**1.5 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. Cured samples of exposed sealants for each color where required to match adjacent material.

D. Manufacturer's Literature and Data:
   1. Caulking compound.
   2. Primers.
   3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

**1.6 PRE-INSTALLATION CONFERENCE**

A. 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 RE/COR and all parties whose work is effected or related to the work of this section.

**1.7 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 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.

**1.8 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).

**1.9 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.

**1.10 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.

**1.11 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):

| | |
|---|---|
| C612-10 | Mineral Fiber Block and Board Thermal Insulation |
| 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 |
| C919-12 | Use of Sealants in Acoustical Applications |
| 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 |
| C1330-02(2013) | Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants |
| D217-10 | Cone Penetration of Lubricating Grease |
| D1056-07 | Flexible Cellular Materials—Sponge or Expanded Rubber |
| E84-12c | Surface Burning Characteristics of Building Materials |

C. California Air Resources Board (CARB)

D. South Coast Air Quality Management District (SCAQMD)

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

**PART 2 - PRODUCTS**

**2.1 SEALANTS**

A. S-1:

1. ASTM C920, polyurethane.
2. Type M.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 20-40.

B. S-2:

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

C. S-3:

1. ASTM C920, polyurethane.
2. Type S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-25.
6. Minimum elongation of 700 percent.

D. S-4:

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

E. S-5:

1. ASTM C920, polyurethane.
2. Type S.
3. Class 25.
4. Grade P.
5. Shore hardness of 15-45.

F. S-6:

1. ASTM C920, silicone, neutral cure.

2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-20.

G. S-7:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

H. S-8:

1. ASTM C920, silicone, acetoxy cure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

I. S-9:

1. ASTM C920 silicone.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Non-yellowing, mildew resistant.

J. S-10:

1. ASTMC C920, coal tar extended fuel resistance polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 15-20.

K. S-11:

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

L. S-12:

1. ASTM C920, polyurethane.
2. Type M/S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade P/NS.
5. Shore A hardness of 25 to 50.

**2.2 CAULKING COMPOUND**

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

B. C-2: Polymer-based acoustical sealant conforming to ASTM C919 must have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Acoustical sealant must have a consistency of 250 to 310 when tested in accordance with ASTM D217, and must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734, and must be non-staining.

**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 aluminum, unless specified otherwise, for other locations.

D. Provide light gray or white 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.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint

where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

**2.5 FILLER**

A. Mineral fiber board: ASTM C612, 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.

F. Take all necessary steps to prevent three sided adhesion of sealants.

**3.4 SEALANT DEPTHS AND GEOMETRY**

A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.

B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

**3.5 INSTALLATION**

A. General:

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

B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.

C. Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.

1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

**3.6 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 Metal: Type S-6, S-7.
   2. Metal to Masonry or Stone: Type S-1.
   3. Masonry to Masonry or Stone: Type S-1.
   4. Stone to Stone: Type S-1.
   5. Cast Stone to Cast Stone: Type S-1.
   6. Threshold Setting Bed: Type S-1, S-3, S-4.
   7. Masonry Expansion and Control Joints: Type S-6.
   8. Wood to Masonry: Type S-1.

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 or S-12.

E. Interior Caulking:
   1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1, C-2 and C-3.
   2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1, C-2 and C-3.
   3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Types C-1, C-2 and C-3.
   4. Exposed Isolation Joints at Top of Full Height Walls: Types C-1, C-2 and C-3.
   5. Exposed Acoustical Joint at Sound Rated Partitions: Type C-2.
   6. Concealed Acoustic Sealant Type: S-4, C-1, C-2 and C-3.

- - - 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, 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. Contractor shall follow the latest versions of the codes listed herein, based on the date of the signed contract.

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 four 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 COTR/Resident Engineer 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 Resident Engineer 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**

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.

**1.7 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 COTR/Resident Engineer, 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 COTR/Resident Engineer. 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.

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, 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. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
   3. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
   4. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

F. Manuals: Submit per specifications.
   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 COTR/Resident Engineer 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**

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.

**1.13 PCB EQUIPMENT**

A. This project requires the removal, transport and disposal of electrical equipment containing Polychlorinated Biphenyl (PCB) in accordance with the Federal Toxic Substances Control Act (TSCA).

B. The equipment for removal is shown on the drawings.

C. The selective demolition shall be in accordance with specifications.

**1.14 TRAINING**

A. Training shall be provided in accordance with specifications.

B. Training shall be provided for the particular equipment or system as required in each associated specification.

C. A training schedule shall be developed and submitted by the contractor and approved by the COTR/Resident Engineer at least 30 days prior to the planned training.

- - - E N D - - -

**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 the low voltage power and lighting wiring.

**1.2 RELATED WORK**

A. Excavation and backfill for cables that are installed in conduit: Section 31 20 00, EARTH MOVING.

B. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.

C. General electrical requirements that are common to more than one section in Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

D. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

**1.3 SUBMITTALS**

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

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certificates: Two weeks prior to final inspection, deliver to the 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):

70-08.....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 coordinate for a final color coding with the COTR/Resident Engineer.

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 (3 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 non-detectable type.
B. The tape shall be red with black letters indicating “CAUTION BURIED ELECTRIC LINE BELOW”.

**PART 3 - EXECUTION**

**3.1 INSTALLATION, GENERAL**

A. Install in accordance with the NEC, and as specified.
B. Install all wiring in raceway systems, except where direct burial or HCF Type AC cables are used.
C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.

D. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
F. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
G. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
H. Wire Pulling:
   1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
   2. Use ropes made of nonmetallic material for pulling feeders.
   3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COTR/Resident Engineer.
   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 INSTALLATION IN MANHOLES**

A. Install and support cables in manholes on the steel racks with porcelain or equal insulators. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.
B. Fireproofing:
   1. Install fireproofing where low voltage cables are installed in the same manholes with high voltage cables; also cover the low voltage cables with arc proof and fireproof tape.
   2. Use tape of the same type as used for the high voltage cables, and apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.
   3. Secure the tape in place by a random wrap of glass cloth tape.

**3.3 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.

**3.4 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.

**3.5 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.

**3.6 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.

**3.7 DIRECT BURIAL CABLE INSTALLATION**

A. Tops of the cables:

1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
2. Below road and other pavement surfaces: In conduit as specified, minimum 750 mm (30 inches) unless greater depth is shown.
3. Do not install direct burial cables under railroad tracks.

B. Under road and paved surfaces: Install cables in concrete encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (two inch) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare, unless more spares are indicated on drawings.
C. Work with extreme care near existing ducts, conduits, cables and other utilities to prevent any damage.
D. Cut the trenches neatly and uniformly:
   1. Excavating and backfilling is specified in Section 31 20 00, EARTH MOVING.
   2. Place a 75 mm (3 inch) layer of sand in the trenches before installing the cables.
   3. Place a 75 mm (three inch) layer of sand over the installed cables.
   4. Install continuous horizontal, 25 mm by 200 mm (1 inch by 8 inch) preservative impregnated wood planking 75 mm (three inches) above the cables before backfilling.
E. Provide horizontal slack in the cables for contraction during cold weather.
F. Install the cables in continuous lengths. Splices within cable runs will not be accepted.
G. Connections and terminations shall be submersible type designed for the cables being installed.
H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried cables.

**3.8 EXISITNG 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.

**3.9 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.

- - - E N D - - -

# SECTION 26 05 26
# GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.

B. “Grounding electrode system” refers to all electrodes required by NEC, as well as including made, supplementary, lightning protection system grounding electrodes.

C. The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning.

### 1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

C. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.

### 1.3 SUBMITTALS

A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR/Resident Engineer:

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):

70-2008.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

44-2005 .....Thermoset-Insulated Wires and Cables

83-2003 .....Thermoplastic-Insulated Wires and Cables

467-2004 .....Grounding and Bonding Equipment

486A-486B-2003 .....Wire Connectors

**PART 2 - PRODUCTS**

**2.1 GROUNDING AND BONDING CONDUCTORS**

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

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 ground resistance required per NEC for the building and its occupancy.

**2.3 SPLICES AND TERMINATION COMPONENTS**

A. 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**

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

**2.6 GROUND TERMINAL BLOCKS**

A. 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**

A. 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, 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**

A. 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. Transformers:

1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide

a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system or to the ground bar at the service equipment.

F. Conduit Systems:
   1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
   2. All conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
   3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

G. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

H. Boxes, Cabinets, Enclosures, and Panelboards:
   1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
   2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
   3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

I. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

J. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

K. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

L. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

M. Raised Floors: Provide bonding of all raised floor components.

**3.4 CORROSION INHIBITORS**

A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

**3.5 CONDUCTIVE PIPING**

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

**3.6 LIGHTNING PROTECTION SYSTEM**

A. Bond the lightning protection system to the electrical grounding electrode system.

**3.7 ELECTRICAL ROOM GROUNDING**

A. Building Earth Ground Busbars: Provide ground busbar hardware at each electrical room and connect to pigtail extensions of the building grounding ring.

**3.8 WIREWAY GROUNDING**

A. Ground and Bond Metallic Wireway Systems as follows:

1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated 16 mm² (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
3. Use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.

**3.9 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.

C. Services at power company interface points shall comply with the power company ground resistance requirements.

D. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 48 hours before the connections are ready for inspection.

**3.10 GROUND ROD INSTALLATION**

A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

- - - E N D - - -

# SECTION 26 05 33
# RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

### 1.2 RELATED WORK

A. Bedding of conduits: Section 31 20 11, EARTH MOVING SHORT FORM.

C. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.

D. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

G. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

H. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

### 1.3 SUBMITTALS

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

A. Shop Drawings:

1. Size and location of main feeders;
2. Size and location of panels and pull boxes
3. Layout of required conduit penetrations through structural elements.
4. The specific item proposed and its area of application shall be identified on the catalog cuts.

B. Certification: Prior to final inspection, deliver to the COTR/Resident Engineer 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):
70-08.....National Electrical Code (NEC)
C. Underwriters Laboratories, Inc. (UL):
1-05.....Flexible Metal Conduit
5-04.....Surface Metal Raceway and Fittings
6-07.....Rigid Metal Conduit
50-07.....Enclosures for Electrical Equipment
360-09.....Liquid-Tight Flexible Steel Conduit
467-07.....Grounding and Bonding Equipment
514A-04.....Metallic Outlet Boxes
514B-04.....Fittings for Cable and Conduit
514C-96.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-05.....Schedule 40 and 80 Rigid PVC Conduit
651A-00.....Type EB and A Rigid PVC Conduit and HDPE Conduit
797-07.....Electrical Metallic Tubing
1242-06.....Intermediate Metal Conduit
D. National Electrical Manufacturers Association (NEMA):
TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing
FB1-07.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

**PART 2 - PRODUCTS**

**2.1 MATERIAL**

A. Conduit Size: In accordance with the NEC, but not less than (3/4 inch) unless otherwise shown. Where permitted by the NEC, (3/4 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. Paint for exterior protection (submit for approval). Color selected by VA.
7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
C. Conduit Fittings:
1. Rigid steel conduit fittings:
a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable.
c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.

d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.

e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.

f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

6. Direct burial plastic conduit fittings:

a. Fittings shall meet the requirements of UL 514C and NEMA TC3.

b. As recommended by the conduit manufacturer.

8. 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 non-detectable type, red with black letters, and imprinted with “CAUTION BURIED ELECTRIC LINE BELOW”.

**PART 3 - EXECUTION**

**3.1 PENETRATIONS**

A. Cutting or Holes:
1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COTR/Resident Engineer prior to drilling through structural sections.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the COTR/Resident Engineer as required by limited working space.

B. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight.

**3.2 INSTALLATION, GENERAL**

A. In accordance with UL, NEC, as shown, and as hereinafter specified.

B. 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 conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
12. Do not use aluminum conduits in wet locations.
13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

C. 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.

D. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COTR/Resident Engineer.

**3.3 CONCEALED WORK INSTALLATION**

A. In Concrete:
1. Conduit: Rigid steel.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:
a. Where shown on the structural drawings.
b. As approved by the Resident Engineer/COTR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.

4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
   a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
   b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
   c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:
1. Conduit for conductors above 600 volts:
   a. Rigid steel.
2. Conduit for conductors 600 volts and below:
   a. Rigid steel. 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.
C. Conduit for Conductors 600 volts and below:
1. Rigid steel.
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.
H. Painting:
1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
2. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high

black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

**3.5 DIRECT BURIAL INSTALLATION**

A. Exterior routing of Lighting Systems and Other Branch circuits (600 Volt and Less, and 1500 mm (5 feet) from the buildings):
   1. Conduit: Thick wall PVC or high density PE, unless otherwise shown.
   2. Mark conduit at uniform intervals to show the kind of material, direct burial type, and the UL approval label.
   3. Install conduit fittings and terminations as recommended by the conduit manufacturer.
   4. Tops of conduits shall be as follows unless otherwise shown:
      a. Not less than 600 mm (24 inches) below finished grade.
      b. Not less than 750 mm (30 inches) below road and other paved surfaces.
   5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
   6. Excavation for conduit bedding and back-filling of trenches is specified.
      a. Cut the trenches neatly and uniformly.
      b. Do not kink the conduits.
   7. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents the entrance of moisture and gases.
   8. Where metal conduit is shown, install threaded heavy wall rigid steel galvanized conduit or type A20 rigid steel galvanized conduit coated with .5 mm (20 mil) bonded PVC, or rigid steel, PVC coated or standard coated with bituminous asphaltic compound.
   9. Warning tape shall be continuously placed 300 mm (12 inches) above conduits or electric lines.

B. Exterior routing of lighting systems and other branch circuits (600 volts and less-under buildings slab on grade to 1500 mm (5 feet) from the building):
   1. Pre-coated rigid galvanized steel conduit in accordance with the requirements of Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

**3.6 HAZARDOUS LOCATIONS**

A. Use rigid steel conduit only, notwithstanding requirements otherwise specified in this or other sections of these specifications.

B. Install UL approved sealing fittings, that prevent passage of explosive vapors, in hazardous areas equipped with explosive proof lighting fixtures, switches, and receptacles, as required by the NEC.

**3.7 WET OR DAMP LOCATIONS**

A. Unless otherwise shown, use conduits of rigid steel.

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 within 1500 mm (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

**3.8 MOTORS AND VIBRATING EQUIPMENT**

A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.

B. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

**3.9 EXPANSION JOINTS**

A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

C. Install expansion and deflection couplings where shown.

D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

**3.10 CONDUIT SUPPORTS, INSTALLATION**

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:

1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
2. Existing Construction:
   a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
   b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
   c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

**3.11 BOX INSTALLATION**

A. Boxes for Concealed Conduits:

1. Flush mounted.
2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)
E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2 1/8 inches) deep, with device covers for the wall material and thickness involved.
F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
G. On all Branch Circuit junction box covers, identify the circuits with black marker.

- - - E N D - - -

**SECTION 26 51 00**
**INTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

A. This section specifies the furnishing, installation and connection of the interior lighting systems. ***All new lighting to be installed as part of this project shall be LED bulbs and fixtures. Any references below to other bulb or fixture types is provided to establish a minimum acceptable quality standard to be used in the selection of LED bulbs and fixtures.***

**1.2 RELATED WORK**

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.

C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

E. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

B. Product Data: For each type of lighting fixture (luminaire) designated, submit the following information.

1. Material and construction details include information on housing, optics system and lens/diffuser.
2. Physical dimensions and description.
3. Wiring schematic and connection diagram.
4. Installation details.
5. Energy efficiency data.
6. Photometric data based on laboratory tests complying with IESNA Lighting Measurements, testing and calculation guides.
7. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours) and color temperature (degrees Kelvin).

8. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts and total harmonic distortion (THD).

C. Manuals:

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 Resident Engineer/COTR.

D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the Resident Engineer/COTR:
   a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

**1.5 APPLICABLE PUBLICATIONS**

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Institute of Electrical and Electronic Engineers (IEEE):

C62.41-02.....Guide on the Surge Environment in Low Voltage (1000V and less) AC Power Circuits

C. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

101-09.....Life Safety Code

D. National Electrical Manufacturer's Association (NEMA):

C78.138-98 .....Electric Lamps - 250-Watt, 70 Watt, M85 Metal-Halide Lamps

C78.43-07 .....Standard for Electric Lamps - Single-Ended Metal-Halide Lamps

C78.81-05 .....Electric Lamps - Double-capped Fluorescent Lamps Dimensional and Electrical Characteristics

C78.901-05.....Electric Lamps - Single Base Fluorescent Lamps Dimensional and Electrical Characteristics

C82.1-04.....Ballasts for Fluorescent Lamps - Specifications

C82.2-02.....Method of Measurement of Fluorescent Lamp Ballasts

C82.4-02.....Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps

C82.11-02.....High Frequency Fluorescent Lamp Ballasts

E. Underwriters Laboratories, Inc. (UL):

496-08.....Safety Lampholders
542-05.....Lampholders, Starters, and Starter Holders for Fluorescent Lamps
844-06.....Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
924-06.....Emergency Lighting and Power Equipment
935-01.....Fluorescent-Lamp Ballasts
1029-94.....High-Intensity-Discharge Lamp Ballasts
1029A-06.....Ignitors and Related Auxiliaries for HID Lamp Ballasts
1598-08.....Luminaires
1574-04.....Standard for Track Lighting Systems
2108-04.....Standard for Low-Voltage Lighting Systems
8750-08.....Light Emitting Diode (LED) Light Sources for Use in Lighting Products

F. Federal Communications Commission (FCC):
Code of Federal Regulations (CFR), Title 47, Part 18

**PART 2 - PRODUCTS**

**2.1 LIGHTING FIXTURES (LUMINAIRES)**

A. Shall be in accordance with NFPA 70 and UL 1598, as shown on drawings, and as specified.

B. Sheet Metal:
1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved) and parallel to each other as designed.
2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
3. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
4. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, latches shall function easily by finger action without the use of tools.

C. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.

D. Lamp Sockets:
1. Porcelain or approved equal.

E. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

G. Metal Finishes:

1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
3. Exterior finishes shall be as shown on the drawings.

H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

I. Light Transmitting Components for Fixtures:

1. Shall be 100 percent virgin acrylic.
2. Flat lens panels shall have not less than 3.2mm (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.

J. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Group areas as defined in NFPA 70, and shall comply with UL 844.

K. Fixtures shall be provided with ballast integral to the fixture. Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures (not the lamp). Fixtures shall be designed for lamps as specified.

**2.2 BALLASTS**

A. Ballasts for LED fixtures: Multi-tap voltage (120- 480v) electromagnetic ballast for lamps. Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.

2. Minimum Starting Temperature: Minus 30 deg C (Minus 22 deg F) for single-lamp ballasts.
3. Rated Ambient Operating Temperature: 40 deg C (104 deg F).
4. Open-circuit operation that will not reduce average life.
5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

**2.3 LAMPS**

A. LED.

**2.4 EMERGENCY EXIT LIGHTING UNITS WITH EMERGENCY BACKUP BATTERY LIGHTING**

A. Shall be LED light fixtures.

B. Shall provide a minimum of 90 minutes of battery backup lighting during power failure via minimum quantity of 2, each a minimum 5W tungsten wedge base lamp.

C. 120/277 VAC Operation.

D. Minimum 11″H x 23.5″W x 4.5″D.

E. Shall meet NFPA 101, NEC and OSHA requirements.

F. UL 924 listed.

G. Minimum 3.5W at normal operation and 15W at emergency 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. Lighting Fixture Supports:

1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
2. Shall maintain the fixture positions after cleaning and relamping.
3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
4. Hardware for recessed fixtures:
   a. Where the suspended ceiling system is supported at the four corners of the fixture opening, hardware devices shall clamp the fixture to the ceiling system structural members, or plaster frame at not less than four points in such a manner as to resist spreading of the support members and safely lock the fixture into the ceiling system.
   b. Where the suspended ceiling system is not supported at the four corners of the fixture opening, hardware devices shall

independently support the fixture from the building structure at four points.

5. Hardware for surface mounting fixtures to suspended ceilings:
   a. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 6mm (1/4 inch) secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
   b. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 6mm (1/4 inch) studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 6mm (1/4 inch) toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.//

E. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.

F. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.

G. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

H. Exercise electronic dimming ballasts over full range of dimming capability by operating the control devices(s) in the presence of the Resident Engineer/COTR. Observe for visually detectable flicker over full dimming range.

I. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless a lesser period is specifically recommended by lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

J. At completion of project, relamp/reballast fixtures which have failed lamps/ballasts. Clean fixtures, lenses, diffusers and louvers that have

accumulated dust/dirt/fingerprints during construction. Replace damaged lenses, diffusers and louvers with new.

- - - END - - -

# 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.

### 1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.

C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.

D. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.

E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

### 1.3 SUBMITTALS

A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting, details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, poles, luminaries, lamps and controls.

C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the RESIDENT ENGINEER/COTR. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement parts.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer/COTR:

1. Certification that the materials are in accordance with the drawings and specifications.

2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

**1.4 APPLICABLE PUBLICATIONS**

Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

A. Aluminum Association Inc. (AA):

AAH35.1-2006 .....Alloy and Temper Designation Systems for Aluminum

B. American Association of State Highway and Transportation Officials (AASHTO):

LTS-4-2006.....Structural Supports for Highway Signs, Luminaries and Traffic Signals

C. American Concrete Institute (ACI):

318-2008 .....Building Code Requirements for Structural Concrete

D. American National Standards Institute (ANSI):

IEEE C57.12-2006.....General Requirements For Liquid-Immersed Distribution, Power, and Regulating Transformers

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

A123/A123M-2009 .....Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153/A153M-2009.....Zinc Coating (Hot-Dip) on Iron and Steel Hardware – AASHTO No.: M232

B108-03a-2008 .....Aluminum-Alloy Permanent Mold Castings

D3487-2008.....Mineral Insulating Oil Used in Electrical Apparatus

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):

C81.61-2005 .....Electrical Lamp Bases

ICS 2-2008 .....Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts

ICS 6-2006 .....Industrial Control and Systems Enclosures

I. National Fire Protection Association (NFPA):

70-2008 .....National Electrical Code (NEC)

J. Underwriters Laboratories, Inc. (UL):

496-2008 .....Edison-Base Lamp holders

773-1995.....Plug-in, Locking Type Photo controls, for Use with Area Lighting

773A-2006 .....Non-industrial Photoelectric Switches for Lighting Control

1598-2008 .....Luminaries

**1.5 DELIVERY, STORAGE, AND HANDLING**

A. Store in accordance with manufacturer’s instructions.

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

A. Materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

**2.4 LUMINAIRES**

A. UL 1598 and NEMA C136.17. Luminaries shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat and safe cleaning and relamping.

B. IESNA HB-9 and RP-8 light distribution pattern types shall be as shown on the drawings.

C. Incorporate ballasts in the luminaire housing except where otherwise shown on the drawings.

D. Lenses shall be frame-mounted heat-resistant, borosilicate glass, prismatic refractors. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging resistant resilient gaskets to seal and cushion lenses and refractors in luminary doors.

F. Pre-wire internal components to terminal strips at the factory.

G. Bracket mounted luminaries shall have leveling provisions and clamp type adjustable slip-fitters with locking screws.

H. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.

I. IESNA Cutoff Category: semi cutoff.

**2.5 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.

C. LED as shown on the drawings and specifications.

D. Mercury vapor, high pressure sodium, and any other high intensity discharge lamps shall not be used.

**2.6 HIGH INTENSITY DISCHARGE BALLASTS**

A. For low voltage systems, the ballasts shall be the high efficiency, high power factor, copper-wound constant wattage type and shall meet the requirements of UL 1029 and NEMA C82.4.

1. Ballasts shall operate the discharge lamp of the type, wattage, and voltage shown on the drawings.
2. Ballasts shall have individual overcurrent protection (inline fuse holder) as recommended by the ballast manufacturer.
3. Ballasts shall be capable of providing reliable starting of the lamps at minus 30 degrees C.
4. Open-circuit operation shall not reduce the average life.

B. For series systems, the ballasts shall be the high efficiency, high power factor, copper wound constant current type.

1. Provide each ballast with a film type lamp failure protector to prevent excessive secondary voltage.
2. Provide ballasts to operate the discharge lamp of the type, wattage, and voltage shown on the drawings.
3. Ballasts shall be capable of providing reliable starting of the lamps at minus 30 degrees C.

C. Locate protective devices for ballasts to be accessible if the devices are not integral with ballasts.

D. Each ballast shall operate not more than one lamp except where otherwise shown on the drawings.

**2.7 LIGHTING CONTACTORS**

NEMA ICS 2, electrically held contactors. Rate contactors as indicated. Provide in NEMA 4 enclosure conforming to NEMA ICS 6. Contactors shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor] and shall require no arcing contacts. Provide contactors with hand-off-automatic selector switch.

**2.8 CONTROLS**

A. Each Lighting System:

1. Shall be controlled the following method:
   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.
2. Mount and connect photocells.
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 foot candles, and maintains the system energized until the north sky light increases to approximately 3 to 5 foot candles.

**2.9 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.

**2.10 AUXILIARY EQUIPMENT**

A. Parallel-Type Systems: Shall be supplied power as shown on the drawings.

B. Series Type Systems:
1. Provide components specifically for constant-current series type lighting systems.
2. Constant-Current Transformers:
   a. Self-cooled by natural convection, liquid-immersed, fully automatic, outdoor type.
   b. Liquid shall be oil conforming to ASTM D3487, except where otherwise shown.
   c. Temperature rises shall not exceed the following ANSI C57.12. test values for the respective insulation systems:
      1) Standard, 55 degrees C by resistance and 65 degrees C hottest spot.
      2) Thermally upgraded, 65 degrees C by resistance and 80 degrees C hottest spot.
   d. Core Coil Assemblies:

1) Braced to withstand the stresses caused by the maximum current available under all conditions and rough handling during shipment.
2) Cores, silicon steel.
3) Coils, continuous windings without splices except for taps.

e. Bring primary and secondary leads out through wet-process, porcelain bushings, pressure-tight. Terminals shall be suitable for the specific cables being connected to them.
f. Shall have capacitors for power factor improvement. The value of power factor under the percent of full load rating shall be as shown on the drawings.
g. Shall regulate the secondary current within one percent over the entire load rating range while the primary voltage remains within five percent of the rated voltage.
h. Operation of the transformers shall not be adversely affected while the transformers are mounted five degrees off of perpendicular.
i. Provide tanks and covers of steel to meet NEMA and ANSI requirements; which are cleaned, phosphatized and painted at the factory with primer and the manufacturer's standard extremely durable finish.
j. Sound levels shall not exceed 45 db.
k. Standard ANSI features and accessories including a pressure relief device, ground pad, lifting provisions and diagrammatic nameplate.
l. Dimensions and configurations shall conform to the spaces designated for installations.
m. Install the transformers so they will have adequate air circulation for heat removal.

3. Controllers:
a. Oil-immersed, rated-load-interrupter, outdoor type with heavy duty, silver-alloy contacts.
b. Oil, ASTM D3487.
c. Operate at 120 volts, 60 Hz.
d. Have an auxiliary hand lever for manual operation during emergencies.
e. The depth below the oil surface of the contacts shall be not less than the depth of the switch mechanism.

f. Bring leads out through wet-process, porcelain bushings, pressure-tight. Terminals shall be suitable for the specific cables being connected to them.

g. Provide steel tanks and covers, thoroughly cleaned, phosphatized, and painted at the factory with primer and the manufacturer's standard durable finish.

h. Dimensions and configurations shall conform to the spaces designed for installations.

4. Provide protective relays to de-energize the control circuits for the controllers and thereby de-energize the series lighting load circuits when open circuit faults occur in the series lighting load circuits.

5. Transformer, equipment enclosure, lightning arresters, primary and secondary protection shall be provided.

6. Disconnecting Devices: Watertight, submersible types suitable for the cables being installed and for use in outdoor lighting systems.

**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. Mount switch on or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm.

**3.2 GROUNDING**

A. 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 a conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable and listed for this purpose.

- - - E N D - - -