# SPECIFICATIONS

# PROJECT SPECIFICATIONS MANUAL

100% Construction Documents

## BRAZOS BEND STATE PARK – UTILITY UPGRADES

TPWD PROJECT NUMBER: 124722

TEXAS PARKS AND WILDLIFE

December 17, 2015

PREPARED BY:

EEA CONSULTING ENGINEERS


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# DIVISION 1 – GENERAL REQUIREMENTS

## SECTION 01000 – SPECIAL CONDITIONS

## PART 1 – GENERAL

1.01 RELATED DOCUMENTS:

Drawings and general provisions of Contract, including Uniform General and Supplementary General Conditions and other Division 1 specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK:

Furnish all labor, materials, tools, equipment and incidentals necessary for performance of all work associated with **Project Number 124722 –Upgrade Utilities in Burr Oak & Screen Shelter Loops at Brazos Bend State Park, Fort Bend County, Texas,** such work being as more particularly described in these Special Conditions, the drawings, and elsewhere in these Bidding and Contract Documents.

1.03 INQUIRIES:

All inquiries regarding the Bidding and Contract Documents, including any apparent discrepancies thereto and administration of the contract, shall be directed to the Texas Parks and Wildlife Department, Infrastructure Division, 4200 Smith School Road, Austin, Texas 78744, **Kim Shelton, Sr. Contract Manager, 512/389-4695 or email at: kim.shelton@tpwd.texas.gov.**

1.04 EXAMINATION OF SITE:

Bidders should visit the site and be thoroughly familiar with job conditions such as the location, accessibility, and general character of the site and/or building prior to submitting a bid. Visits shall be scheduled with **Chris Bishop, Park Superintendent, 979/553-5102, Extension 225.** Failure to give proper consideration to site conditions when preparing bids will not constitute grounds for additional compensation. **(See UGC, Article 3).**

1.05 INTENT OF THE CONTRACT DOCUMENTS: **(See also UGC, Article 6)**

A. The intent of the Contract Documents is to include all of the work for the contract price and within the contract time. Contract Documents are to be considered as cooperative. All work not specified and/or not shown on the drawings but which is necessary for the completion and/or functioning and operation of the project, shall be understood and implied as part of the contract to be performed by the Contractor for the contract price. Such work shall be executed by the Contractor in the same manner and with the same character of material as other portions of the contract without extra compensation.

B. It is the intention of the Contract Documents to call for finished work, tested, and ready for operation.

1. Any apparatus, material or work described in the Contract Documents and any incidental accessories necessary to make the work complete in all respects and ready for operation (even though not particularly specified) shall be furnished, delivered, and installed by the Contractor without additional expense to the Owner.

2. Minor details not usually shown or specified but necessary for proper installation and operation are included in the work just as if herein specified or shown.

C. All work shall be performed and furnished by the Contractor in accordance with accepted construction industry practices.

D. A duplication of work is not intended by the Contract Documents and any duplication shall not become a basis for extra cost to the Owner.

E. Explanatory notes on the drawings shall take precedence over conflicting drawn-out indications. Figured dimensions on drawings shall take precedence over scale measurements. Where figures are lacking, scale measurements may be followed, but in all cases the measurements are to be checked from the work in place and those measured dimensions taken at the site shall take precedence over scale dimensions in drawings.

F. Upon discovery by Contractor of errors, omissions or inconsistencies in the Contract Documents, Contractor shall promptly report them to the Owner and shall wait for instruction from Owner prior to proceeding with the work.

G. In the event of conflict between the Special Conditions, the Supplementary Conditions, and the Uniform General Conditions, the following priority order shall apply in resolving such conflicts: Special Conditions, Supplementary Conditions, and then Uniform General Conditions.

H. The drawings consist of all project drawings and any drawings issued by addenda.

1.06 ADDENDA:

Any addenda issued in writing by the Owner during the period of bidding shall be included in the bid and Bidder's receipt of addenda shall be acknowledged in the bid form. Such addenda shall become a part of the contract and shall modify the Contract Documents accordingly. Oral changes in the work made during the period of bidding will not be binding. **BIDDER'S FAILURE TO ACKNOWLEDGE RECEIPT OF ADDENDA MAY RESULT IN REJECTION OF BID.**

1.07 PERMITS AND LAWS **(See also UGC Article 3):**

Contractor shall comply with all laws, ordinances, statutes, rules and regulations applicable to the project, including but not limited to those pertaining to the collection, transportation and disposal of trash and refuse and shall obtain such permits, licenses or other authorizations as may be required.

If applicable governmental laws, rules, regulations or ordinances conflict with the Contract Documents, then such laws, rules, regulations, or ordinances shall govern instead of the Contract Documents, except in such cases where the Contract Documents exceed them in quality of materials or labor, then the Contract Documents shall be followed.

1.08 PRECONSTRUCTION CONFERENCE AND PROGRESS MEETINGS: **(See also UGC Article 3)**

Prior to, or concurrent with, the issuance of the Notice to Proceed letter and prior to start of work, a conference between the Owner and the Contractor will be held to discuss provisions of the Contract Documents and to coordinate the work effort. Attendance by Contractor and Contractor's superintendent(s) is required, along with major trades if requested by Owner. Construction progress

meetings may be called at any time by the Owner's Project Manager, On-Site ODR, or the Contractor to review job progress or problems.

1.09 SUBMITTALS:

A. GENERAL **(See also UGC Article 8):**

1. A TPWD standard *Submittal Cover Sheet* must accompany each numbered submittal set. **One Submittal per *Submittal Cover Sheet*.**
2. The number of copies of submittals required for each item shall be not less than one (1) original and four (4) copies for Owner's use, plus the number of additional copies that the Contractor desires for his own use.
3. The Contractor must double-check and sign all submittals before forwarding them to the Owner for review and action.
4. The Architect/Engineer and the Owner will review the submittal data. If there are no exceptions taken to the submittal, the original and three copies will be retained by the Owner. All remaining copies will be returned to the Contractor. The Contractor must keep one copy at the jobsite at all times.
5. If further action is required by the Contractor, Owner will retain three copies of the submittal data for the Owner's use and return all remaining copies to the Contractor.
6. Any and all costs, direct or indirect, incurred by Owner in reviewing submittals in excess of two (2) times will be charged to the Contractor and deducted from the total price for the work.
7. Owner's approval of shop drawings and/or any aspects of the work shall not act to transfer Contractor's responsibility for, nor relieve Contractor from the performance of any of Contractor's duties set forth in the contract documents.

B. PRE-CONSTRUCTION SUBMITTALS: The following Pre-construction Submittals shall be submitted by the Contractor for the Owner's review and approval. Prior to the Pre-construction Conference, the Owner will provide more specific clarification regarding the requirements for each PR Submittal.

1. Submittal PR-1 – **To be submitted to Owner no later than ten (10) days after issuance of the Notice of Intent to Award: (See also UGC Article 3)**

   a. Contractor's Superintendent: List of name and qualifications of the person designated as project superintendent.
   b. Subcontractors/Materials Suppliers: List of all subcontractors and major material/equipment suppliers that Contractor and Contractor's major subcontractors propose to use. This list shall include correct names, mailing addresses and phone numbers.
   c. Contractor's Authorized Representatives: List of names and titles of Contractor's representatives authorized to sign contractual documents and construction vouchers.
   d. Licensed Craftspersons: List of names, qualifications and licenses of all licensed crafts required by the contract documents.

2. Submittal PR-2 – **To be submitted to Owner no later than ten (10) days after issuance of the Notice of Intent to Award:**

a. Contract Price Breakdown (Schedule of Values), itemizing material and labor for each classification of work. **(See also UGC, Article 10)**

1. Owner will provide forms entitled "*Construction Voucher Schedule of Values*" for the Contractor's use in preparing the breakdown. After contract award, the Owner will also provide further clarification including an example.

2. Itemization of material and labor costs is required so the Owner may make progress payments on materials delivered. For each bid item or classification of work to be listed in the "Type of Work" column on the *Construction Voucher Schedule of Values*, the Contractor shall multiply the unit bid price by the estimated quantity for each bid item to arrive at the "Contract Cost" for each such bid item. Contractor shall separately itemize material and labor costs for each such bid item in the "Type of Work" column.

b. Construction Progress Schedule (in duplicate) of *Contractor's Proposed Construction Schedule* for work tasks in relation to the entire project. **(See also UGC, Article 9)** Owner will provide a schedule bar chart form to aid the Contractor in preparing a schedule. The Contractor shall follow this format and must indicate all work tasks as well as differentiate critical path work tasks from non-critical path tasks showing the beginning and ending dates for each critical and non-critical path work task.

c. Submittal Register: Submittal Register shall be organized by specification section, listing all items to be furnished for review and approval by the A/E and the Owner, including anticipated sequence and submittal dates. (Refer to Article 8, specifically 8.3.1.2, of the Uniform General Conditions.)

C. MATERIAL SUBMITTALS: **To be submitted to Owner prior to the installation of any materials. It is the Contractor's responsibility to incorporate lead time required for review, resubmittal, ordering, manufacturing, fabrication and delivery. Contractor is responsible if a delay in lead time planning affects the critical path.**

1. Contractor shall submit manufacturer's information on all materials and equipment, regardless of whether substitutions are being requested.

2. Substitution requests must be submitted early enough to allow time for evaluation by the Owner and for re-submittal, if required. Material substitutions will not be allowed following this 10-day period. Contractor's substitution requests shall address the following factors which will be considered in evaluating the proposed substitution:

a. Whether the evaluation and acceptance of the proposed substitution will prejudice the Contractor's achievement of Substantial Completion on time;

b. Whether acceptance of the substitution for use in the work will require a change in any of the Contract Documents to adapt the design to the proposed substitution.

c. Whether incorporation or use of the substitution in connection with the work is subject to payment of any license fee or royalty.

d. Whether all variations of the proposed substitution from the items originally specified are identified.

e. Whether available maintenance, repair, and replacement service are indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.

f. Whether an itemized estimate is included of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.

g. Whether the proposed substitute item meets or exceeds the experience and/or equivalency requirements listed in the appropriate technical specifications.

3. No materials shall be ordered or installed until submittals for such materials have been received and acted upon by the Owner.

1.10 QUALITY ASSURANCE **(See also UGC Article 8):**

A. The Owner's On-Site ODR will periodically inspect and observe the construction progress, procedures, and materials of the Contractor. The Contractor shall coordinate all efforts with the On-Site ODR, offer full cooperation to facilitate such observations, and shall be responsive to questions from such On-Site ODR regarding methods, equipment, materials, and intentions in pursuing the work or any particular thereof. Such observation by the Owner shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

B. The On-Site ODR's responsibilities include but are not limited to:

1. Providing quality assurance for the Owner.
2. Submitting written reports concerning the current status of the work.
3. Reviewing, and verifying to the Owner the amounts shown on the Contractor's monthly *Construction Voucher.*
4. Requesting and receiving payroll and materials invoice amounts from the Contractor.
5. Witnessing testing and confirming in writing to the Owner the results of all tests.

C. Inspections, Notification, and Scheduling:

1. The Contractor shall notify the On-Site ODR when work is ready for inspection or testing. The Contractor shall give such notifications sufficiently in advance of other work to prevent delays. A minimum of five (5) working days advance notice is required, and Contractor shall include in his work schedule such notice periods for inspections and/or testing.
2. Tests cannot be conducted and work cannot be covered-up until the On-Site ODR observes and authorizes continuation of work. The Contractor shall bear all costs for re-tests and for removal and replacement of construction resulting from unauthorized continuation.
3. Should ODR fail to make the necessary inspection within the agreed period, Contractor may proceed with cover-up Work after making every reasonable effort to contact the ODR and after documenting the Work, but is not relieved of responsibility for Work to comply with requirements of the Contract Documents.

D. All permanent utilities shall be connected before final tests are conducted for equipment and systems. Final operational tests shall be conducted prior to project acceptance by the Owner. The Contractor shall provide the materials, energy, equipment and personnel to conduct the tests required in the contract.

E. Contractor's failure to provide notification to Owner of inspection or testing requirements shall void any certifications of testing and shall require the Contractor to re-test at the Owner's request. All expenses for re-testing shall be paid by the Contractor.

F. The Owner (including Owner's On-Site ODR) may reject work not conforming to the contract documents. If the Owner rejects work and/or materials incorporated into the project, Contractor shall bear all expenses associated with testing to prove compliance with the Contract Documents, including but not limited to engineering/architectural expenses associated with such testing. Any and all such expenses that are paid directly by Owner shall be deducted or withheld from subsequent payment(s) to the Contractor.

1.11 INVOICES/PAY REQUESTS AND CHANGE ORDERS:

A. All work items for which Contractor requests payment shall reflect the project number with which those work items are associated. **Change Order pricing for items that are already priced in the contractor's bid shall be limited to such price(s) set forth in such bid and shall not be entitled to additional mark-up for overhead and profit.**

B. Contractor is required to submit an **original** Progress Assessment Report (PAR) to TPWD HUB Administration no later than the 5th day of the month. Contractor shall submit a **copy** of the current month's PAR to the Owner with the application for payment (construction voucher). The PAR is the monthly compliance report verifying Contractor's compliance with the HUB Subcontracting Plan (HSP) including the expenditures the Contractor has made to Subcontractors during the prior month.

1.12 CONTRACT COMPLETION: **(See also UGC, Article 9)**

A. Contract Period: This contract must be completed within the specified number of days commencing on the date cited in the Notice to Proceed letter.

1. Unless specifically stated as "working day," the term "day" or "calendar day" shall mean every day of the calendar year. Along with the work progress schedule, the Contractor shall submit his schedule for normal working days.
2. Claims for extension of time shall be made in accordance with the provisions of Article 9 of the Uniform General Conditions.

B. **Liquidated Damages:** The Owner has determined that the completion of the work in this contract is critical to the proper operation of the facility, and the Contractor's failure to complete the work within such time will cause damage to the Owner. Since exact damages are difficult to determine or forecast, the sum of **$339.22** per calendar day is hereby established by the parties as a reasonable estimate of just compensation to the Owner for the failure of the Contractor to complete the work by the time set forth in the contract or authorized extension thereto. Said sum will be deducted from the money due or to become due to the Contractor, not as a penalty but as liquidated damages from added expense, including administrative and inspection costs, for each and every calendar day the work or any portion thereof remains incomplete after the expiration of the time limit set in the contract or authorized extension.

C. Charges for liquidated damages will begin accumulating on the first calendar day following the final contract completion date and continue until the date of final acceptance as established by the Owner. Final acceptance will not be issued until all punch list items have been completed.

1.13 CONTRACT CLOSE-OUT: **(See also UGC Article 12)**

A. Notification: The Contractor shall provide Owner **Fifteen (15) business-days'** written notice requesting substantial completion inspection.

B. Final Submittals: At the time of the Contractor's request for final inspection, Contractor shall provide to Owner the following material (in addition to final payment documents also required by UGC Article 12 and set forth below in subsection D) which the Contractor shall have accumulated and retained during the course of the project:

1. Two (2) sets of all project submittals and all equipment and material warranties/guarantees as provided by all appropriate suppliers or manufacturers.
2. One set of "as-constructed drawings" showing all revisions to the original Contract Documents. Drawings shall also show routing of underground outside utilities and conduits with actual dimensions from buildings or other known landmarks.
3. Any and all other documents, keys, manuals, etc. required by the Contract Documents.

C. Clean-up: At completion of the job, the Contractor shall remove all waste products, dust, dirt, debris, packaging, trash, fingerprints, grease containers, and other deleterious materials and marks from the site. Refer to individual specification sections for special cleaning required by that section. Contractor is expected to leave the project in spotless, "like new" condition.

D. Final Payment: Submit final construction voucher, *Consent of Surety Company to Final Payment*, and the *Contractor's Final Payment Affidavit*.

1.14 CONTRACTOR'S RESPONSIBILITY DURING THE WARRANTY PERIOD **(See also UGC, Article 13)**:

A. Warranties: The Contractor shall guarantee all work against defects in materials, equipment, or workmanship for a period of one year from the date of final acceptance. The Contractor shall also provide any additional warranties and guarantees of work items and components as hereinafter specified.

B. Service: All necessary service to each electrical and mechanical system and other work requiring specialized training shall be furnished by the Contractor at no cost to the Owner for a period running concurrently with the one year warranty period specified above. Such service shall not include repair of damage due to storm, vandalism or other factors entirely beyond the control of the Contractor.

C. The Contractor will receive no additional compensation for work performed during the one-year warranty period.

## 1.15. REFERENCES AND STANDARDS:

A. Contractor's personnel shall utilize the following adopted Standard Building Codes in all design and construction work.

### 1. INTERNATIONAL CODE COUNCIL ADOPTIONS*

a. BUILDING CODE INTERNATIONAL BUILDING CODE **2012**
b. STRUCTURAL CODE INTERNATIONAL BUILDING CODE **2012**
c. PLUMBING CODE INTERNATIONAL PLUMBING CODE **2012**
d. MECHANICAL CODE INTERNATIONAL MECHANICAL CODE **2012**
e. ENERGY CODE INTERNATIONAL ENERGY CODE **2012**
f. GAS CODE INTERNATIONAL FUEL GAS CODE **2012**
**g.** RESIDENTIAL CODE INTERNATIONAL RESIDENTIAL CODE **2012**
**h.** EXISTING BUILDINGS INTERNATIONAL EXISTING BUILDINGS CODE **2012**

### 2. NATIONAL FIRE PROTECTION ASSOCIATION

i. ELECTRIC CODE NATIONAL ELECTRIC CODE **2014**

### 3. STATE ENERGY CONSERVATION OFFICE/TEXAS COMPTROLLERS OFFICE

j. ENERGY CODES FOR STATE BUILDINGS- Title 34,Part 1,Ch. 19, Sb.C, Rule 19.31

1. CERTIFICATION FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS REQUIRED BY ARCHITECT/ENGINEER-SEE ATTACHED

### 4. ACCESSIBILITY CODES

k. US DEPT. OF JUSTICE, 2010 ADA STANDARDS FOR ACCESSIBLE DESIGN

l. US DEPT. OF JUSTICE, ARCHITECTURAL BARRIERS ACT, ACCESSIBILITY GUIDELINES FOR OUTDOOR DEVELOPED AREAS ON FEDERAL LANDS-EFFECTIVE NOVEMBER 25, 2013

m. 2012 TEXAS ACCESSIBILITY STANDARDS, ELIMINATION OF ARCHITECTURAL BARRIERS, TEXAS GOVERNMENT CODE, CHAPTER 469

### 5. PLAYGROUND SAFETY CODE

n. Public Playground Safety Handbook, U.S. Consumer Product Safety Commission.

B. In addition to the building codes adopted by Texas Parks and Wildlife Department, the latest edition of the following industry testing and quality standards as well as any additional standards set forth in the specifications and/or elsewhere in the Bidding and Contract Documents are incorporated herein and made a part hereof, as applicable:

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|---|---|
| ACI | American Concrete Institute |
| AISC | American Institute of Steel Construction |

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| CRSI | Concrete Reinforcing Steel Institute |
| ASHRAE | American Society of Heating, Refrigeration and Air Conditioning Engineers |
| ASTM | American Society for Testing and Materials |
| AWWA | American Water Works Association |
| UL | Underwriters' Laboratories |
| SMACNA | Sheet Metal and Air Conditioning Contractors National Association |
| TCA | Tile Council of America |
| TXDOT | Texas Department of Transportation |
| TCEQ | Texas Commission on Environmental Quality |

All contractors, including sub-contractors shall ensure all personnel follow the adopted Standardized Building Codes in all design and construction work.

1.16 AVAILABILITY OF FUNDS:

This contract is subject to cancellation, without penalty, either in whole or in part, if funds are not appropriated by the Texas Legislature, or otherwise made available, to the Texas Parks and Wildlife Department.

1.17 ANTIQUITIES.

Contractor shall take precaution to avoid disturbing primitive records and antiquities of archaeological, paleontological or historical significance. No objects of this nature shall be disturbed without written permission of Owner and the Texas Historical Commission. When such objects are uncovered unexpectedly, the Contractor shall stop all Work in close proximity and notify the ODR and the Texas Historical Commission of their presence and shall not disturb them until written permission and permit to do so is granted. All primitive rights and antiquities, as defined in Chapter 191, Texas Natural Resource Code, discovered on the Owner's property shall remain property of State of Texas, the Texas Historical Commission. It is determined by Owner, in consultation with the Texas Historical Commission that exploration or excavation of primitive records or antiquities on Project Site is necessary to avoid loss, Contractor shall cooperate in salvage work attendant to preservation.

1.18 PUBLIC INFORMATION:

All information, documentation, and other materials submitted in response to this solicitation are considered non-confidential and/or non-proprietary and are subject to public disclosure under the Texas Public Information Act (*Texas Government Code*, Chapter 552.001, *et seq.*) after award of a Contract. However, certain information may be confidential and fall under an exception to disclosure under the Public Information Act such as proprietary information, trade secrets, and certain commercial and financial information where disclosure might cause *"substantial competitive harm to your business."* If the Bidder believes that his response to this solicitation contains confidential information in those categories, the Bidder must specifically document this at the top or bottom of each page that contains the information the Bidder considers confidential. The Bidder's documentation must include a statement that confidential information is contained on that page, refer to its exact location on the page, and describe the specific nature of the exception to the Texas Public Information Act that the Bidder believes applies to this information, i.e. copyrighted, trade secret, proprietary, financial etc. A general disclaimer that the Bidder's response contains confidential information will not be sufficient to meet this requirement. If such documentation is not provided, TPWD will assume that all information provided in the response to this solicitation is disclosable under the Act.

The Owner strictly complies with all statutes, court decisions, and opinions of the Texas Attorney General with respect to disclosure of information in this Invitation for Bids.

If an Open Records Request is made for public information, Contractor is required to submit the information in Adobe Acrobat 6.0 .pdf file format to Owner at no additional cost.

1.19 RIGHT TO AUDIT:

The Contractor shall maintain and retain supporting fiscal and any other documents relevant to showing that any payments under this Contract funds were expended in accordance with the laws and regulations of the State of Texas, including but not limited to, requirements of the Comptroller of the State of Texas and the State Auditor. The Contractor shall maintain all such documents and other records relating to this Contract and the State's property for a period of four (4) years after the date of submission of the final invoices or until a resolution of all billing questions, whichever is later. The Contractor shall make available at reasonable times and upon reasonable notice, and for reasonable periods, all documents and other information related to the Project. The Contractor and the subcontractors shall provide the State Auditor with any information that the State Auditor deems relevant to any investigation or audit. Contractor must retain all work and other supporting documents pertaining to this Contract, for purposes of inspecting, monitoring, auditing, or evaluating by TPWD and any authorized agency of the State of Texas, including an investigation or audit by the State Auditor. The Contractor shall cooperate with any authorized agents of the State of Texas and shall provide them with prompt access to all of such State's work as requested. The Contractor's failure to comply with this Section shall constitute a material breach of this Contract and shall authorize the TPWD and the State of Texas to immediately assess appropriate damages for such failure. The acceptance of funds by the Contractor or any other entity or person directly under this Contract, or indirectly through a subcontract under this Contract, shall constitute acceptance of the authority of the State Auditor to conduct an audit or investigation in connection with those funds. The Contractor acknowledges and understands that the acceptance of funds under this Contract shall constitute consent to an audit by the State Auditor, Comptroller or other agency of the State of Texas. The Contractor shall ensure that this paragraph concerning the State's authority to audit funds received indirectly by subcontractors through the Contractor and the requirement to cooperate is included in any subcontract it awards.

1.20 IMMIGRATION REFORM:

The Immigration Reform and Control Act of 1986 and 1990, as amended require that all employees hired since 1986 provide proof of identity and employment eligibility before they can work in the United States. The Owner is committed to complying with all applicable immigration laws of the United Sates and requires compliance by all Contractors and Subcontractors who contract with the State. Contractor shall not place any employee of Contractor at a worksite, nor shall Contractor permit any employee, nor any Subcontractor, to perform any work on behalf of or for the benefit of the State, without first ensuring said employee's authorization to lawfully work in the United States.

Contractor acknowledges, agrees and warrants (a) that Contractor maintains and follows an established policy to verify the employment authorization of its employees and to ensure continued compliance for the duration of employment, (b) that Contractor has verified the identity and employment eligibility of all employees in compliance with applicable law, (c) that Contractor has established internal safeguards and reporting policies to encourage its employees to report any suspected violations of immigration policies or of immigration law promptly to Contractor's senior management and (d) that Contractor is without knowledge of any fact that would render any employee or subcontractor of Contractor ineligible to legally work I the United States.

Contractor further acknowledges, agrees and warrants that Contractor (e) has complied and shall at all times during the term of this Contract comply in all respects with the Immigration Reform and Control Act of 1986 and 1990 as amended, the Illegal Immigration Reform and Immigrant Responsibility Act of 1996, as amended, and all of the laws, rules and regulations relating thereto (f) has properly maintained and shall at all times during the term of this Contract properly maintain all records required by Department of Homeland Security, Immigration and Customs Enforcement (DHS-ICE), including, with limitation, the completion and maintenance of the Form I-9 for each of Contractor's employees and (g) has responded and shall at all times during the term of this Contract respond, in a timely fashion to any inspection requests related to such I-9 Forms. During the term of this Contract, Contractor shall cause its directors, officers, manager, agents and employees to, fully cooperate in all respects with any audit, inquiry, inspection or investigation that may be conducted by the Owner or any State Agency of Contractor or any of its employees.

1.21 CIVIL RIGHTS:

Contractor shall comply with all federal, state and local laws, regulations, executive orders, ordinances and requirements and guidelines applicable to a Contractor providing services to the State of Texas as these laws, regulations, executive orders, ordinances, and requirements and guidelines currently exist and as they are amended throughout the term of this Contract. The Owner reserves the right in its sole discretion to unilaterally amend this Contract throughout its term to incorporate any modifications necessary for Owner's or Contractor's compliance with all applicable State and federal laws and regulations. Without limiting the foregoing, Contractor expressly agrees to comply with the following laws, regulations and executive order to the extent they are applicable to the Contract: (i) Titles VI and VII of Civil Rights Act of 1964, as amended; (ii) Sections 503 and 504 of the Rehabilitation Act of 1973, as amended; (iii) the Americans with Disabilities Act of 1990, as amended; (iv) Executive Order 11246, as amended; (v) The Age Discrimination in Employment Act of 1967, as amended, and the Age Discrimination Act of 1975, as amended; (vi) The Vietnam Era Veterans' Readjustment Assistance Act of 1974, as amended; (vii) 40 TAC § 819.12 & Tex Labor Code Chapter 21 relating to Prohibitions relating to employment and discrimination; (viii) all regulations and administrative rules established pursuant to the foregoing laws; (ix) all other applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations; and (x) all federal and state laws governing the handling, processing, packaging, storage, labeling and delivery of food products, if applicable. All laws, regulations and executive orders applicable to the Contract are incorporated by reference where so required by law.

1.22 FEDERAL, STATE AND LOCAL REQUIREMENTS:

Contractor shall demonstrate on-site compliance with the Federal Tax Reform Act of 1986, Section 530 of the Revenue Act of 1978, dealing with issuance of Form W-2's to common law employees. Contractor is responsible for both federal and State unemployment insurance coverage and standard Worker's Compensation insurance coverage. Contractor shall comply with all federal and State tax laws and withholding requirements. The State of Texas shall not be liable to Contractor or its employees for any Unemployment or Worker's Compensation coverage or federal or State withholding requirements. Contractor shall indemnify the State of Texas and shall pay all costs, penalties or losses resulting from Contractor's omission or breach of this Section.

1.23 SEVERABILITY CLAUSE: In the event that any provision of this Contract is later determined to be invalid, void, or unenforceable, then the remaining terms, provisions, covenants and conditions of this Contract shall remain in full force and effect and shall in no way be affected, impaired or invalidated.

1.24 NO WAIVER: Nothing in this Contract shall be construed as a waiver of the state's sovereign immunity. This Contract shall not constitute or be construed as a waiver of any of the privileges, rights, defenses, remedies or immunities available to the State of Texas. The failure to enforce or any delay in the enforcement of any privileges, rights, defenses, remedies or immunities available to the State of Texas under this Contract or under applicable law shall not constitute a waiver of such privileges, rights, defenses, remedies or immunities or be considered as a basis for estoppel. The Owner does not waive any privileges, rights, defenses or immunities available to the Owner by entering into this Contract or by its conduct prior to or subsequent to entering into this Contract.

1.25 DECEPTIVE TRADE PRACTICES; UNFAIR BUSINESS PRACTICES:

Contractor represents and warrants that it has not been the subject of allegations of Deceptive Trade Practices violations under Tex. Bus. & Com Code, Chapter 17 or allegations of any unfair business practice in any administrative hearing or court suit and that Contractor has not been found to be liable for such practices in such proceedings. Contractor certifies that it has no officers who have served as officers of other entities who have been the subject allegations of Deceptive Trade Practices violations or allegations of any unfair business practices in an administrative hearing or court suit and that such officers have not been found to be liable for such practices in such proceedings.

1.26 EQUAL OPPORTUNITY: Contractor represents and warrants that it shall not discriminate against any person on the basis of race, color, national origin, creed religion, political belief, sex, sexual orientation, age and disability in the performance of this Contract.

1.27 FELONY CRIMINAL CONVICTIONS: Contractor represents and warrants that Contractor has not and Contractor's employees have not been convicted of a felony criminal offense or that if such a conviction has occurred, Contractor has fully advised the Owner as to the facts and circumstances surrounding the conviction.

1.28 ASSIGNMENTS: Without the prior written consent of the Owner, Contractor may not assign this Contract, in whole or in part and may not assign any right or duty required under it.

1.29 INDEPENDENT CONTRACTOR: Contractor shall serve as an independent contractor in providing services under this Contract. Contractor's employees are not and shall not be construed as employees or agents of the State of Texas.

1.30 PATENT, TRADEMARK, COPYRIGHT AND OTHER INFRINGEMENT CLAIMS:

Contractor shall indemnify, save and hold harmless the State of Texas from and against claims of patent, trademark, copyright, trade secret or other proprietary rights, violations or infringements arising from the State's or Contractor's use of or acquisition of any services or other items provided to the State of Texas by Contractor or otherwise to which the State of Texas has access as a result of Contractor's performance under this Contract, provided that the State shall notify Contractor of any such claim within a reasonable time of the State's receiving notice of any such claim. If Contract is notified of any claim subject to this section, Contractor shall notify the Owner of such claim within five (5) business days of such notice. No settlement of any such claim shall be made by Contractor without the Owner's prior written approval. Contractor shall reimburse the State of Texas for any claims, damages, losses, costs, expenses, judgments or any other amounts, including, but not limited to, attorney's fees and court costs, arising from any such claim. Contractor shall pay all reasonable costs of the State's counsel and shall also pay costs of multiple counsel, if required to avoid conflicts of interest. Contractor represents that it has determined what licenses, patents and permits are required under this Contract and has acquired all such licenses, patents and permits.

1.31 FORCE MAJUERE

Contractor is not responsible for failure to perform an obligation under this Agreement if such failure is as a result of acts of God, war, order of legal authority, or other unavoidable cause not attributable to the fault or negligence of Contractor. The burden of proof for relief based on force majeure rests upon Contractor. Before Contractor may be granted relief under force majeure for a failure to perform an obligation under this Agreement, Contractor must notify Owner in writing of their intent to claim relief under force majeure, perform all reasonable measures to minimize delay or damages caused by foreseeable events, and fulfill all non-excused obligations under this Agreement.

1.32 U.S. DEPARTMENT OF HOMELAND SECURITY'S E-VERIFY SYSTEM

By entering into this Contract, the Contractor certifies and ensures that it utilizes and will continue to utilize, for the term of this Contract, the U.S. Department of Homeland Security's E-Verify system to determine the eligibility of:

A. All persons employed to perform duties within Texas, during the term of the Contract; and
B. All persons (including subcontractors) assigned by the Respondent to perform work pursuant to the Contract, within the United States of America.

The Contractor shall provide, upon request of Texas Parks and Wildlife Department, an electronic or hardcopy screenshot of the confirmation or tentative non-confirmation screen containing the E-Verify case verification number for attachment to the Form I-9 for the three most recent hires that match the criteria above, by the Contractor, and Contractor's subcontractors, as proof that this provision is being followed.

**If this certification is falsely made, the Contract may be immediately terminated, at the discretion of the state and at no fault to the state, with no prior notification. The Contractor shall also be responsible for the costs of any re-solicitation that the state must undertake to replace the terminated Contract.**

1.33 MINIMUM EXPERIENCE REQUIREMENTS:

CONTRACTOR MUST SHOW EVIDENCE OF FIVE (5) **YEARS PRIOR EXPERIENCE** IN CONSTRUCTION SIMILAR TO THIS PROJECT (AS JUDGED BY OWNER) TO BE ELIGIBLE FOR AWARD OF THIS CONTRACT. **Contractor should ensure that it provides information on a representative project that was completed prior to March, 2011.**

1.34 RESERVED

1.35 RESERVED

1.36 RESERVED

## PART 2 – PRODUCTS

2.01 CONSTRUCTION MATERIALS:

A. Materials:

1. All materials shall be new and of the quality specified. Materials shall be free from defects. Where manufacturer's names are mentioned in the specifications, it has been done in order to establish a standard of quality and construction, not to preclude the use of equal or superior materials or products of other manufacturers. However, substitutions must have Owner's prior approval.
2. Unless otherwise indicated in the specifications or drawings, equipment and material shall be installed in accordance with the manufacturer's recommendations and shall include such tests as manufacturer recommends.

B. Storage and Protection of Materials:

1. All materials shall be suitably stored to be protected from damage. Water-tight storage facilities of suitable size with floors raised above the ground shall be provided for all materials subject to damage from exposure to the weather. Other materials shall be stored on blocks off the ground. Materials shall be stored to permit easy access for inspection and identification. Any material which has deteriorated, become damaged or otherwise unfit for use shall not be used in the work (as judged by Owner). Upon completion of all work, or when directed, the Contractor shall remove storage facilities from the site.
2. During construction, open ends of all drains, piping and conduit, and all openings in equipment, shall be closed before leaving the work at any time so as to prevent the entrance of all foreign matter.

## PART 3 – EXECUTION

3.01 CONSTRUCTION SITE AND JOB CONDITIONS:

A. The Contractor's Superintendent shall be on site at all times that work is in progress.

B. The Contractor will be provided with designated space in the immediate vicinity of the job site for his use during construction. Unauthorized damage to any existing utilities, building facilities, structures, or plant life shall be repaired by the Contractor at no expense to the Owner. The Contractor shall not allow any unsafe or unsanitary conditions to develop as a result of Contractor's operations.

C. The Contractor shall not allow trash or debris to accumulate on the site. At the end of the contract Contractor shall clean the entire area of any litter resulting from Contractor's operations. The Contractor shall maintain the premises as clean and presentable as good construction practices will allow at all times.

D. Utilities: Water and electrical power are available and will be furnished by the Owner at no charge to the Contractor. However, any temporary connections, appurtenances or extensions shall be provided by the Contractor at no cost to the Owner and removed from the premises at

the conclusion of the contract. Contractor shall provide cellular telephone service at all times and shall keep Owner informed of telephone number.

E. Field Office: The Owner will provide the Contractor with a site on which the Contractor may place a small, temporary office structure.

F. Temporary Toilets: The Contractor shall provide and maintain in neat, sanitary condition toilets and other necessary accommodations for employees' use to comply with the regulations of the State Department of Health or other jurisdictions.

G. Project Identification: There shall be no project signs of any size or type allowed on the project site or surrounding Texas Parks and Wildlife Department property at any time.

H. Fire Protection: The Contractor shall take stringent precautions against fire. Open fires are not allowed unless approved in writing by Owner.

3.02 OCCUPATIONAL SAFETY AND HEALTH STANDARDS **(See also UGC Article 7):**

Prior to trenching below a depth of four (4) feet (if applicable), a Contractor must submit separate pay items for: (i) trench safety to be determined by the linear feet of trench excavated, and (ii) special shoring requirements, if any, to be determined by the square feet of shoring used, pursuant to Texas Government Code, Title 10, Chapter 2166, Section 2166.303. Such pay item(s), following calculation as required above, shall be quoted on the basis of a total lump sum price.

3.03 LAYOUT OF WORK AND SURVEYS:

The Contractor, at Contractor's expense, shall be responsible for establishing base lines, and bench marks if applicable, for the limits of the project. The Contractor shall also be responsible for all measurements that may be required for the execution of the work to the location and limit marks prescribed in the specifications or on the drawings, subject to such modifications as the Owner may require to meet changed conditions or as a result of necessary modifications to the work.

3.04 PARK OPERATIONS:

During construction of this project the Park will remain open to public visitation. It is the responsibility of the Contractor to maintain convenient access and egress to park facilities in a manner to be approved by the Owner. The Contractor shall also be responsible for public safety at the construction site. All temporary fencing, barricades, warning lights, signs, and flagmen shall be provided and maintained by Contractor as needed. The Contractor shall maintain security of construction sites.

3.05 CUTTING AND PATCHING:

A. Where indicated in the Contract Documents, this project requires cutting into existing construction for the performance of the work and requires subsequent fitting and patching to restore the existing work to original condition.

B. Utilities:

1. Contractor shall not cut or patch utilities until all necessary approvals and coordination requirements are accomplished.

2. Before cutting services that are to remain permanently or temporarily in service, Contractor shall provide by-pass system as necessary to maintain service.
3. After by-pass and cutting, Contractor shall cap, valve or plug and tightly seal remaining portion of service piping or conduit to prevent entrance of moisture and foreign matter.

C. Structural Work: Contractor shall not cut or patch structural work in a manner that would result in a reduction of load-carrying capacity or of load-deflection ratio.

D. Inspection:

1. Before cutting, Contractor shall examine items to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, Contractor shall take corrective action before proceeding with the work.
2. Contractor shall meet at the work site with all trades involved in cutting and patching. Contractor shall review areas of potential interference and conflict between the various trades and shall coordinate layout of the work and resolve potential conflicts before proceeding with the work.

3.06 AS-CONSTRUCTED DRAWINGS **(See also UGC Article 6):**

The Contractor shall maintain on a separate set of the Contract Documents a record of all changes made during construction. The Contractor shall be responsible for keeping these records and neatly noting with colored pencil or ink all changes. Progress payments will not be made to the Contractor unless such records are maintained. Verification by the On-Site ODR of such records is solely for assurance that the records are being maintained. Such inspections shall not constitute review or approval of the as-constructed drawings for accuracy or completeness.

**END OF SECTION**

# SECTION 22 05 03 - PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes: Pipe and pipe fittings for the following systems:
1. Domestic water piping.
2. Underground pipe markers.
3. Bedding and cover materials.

### 1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.3 - Malleable Iron Threaded Fittings.

B. ASTM International:
1. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
4. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
5. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
6. ASTM D2513 - Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
7. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
8. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
9. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
10. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
11. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
12. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
13. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

C. American Water Works Association:
1. AWWA C651 – Disinfecting Water Mains.
2. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.

D. Uniform General Conditions, including Supplementary General Conditions.

E. Division 1 – General Requirements, Section 01000 – Special Conditions.

1.3 SUBMITTALS

A. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes.

B. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

C. Test procedures:
1. Submit plan for testing sanitary piping.
2. Submit plan for disinfecting potable water system. – Potable water test to be performed at testing facility chosen by the owner.

D. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.4 QUALITY ASSURANCE

A. Comply with AWWA Standards for public drinking water.

B. Comply with NSF 61 for potable water pipes and piping systems.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 COORDINATION

A. Coordinate installation of buried piping with trenching.

PART 2 PRODUCTS

2.1 DOMESTIC WATER PIPING

A. Refer to schedule on drawings.

B. PVC water pipe shall bear NSF seal of approval.

2.2 UNIONS AND FLANGES

A. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

2.3 MECHANICAL JOINT RESTRAINTS

A. Mechanical joint restraints shall be EBAA MEGALUG 2000PV.

B. Design:
1. Restraint devices for nominal pipe sizes 3 inch through 36 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
2. The devices shall have a working pressure rating equal to that found in the most current product brochure. Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.

C. Material:
1. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
2. Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.
3. Chemical and nodularity tests shall be performed as recommended by the Ductile Iron Society, on a per ladle basis.

D. Installation:
1. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly.
2. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.

E. Coating:

1. All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. The coating shall consist of a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
2. All casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance.
3. The coating system shall be MEGA-BOND by EBAA Iron, Inc. or approved equal. Requests for approved equal must submit coating material and process details for review prior to bid.

2.4 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

B. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Domestic Water Service".

2.5 BEDDING AND COVER MATERIALS

A. Bedding: Fine granular fill.

B. Soil Backfill: Refer to details on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

B. Verify trenches are ready to receive piping.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection to existing piping system size, location, and invert.

B. Establish elevations of buried piping with not less than two feet of cover.

C. Excavate pipe trench.

D. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted depth; compact to 95 percent maximum density.

E. Install pipe on prepared bedding.

F. Route pipe in straight line.

G. Install pipe to allow for expansion and contraction without stressing pipe or joints.

H. Install plastic ribbon tape continuous over top of pipe when cast iron is used. Install trace wire continuous over top of pipe above non-metallic pipe line.

I. Pipe Cover and Backfilling:
   1. Backfill trench.
   2. Maintain optimum moisture content of fill material to attain required compaction density.
   3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 6 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
   4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
   5. Do not use wheeled or tracked vehicles for tamping.

J. Install concrete thrust blocks per details at changes in direction for unrestrained piping systems.

K. Install PCV water pipe in accordance with AWWA C605.

L. Do not exceed pipe manufacturer's recommended deflection limits.

M. Pipe joints:
   1. Joints for PVC water pipe shall be gasketed using flexible elastomeric seals.
   2. Make push-on joints in accordance with manufacturer's recommendations.
   3. Install piping with thrust blocks and mechanical joint restraints at horizontal and vertical changes in direction. Use anchors, tierods, clamps, or other supports where necessary. Anchor blocks to be minimum 3,000 psi concrete.
   4. When joining dissimilar piping materials, use couplings or adapters compatible with both piping materials, outside diameter, system working pressure, and manufactured specifically for the intended use.
   5. Install mechanical joints in accordance with manufacturer's recommendations.

N. Install fittings for changes in direction and branch connections.

O. Wrap all ductile iron fittings and valves in polyethylene sheet in accordance with AWWA C105.

P. Anchorage or Fittings - Thrust Block: Anchor tees, bends and plugged, valved or capped ends of lines of water mains. Place blocks so that the joints will be accessible for inspection and repair.

3.4 INSTALLATION - ABOVE GROUND PIPING

A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

B. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

C. Install non-conducting dielectric connections wherever jointing dissimilar metals.

D. Slope piping and arrange systems to drain at low points.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

F. Install valves.

G. Install piping specialties.

H. Insulate piping.

I. Install pipe identification.

3.5 INSTALLATION - DOMESTIC WATER PIPING SYSTEMS

A. Install domestic water piping system in accordance with ASME B31.9, local codes and authority having jurisdiction.

3.6 FIELD QUALITY CONTROL

A. Test domestic water piping system in accordance with ASME B31.
   1. Provide temporary equipment for testing, including pump and gages. Test piping systems before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
   a. Required test periods are 2 hours each.
   b. Test each piping system at 150% of operating pressure indicated, but not less than 125 psi test pressure.
   c. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure

B. Test sanitary waste and vent piping system in accordance with local authority having jurisdiction.
   1. Fill sanitary piping with water for two hours under atmospheric pressure.
   a. Observe each test section for leakage at end of test period. Test fails if leakage is observed.

C. Repair piping systems sections which fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

3.7 CLEANING

A. Clean and disinfect domestic water distribution system prior to final completion per AWWA C651-05.

B. Provide water sample of disinfected water to testing agency of the owners choosing for verification of potable water disinfection. Provide test upon completion of each phase.

END OF SECTION

# SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Gate valves.

### 1.2 REFERENCES

A. ASTM International:
   1. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   2. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 67 - Butterfly Valves.
   2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
   3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
   4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
   5. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
   6. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

C. Uniform General Conditions, including Supplementary General Conditions.

D. Division 1 – General Requirements, Section 01000 – Special Conditions.

### 1.3 SUBMITTALS

A. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

### 1.4 CLOSEOUT SUBMITTALS

A. Refer to Uniform General Conditions, 12.1.

B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

### 1.5 QUALITY ASSURANCE

A. For drinking water service, provide valves complying with NSF 61.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install valves underground when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers:
1. Crane Valve, North America
2. Mueller Valve
3. Apollo Valve
4. Hammond Valve
5. Milwaukee Valve Company
6. NIBCO, Inc.
7. Stockham Valves & Fittings
8. DeZURIK, Unit of SPX Corp.
9. Flow Control Equipment, Inc. Model
10. Homestead Valve Model

2.2 BALL VALVES

A. Refer to schedule on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify piping system is ready for valve installation.

3.2 INSTALLATION

A. Install valves with stems upright, not inverted.

3.3 VALVE APPLICATIONS

A. Install shutoff valves at locations indicated on Drawings in accordance with this Section.

END OF SECTION

# SECTION 26 00 00 - ELECTRICAL GENERAL CONDITIONS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes electrical materials and methods.

B. The scope of work shall include complete provisions for electrical power distribution to all lighting, devices, appliances, and equipment shown on the construction documents.
   1. Provisions include, but are not limited to, all supplies, materials, equipment, tools, and labor.
   2. Provisions also include all miscellaneous materials required to complete the work shown including, but not limited to, supports, hangers, raceways, boxes, sleeves, seals, equipment pads, wiring connectors, terminals, labels, signs, and markers
   3. The construction documents include all plans, elevations, details, diagrams, schedules, and notes on the drawings and the written specifications including any items mentioned in either the specifications or on the drawings but not in the other.
   4. Where used on the plans and in the specifications and where not specifically noted otherwise, the term "provide" and the term "install" shall mean furnish, install, connect, and test.
   5. Unless explicitly noted "by others" or "existing", all items shown graphically or specified by notes and details on the plans shall be furnished, installed, connected, and tested as needed.

C. In addition to the general scope described above, the work shall include:
   1. Application for temporary and permanent electrical service, Permitting, Inspection, and payment of all associated fees.
   2. Testing and Commissioning.
   3. Equipment rental.
   4. Temporary construction power and lighting. GFCI receptacles shall be used for all construction power.

D. The intent of the drawings and specifications is to set forth the general requirements and equipment necessary for the functioning of the electrical system. The drawings and specifications do not provide a complete list of materials and work required. All miscellaneous electrical components required by good practice and workmanship for the complete installation of the electrical system shall be provided by the contractor.

E. Related Sections:
   1. This and all other division 26 specifications, the construction drawings, general contract provisions, and division 1 specifications shall be considered collectively as the total general requirements for the electrical equipment and electrical system installation and all special systems shown or described on the electrical or "E series" sheets.

### 1.2 REFERENCES

A. Materials, equipment, and the work performed shall comply with current requirements, rules and regulations of and, where applicable, be certified by the following standards, codes and organizations:
   1. American National Standards Institute (ANSI)

2. American Society for Testing and Materials (ASTM)
3. Americans with Disabilities Act (ADA)
4. ASHRAE/IES 90.1
5. Institute of Electrical and Electronics Engineers (IEEE)
6. IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code
7. IEEE C57.12.28 (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity
8. IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms
9. National Electrical Manufacturer's Code (NEMA)
10. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
11. National Fire Protection Associations (NFPA)
12. NFPA 70 National Electrical Code - 2014 Edition
13. Underwriter's Association (UL)
14. Where discrepancies are found between the requirements of these standards codes, ordinances, regulations and the drawings and specifications, the contractor should notify the engineer prior to installation. Installed work that fails to comply with the requirements of the above shall be replaced at contractor's expense.

1.3 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

C. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 SUBMITTALS

A. Submittal requirements shown here shall be used in conjunction with the requirements of the other specification sections. Where in conflict, the more stringent requirements shall apply.

B. For each product required to be submitted, provide the following
   1. Product Data: Submit catalog data showing manufacturer's name and contact information, all standard features, dimensions, weights, listings and product labels, material types, finishes and clearly indicating which optional features will be provided.
      a. Include amperage and voltage ratings, over-current protective device ratings, AIC ratings, etc
      b. Where multiple sizes are listed, indicate sizes to be used.
      c. Where multiple products are shown on the same page, indicate which products to be used.
   2. Shop Drawings (where applicable): Manufacturer or contractor prepared drawings showing all relevant dimensions, weights, electrical and mechanical connection requirements, conduit entry points, assembly requirements, lifting requirements, lifting points, and required clearances.
      a. Include dimensioned plan views and elevations.

b. Include all relevant electrical diagrams including schematic and interconnection diagrams for power, signal, and control wiring.

C. Submittals shall be organized by specification section, provided with a table of contents, and a cover page with all pertinent project information including contractor's name and contact information, project name and number, and specification sections submitted.

D. Rejected submittals shall be resubmitted within 15 calendar days of notification of rejection.

E. Any equipment covered by division 26 specifications that is installed by the contractor without submittal approval and is not in compliance with the appropriate specifications shall be replaced at the contractor' expense.

F. As-Constructed Record Drawings: The Contractor shall maintain a master set of As-Constructed Record Drawings that show changes and any other deviations from the drawings. The markups must be made as the changes are done. At the conclusion of the job, these As-Built Record Drawings shall be transferred to AutoCad electronic files, in a format acceptable to the Owner, and shall be complete and delivered to the Owner's Representative prior to final acceptance.

1.5 CLOSEOUT SUBMITTALS

A. Refer to UGC 12.1.

B. At the end of construction, provide a closeout submittal containing the following information in addition to items specified in other sections.
1. As constructed drawings showing the actual locations of installed equipment, site raceways and boxes.
2. Operation and Maintenance data
3. Shop Drawings
4. Test results
5. Actual circuit arrangements at panels and equipment. Provide complete, typed as built of all panel schedules.

C. Operation and Maintenance Data: At the end of construction, provide the owner with an 8.5x11 bound manual including the following information:
1. Provide product data as defined under submittals.
2. Provide manufacturer's installation and maintenance instructions for normal operation, routine maintenance and testing, and emergency maintenance procedures.
3. Spare parts listing; source of replacement parts and supplies; and recommended maintenance procedures and intervals.

D. Shop Drawings: At end of construction, provide owner with a final draft, new copy of all shop drawings that were field modified after the original submittal was approved

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products shown on the construction documents with minimum five years documented experience.

1. Manufacturer shall maintain or certify an independently operated service center capable of providing training, support, parts, and maintenance services.

B. Supplier: Authorized distributor

C. Installer: A state licensed electrician with documented experience installing all equipment specified here in shall directly supervise all work. Where noted in the specifications, required by code, or required by the manufacturer, installer shall be a manufacturer trained and/or certified installer of the specific product to be installed.

D. Testing Agency: Where required by the construction documents, equipment manufacturer, or code; testing shall be performed by an agency
1. With the documented experience and properly calibrated, fully functioning equipment.
2. That is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL).
3. That is acceptable to the authority having jurisdiction.
4. Testing may be required to be performed by an independent agency. Refer to individual specification sections for detailed testing requirements.

1.7 QUALITY ASSURANCE

A. Inclusion of specific products in these specifications and on the plans does not mean that said products may be used for all applications in all environments. Products may only be used where approved either in the specification installation requirements sections or on the plans. Where the construction documents do no explicitly state what products are acceptable for an application, the most robust products specified are assumed to be the minimum requirement.

B. Regulatory Requirements
1. The contractor shall comply with the requirements of all laws, rules, regulations, code and ordinances that have been adopted by the federal, state, and local authorities having jurisdiction (AHJ). All equipment, materials, means and methods shall be acceptable to the AHJ's.
2. Electrical installations shall conform to IEEE C2, NFPA 70, local codes and specified requirements herein. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.
3. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. Standard Products
1. Unless otherwise approved, all equipment shall be new, properly designed, from a reputable manufacturer meeting the specification qualifications, in compliance with the specification requirements, and in full working order.
2. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.
3. Listing and Labeling: Where required, all electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable

to authorities having jurisdiction and marked for the intended use. Testing agency shall be UL unless noted otherwise or pre-approved by owner and AHJ.

4. Products shall have been in satisfactory commercial or industrial use prior to bid opening. The minimum time of use shall be 2 years. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. Longer periods may be specified for specific products. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

D. Material and Equipment Manufacturing Date
   1. Products manufactured more than 2 years prior to date of delivery to site shall not be used, unless specified otherwise.

E. All equipment used for testing shall be in full working order and calibrated per the manufacturer's recommendations.

1.8 WARRANTY

A. The equipment items shall be supported by service organizations which are within 100 miles to the project site in order to render service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.9 COORDINATION

A. All power outages shall be coordinated in writing with the owner a minimum of one(1) week prior to the outage.

B. If the owner will occupy any portion of the facility during any period of construction, cooperate fully with the owner or his representative during construction operations to minimize conflicts and to facilitate owner usage so as not to interfere with the owner's operations.

C. The drawings are diagrammatic. They do not show switches, power and data outlets, special systems components (FA, Access Control, AV, etc), electrical equipment, equipment connections, required raceways, etc. in their exact dimensioned locations. The contractor must carefully review the field conditions and plans to identify conflicts and areas that require coordination.

D. Coordinate electrical and special systems equipment rough in with millwork, signs, mechanical and plumbing systems, sprinkler systems, architectural and structural elements, and the owner's representative. Minor changes in electrical equipment locations and layout that are required by site conditions or order by the design team prior to performance of work shall be made by the contractor without additional charges to the owner.

E. Maintain required NEC working space and dedicated equipment spaces around all electrical equipment, control panels, etc that are subject to maintenance, testing, or user interface. Coordinate with other trades prior to installation. If clearance cannot be provided, the contractor shall notify the engineer prior to rough-in.

F. Coordinate color selections for luminaires and all device plates with owner.

G. Contractor shall be responsible for field coordinating with other trades.

H. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. To allow for the appropriate installation of furniture and equipment relative to receptacles and switches.

I. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

J. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

K. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

L. Determine connection locations and requirements.

M. Sequence rough-in of electrical connections to coordinate with installation of equipment.

N. Sequence electrical connections to coordinate with start-up of equipment.

1.10 DELIVERY STORAGE AND HANDLING

A. Store in clean, dry space located above grade and protect from dirt, water, construction debris, traffic, freeze, and where applicable, deterioration from sun light.

B. Maintain factory wrapping or provide additional canvas or plastic cover for all large electrical equipment. Follow all manufacturer recommendations for humidity and max/min temperatures for storing electrical equipment.

1.11 SAFETY

A. The Contractor shall follow all industry standard safety procedures.
   1. The Contractors shall be responsible for training all personnel under their employ in areas concerning safe work habits and construction safety. The Contractor shall continually inform personnel of hazards particular to this project and update the information as the project progresses.
   2. The Contractor shall secure all electrical rooms, to limit access, prior to energizing any high voltage switchgear and shall control access during the project after energization. The Contractor shall post and maintain warning and caution signage in areas where work is on going near energized equipment. The Contractor shall cover all energized live parts when work is not being done in the equipment. This includes lunch and breaks.
   3. The Contractor shall strictly enforce OSHA lock out/tag out procedures. Initial infractions shall result in a warning; a second infraction shall result in the removal of the workman and his foreman from the site. Continued infractions shall result in removal of the Contractor from the site.

1.12 SHORING AND EQUIPMENT SUPPORTS

A. Provide all permanent and temporary bracing, anchoring, supports, and shoring required to firmly stabilize and secure all raceways, boxes, enclosure, equipment, and devices.

B. Provide free standing racks to supports equipment. Racks shall be securely bolted to the floor, wall, and or ceilings. Where secured to only one surface, provide angle bracing so that racks have a minimum of 4 attachment points.

C. Provide concrete housekeeping pads for floor mounted electrical equipment. Coordinate with flooring contractor for installation.
   1. 3000PSI, with rebar reinforcement.
   2. Provide dowels for connection to new or existing adjacent slabs
   3. Pad shall be 4" thick and protrude a minimum of 1" beyond the edge of equipment.
   4. Chamfer top edges of slab

1.13 TEMPORARY CONSTRUCTION POWER AND LIGHTING

A. Provide temporary power service per utility company specifications
   1. Contractor shall be responsible for securing permits and coordinating temporary service with utility provider.
   2. Provide temporary power service pole per utility company specifications.
   3. Provide service feeder from temporary service point to construction trailers and power distribution assemblies to serve power tools and construction equipment.

B. Provide panel or assembly containing GFCI receptacles for power tools to be used on site.

C. Provide temporary power cables neatly trained and protected from damage.

D. Provide temporary lighting throughout area of construction. Install at ceiling level out of way of construction work.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Equipment to be installed outdoors, in corrosive or hazardous environments shall be rated for the intended use.

B. Compliance with the requirements of the contract documents shall not relieve the contractor of the responsibility of providing equipment that is new, properly designed, from a reputable manufacturer, and in full working order.

C. If conflicts occur between the specifications and drawings, the higher quality, price or quantity shall be provided and installed.

D. If there is any question as to quality, size or quantity necessary, the contractor shall provide a written request for clarification from the Engineer. Contractor shall be responsible for any additional expenses incurred as a result of the contractor's failure to obtain clarification.

E. Detailed product specifications are included in other specification section and on the plans.

2.2 FINISHES

A. Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

B. Raceways, boxes, supports, etc shall be galvanized: gold, silver, or hot dipped, unless noted otherwise.
   1. Do not use pre-galvanized products that are formed, cut, or punched after galvanization.
   2. Do not use hot dip galvanized threaded products.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time,

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

A. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.2 FIELD PROGRAMMING

A. Electrical contractor shall be responsible for the coordination and payment of programming for all programmable devices and equipment including, but not limited to, lighting controls, circuit breakers, etc.

B. Where required, the manufacturer of the product shall be engaged to perform the programming.

3.3 EXAMINATION

A. If a conflict is found between the specification and plans, notify the Architect or Engineer of the conflict.

B. Verify equipment is ready for electrical connection, for wiring, and to be energized.

C. Verify existing conditions are as shown on the plans and that adequate space is available for the equipment for installation.

3.4 EXISTING WORK

A. Maintain in service existing systems that are required for life safety or ongoing operations during construction.

B. Remove exposed abandoned equipment wiring connections, conduit, and boxes , including abandoned connections, conduit, and boxes above accessible ceiling finishes.

C. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.

D. Extend existing equipment connections using materials and methods compatible with existing electrical installations, or as specified.

E. Contractor to remove all abandoned wire near the surface and leave all wiring buried in place.

3.5 INSTALLATION

A. The installation requirements shown here are general scope requirements. More detailed information is provided for each of these topics in other specifications and on the plans.

B. No foreign systems such as piping, duct work, etc shall be installed above electrical equipment.

C. Grounding and Bonding
   1. All circuits shall be provided with NEC compliant green ground conductor sized per NEC 250, UNO.
   2. All equipment shall be properly bonded.
   3. Provide grounding electrodes as specified on plans and as required by code.

D. Raceways, Boxes and Enclosures
   1. Provide complete raceway systems from source to all loads with dedicated supports for each raceway element.
   2. Provide all required back boxes and supports for wiring devices, sensors, etc.
   3. Provide pull box at appropriate locations for all power and special systems raceways whether shown on plans or not.

E. Electrical connections and terminations.
   1. Make all connections and terminations within the power distribution system and between the distribution system and the equipment served.
   2. Make conduit connections to vibrating equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
   3. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
   4. Provide calibrated torque wrenches and screwdrivers and tighten terminals, lugs and bus joints using it.

F. Equipment wiring requirements

1. Install disconnect switches, controllers, control stations, and control devices as required for equipment.
2. Install terminal block jumpers to complete equipment wiring requirements.
3. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

G. Identification
1. Provide appropriate labels for all equipment, wiring devices, conductors, cables, box, and enclosures
2. Provide warning signs for electrical equipment and buried circuits.

H. Code and manufacturer requirement compliance
1. Install work in compliance with the latest edition of the NEC, City and Owner design criteria manuals, and the authority having jurisdiction.
2. Apply, install, connect, erect, use, clean, adjust, and condition materials and equipment as recommended by the manufacturers in their published literature.
3. All terminals, lugs and bus joints shall be tightened per the manufacturer's torque recommendations.

I. Arrangement and planning
1. Arrange electrical work in neat, well-organized manner.
2. Do not block future connection points of electrical service.
3. Install all electrical work parallel or perpendicular to building lines unless noted otherwise, properly supported with purpose-designed apparatus, in a neat manner.
4. Maintain required NEC working space and dedicated equipment spaces around all electrical equipment subject to maintenance, testing, or user interface. Coordinate with other trades prior to installation.
5. Do not block equipment control panels with lighting, raceways, structural elements or other equipment. Orient equipment so that control panels do not face structural elements or other equipment that will restrict access.
6. Coordinate with engineer before installation if any of the above conditions can not be met due to undiscovered site conditions or if locations shown on plans are field determined to be in conflict with equipment and structures called for on other plans.

J. Cutting and Patching
1. Make opening through masonry and concrete by core drilling in acceptable locations. Restore openings to original condition to match remaining surrounding materials.
2. Provide sleeves for penetrations through floors and walls
3. Seal all openings using appropriate materials
4. Where existing conditions are not documented, perform ground penetrating radar scan of structural element to be cut.

END OF DOCUMENT

# SECTION 26 05 19 - CONDUCTORS AND CABLES 600V OR LESS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes building wire and cable; service entrance cable; metal clad cable; and wiring connectors and connections.

### 1.2 REFERENCES

A. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

C. Uniform General Conditions, including Supplementary General Conditions.

D. Division 1 – General Requirements, Section 01000 – Special Conditions.

### 1.3 SUBMITTALS

A. Product Data: Submit catalog data showing all standard features, dimensions, weights, listings and product labels, material types, finishes and clearly indicating which optional features will be provided.
   1. Include amperage and voltage ratings.
   2. Where multiple sizes are listed, indicate sizes to be used.
   3. Where multiple products are shown on the same page, indicate which products to be used.

### 1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and circuits.

B. Uniform General Conditions, including Supplementary General Conditions.

C. Division 1 – General Requirements, Section 01000 – Special Conditions.

### 1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: A licensed electrician with documented experience installing all equipment specified here in shall directly supervise all work. Where noted in the specifications or required by the

manufacturer, installer shall be a manufacturer trained and/or certified installer of the specific product to be installed.

1.6 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

B. Perform Work in accordance with all applicable city, state, and federal requirements.

C. Maintain one copy of each document on site.

D. Source Limitations: All components required for a complete functioning system as described here in shall be obtained through one source from a single manufacturer.

E. Listing and Labeling: Where required, all electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for the intended use. Testing agency shall be UL unless noted otherwise or pre-approved by owner and AHJ.

1.7 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.8 COORDINATION

A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

B. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:
   1. Solid, insulated conductor in raceway for feeders and branch circuits 10 AWG and smaller.
   2. Stranded, insulated conductors in raceway for feeders and branch circuits 8 AWG and larger
   3. Stranded, insulated conductors for control circuits. Route in raceway, except were otherwise allowed to be run exposed in plenum, in tray, etc.
   4. Conductor not smaller than 12 AWG for power and lighting circuits.
   5. Conductor not smaller than 14 AWG for control circuits.

B. Wiring Methods: Provide the following wiring methods:
   1. Concealed and Exposed Dry, Wet, or Damp Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
   2. Exterior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.

3. Underground Locations: Use only building wire, Type THHN/THWN insulation, in raceway.

2.2 BUILDING WIRE

A. Manufacturers:
1. AETNA
2. American Insulated Wire Corp.
3. Colonial Wire Model
4. Encore Wire Model
5. General Cable Co. Model
6. Republic Wire Model
7. Rome Cable Model
8. Service Wire Co. Model
9. Southwire Model
10. Superior Essex Model
11. Substitutions: With engineer approval.

B. Product Description: Single conductor insulated wire.
1. Conductor: Soft drawn copper, 98% conductivity.
2. Insulation Voltage Rating: 600 volts.
3. Insulation Temperature Rating: 90 degrees C.
4. Insulation Material: Thermoplastic. Type THHN/THWN U.N.O.

C. Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by the NEC. Conductors intended as a neutral shall be colored solid white, or identified as required by the NEC. All motor or equipment power wiring shall be colored according to Section 26 05 53, Electrical Identification.

2.3 METAL CLAD CABLE

A. Manufacturers:
1. Diamond Wire & Cable Co.
2. Essex Group Inc.
3. General Cable Co.
4. Substitutions: With engineer approval.

B. Product Description:
1. Conductor: Soft drawn copper, 98% conductivity.
2. Insulation Voltage Rating: 600 volts.
3. Insulation Temperature Rating: 90 degrees C.
4. Insulation Material: Thermoplastic. Type THHN/THWN U.N.O.

C. Armor Material: Steel.

D. Armor Design: Interlocked metal tape

E. Jacket: Where required.

2.4 WIRING CONNECTORS

A. Provide factory-fabricated, metal connectors of the size, rating, material, type and class as required by manufacturer of the equipment and the NEC. The following types, classes, kinds and styles should be used only where appropriate and as noted
   1. Solderless Pressure Connectors
   2. Crimp
   3. Threaded
   4. Insulated Spring Wire Connectors with plastic caps for 10 AWG and smaller
   5. Split bolt parallel connectors
   6. Pre-insulated multi-tap connectors
   7. Epoxy resin type splicing kits.

B. Wiring connectors shall be insulated to 600V. Conducting components shall match conducting material of wiring (copper, unless noted otherwise).

2.5 TERMINATIONS

A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.

B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

C. Control wiring: Use insulated terminals for control wiring. Use flange spade compression terminal for termination of stranded conductors at wiring devices, including grounding connections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify interior of building has been protected from weather.

B. Verify mechanical work likely to damage wire and cable has been completed.

C. Verify raceway installation is complete and supported.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

B. Clean conductor surfaces before installing lugs and connectors.

3.3 EXISTING WORK

A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.

B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.

C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.

D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

A. Neatly train and lace wiring inside boxes, equipment, and panelboards.

B. Install electrical cable, wire and connectors as indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and as required to ensure that products serve the intended functions.

C. Wiring Installation in Raceways
1. Wire and cable shall be pulled into clean dry conduit. Do not exceed manufacturer's recommended values for maximum pulling tension.
2. Do not install the conductors until the raceway system is complete and properly cleaned.
3. Pull conductors together where more than one is being installed in a raceway.
4. Use UL listed pulling compound or lubricant, when necessary; compound must not deteriorate conductor and insulation.
5. Do not use a pulling means, including fish tape, cable or rope, which can damage the raceway.
6. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
7. Place an equal number of conductors for each phase of a circuit in same raceway.
8. Provide separate conduit or raceway for line and load conductors of motor starters, safety disconnect switches, and similar devices. Those devices shall not share the same raceway.
9. All conduits shall contain a green grounding conductor. Conduit, wireways, or boxes shall not be used as the equipment grounding conductor.

D. Cable:
1. Protect exposed cable from damage.
2. Support cables above accessible ceiling, using spring metal clips or appropriate cable ties to support cables from structure. Do not rest cable on ceiling panels.
3. Use suitable cable fittings and connectors.

E. Wiring Connections and Terminations
1. Install splices, taps and terminations, which have equivalent-or-better mechanical strength and insulation as the conductor. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
2. Keep conductor splices and taps accessible and to a minimum. Splice branch circuits only in accessible junction or outlet boxes. Where terminations of cables that are installed under this

Section are to be made by others, provide pigtail of adequate length for neat, trained and bundles connections, minimum 5 feet at each location, unless noted otherwise on drawings.

3. Splices below grade are not allowed unless it is not possible.
4. Use splice, tap and termination connectors, which are compatible with the conductor material.
5. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
6. Where the construction drawings call for a reduction of wire size in a tap box, utilize splicing product that allows the following:
    a. Conductors to be connected in-line
    b. Insulated with high dielectric strength plastisol.
    c. Supplied with removable access plugs over the hex screw
    d. Abrasion and chemical resistant
    e. UL Listed
    f. Rated for copper cables at 600V and 90•C.
7. Tape un-insulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor and label as spare.
8. Power and Lighting Circuits:
    a. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger.
    b. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps on lighting and receptacle circuits.
    c. Use split bolt connectors for copper wire splices and taps, 6 AWG and larger.
9. Connections for all wire sizes in motor terminal boxes where the motor leads are furnished with crimped-on lugs shall be made by installing ring type compression terminals on the motor branch circuit ends and then bolting the proper pairs of lugs together. First one layer of No. 33 scotch tape reversed (sticky side out), then a layer of rubber tape, then two layers of No. 33 half-lapped.

F. Terminal Lugs
1. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
2. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
3. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

G. Voltage Drop
1. No conductor smaller than No. 12 wire shall be used for lighting purposes. In the case of "home runs" over 50' length (100' for 277 volt) no conductor smaller than a No. 10 wire shall be used.
2. Voltage drop on feeders and branch circuits shall not exceed 5%.
3. Voltage drop on control circuits shall not exceed the requirements of the equipment that the wiring serves.

H. Wiring Within An Enclosure:
1. Contractor shall bundle AC and DC wiring separately within an enclosure.
2. The Contractor shall utilize panel wire-ways when they are provided.

3. Where wireways are not provided, the Contractor shall neatly tag and bundle wires and secure to sub-panel at a minimum of every three inches.

I. Separate neutral conductors shall be provided for each single phase circuit.

J. Where terminations of cables that are installed under this Section are to be made by others, provide pigtail of adequate length for neat, trained and bundles connections, minimum 5 feet at each location, unless noted otherwise on drawings.

K. Do not band any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of 600-volt insulated conductors.

3.5 WIRE COLOR

A. General:
1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following for each phase A,B,C, and Neutral:
a. Black (A), Red (B) for single phase circuits at 120/240 volts.
2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Use colors listed above.

B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:
1. For 6 AWG and smaller: Green.
2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.6 FIELD QUALITY CONTROL

A. Before final acceptance, the Contractor shall make voltage, insulation, and load tests, necessary to demonstrate to the Owner's representative the satisfactory installation and proper performance of all circuits.

B. All terminations rated 60A or larger shall be made using a torque wrench and the results recorded in a log to be provided to owner with closeout documents.

C. Test feeder conductor insulation. Insulation-resistance test shall be conducted per NETA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
1. 500V DC megger testing is required on all feeders #1/0 AWG and larger after installed in conduit.
2. All testing shall be witnessed by TPWD representatives and all test results shall be documented in writing and signed by the electrician.

3. Test results below 50 megohms shall be cause for rejection of the wiring installation.
4. Replace and retest all non-compliant conductors.
5. Provide written log of testing results to owner with closeout documents.

END OF SECTION

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

## 1.1 SUMMARY

A. Section Includes:
   1. Rod electrodes.
   2. Active electrodes.
   3. Wire.
   4. Mechanical connectors.
   5. Exothermic connections.

## 1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
   2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.
   2. NFPA 99 - Standard for Health Care Facilities.

D. Uniform General Conditions, including Supplementary General Conditions.

E. Division 1 – General Requirements, Section 01000 – Special Conditions.

## 1.3 SUBMITTALS

A. Product Data: Submit catalog data showing all standard features, dimensions, weights, listings and product labels, material types, finishes and clearly indicating which optional features will be provided.
   1. Include amperage ratings, voltage, over-current protective device ratings, AIC ratings.
   2. Where multiple sizes are listed, indicate sizes to be used.
   3. Where multiple products are shown on the same page, indicate which products to be used.

B. Manufacturer's Installation Instructions: Submit for active electrodes.

C. Manufacturer's Certificate: Certify, Products meet or exceed specified requirements.

## 1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and grounding electrodes.

B. Field Quality-Control Test Reports: Report certified by field testing agent indicating results of performance testing required in Part 3 and/or on plans.: Indicate overall resistance to ground and resistance of each electrode.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: A State of Texas licensed electrician with documented experience installing all equipment specified here in shall directly supervise all work. Where noted in the specifications or required by the manufacturer, installer shall be a manufacturer trained and/or certified installer of the specific product to be installed.

1.6 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

B. Listing and Labeling: Where required, all electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for the intended use. Testing agency shall be UL unless noted otherwise or pre-approved by owner and AHJ.

C. Source Limitations: All components required for a complete functioning system as described here in shall be obtained through one source from a single manufacturer.

D. Maintain one copy of each document on site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Store in clean, dry space located above grade and protect from dirt, water, construction debris, traffic, chemical and mechanical damage, freeze, and where applicable, deterioration from sun light. Store in original packaging where possible.

C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.8 COORDINATION

A. Complete grounding and bonding of building reinforcing steel prior to concrete placement.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products that are compliant with these specifications and produced by the following manufacturers are acceptable
   1. Copperweld, Inc
   2. Erico, Inc.
   3. ILSCO Corporation
   4. O-Z Gedney Co.
   5. Thomas & Betts, Electrical.

B. Substitutions: With prior written engineer approval.

2.2 ROD ELECTRODES

A. Product Description:
   1. Material: Copper.
   2. Diameter: 3/4 inch.
   3. Length: 10 feet.

B. Connector: Connector for exothermic welded connection.

2.3 GROUNDING AND BONDING WIRE

A. Material:
   1. Match building wiring material specifications
   2. Except where noted bare, match building wiring insulation.
   3. Minimum requirement: 600V, stranded copper.
   4. Solid copper may be used for #8 AWG and smaller.

B. Grounding Electrode Conductor: stranded Copper conductor bare.

C. Grounding Straps: Tin plated copper braided cable, 1" thick x 0.1" thick (min), #1 awg, with ¾" one hole connections on both ends (note: other connection types may be noted on plans)

2.4 MECHANICAL CONNECTORS

A. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

B. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

2.5 EXOTHERMIC CONNECTIONS

A. Product Description: Exothermic welding kits, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils and surface contaminants at connection points.

3.3 EXISTING WORK

A. Modify existing grounding system to maintain continuity to accommodate renovations.

B. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.

3.4 SERVICE ENTRANCE GROUNDING ELECTRODE SYSTEM

A. Install grounding electrode system as required by NEC. At a minimum, a grounding electrode conductors shall be extended to:
   1. The building metal cold water piping, bolted connection.
   2. Structural steel framing, welded connection.
   3. 20 ft of bare copper encased in concrete, ufer ground.
   4. 20ft of bare copper conductor buried at 24" or driven ground rods.
   5. Additional electrodes as required to achieve minimum ground impedance as specified below.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

C. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically by pass water meters. Connect pipe with a bolted connector.

3. Bond each above ground portion of gas piping system downstream from equipment shutoff valve.

D. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.

E. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.

F. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.

G. Connect to existing site grounding system where applicable

H. Additional grounding electrode requirements and grounding electrode conductor sizes are shown on the plans.

3.5 INSTALLATION

A. Permanently ground and bond the entire light and power system in accordance with NEC, including service equipment, feeders and branch circuits electrical panels, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

B. General Requirements
1. Install in accordance with IEEE 142, NEC requirements, and manufacturer's recommendations.
2. Install grounding and bonding conductors concealed from view.
3. Routing of grounding electrode, special systems ground conductors, and other grounds not routed in feeders or branch circuit raceways shall be installed in a dedicated metal conduit in all locations subject to physical abuse or environmental deterioration such as exterior mounted, exposed below ceiling, etc.
4. Ground system using separate insulated grounding conductor installed with every feeder and branch circuit conductors in conduits. Terminate each end on suitable lug, bus, or bushing.
5. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes, equipment ground terminal, or metal enclosures of equipment.
6. Raceway systems shall be made continuous from source to load.
   a. Provide bonding jumpers were raceway system is inherently discontinuous such as where conduits terminate at cable trays.
   b. Raceway shall be made continuous using mechanical connections that have been securely tightened using the appropriate tool. Hand tight is not acceptable.
7. Permanently attach equipment and grounding conductors prior to energizing equipment.
8. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors
9. Provide grounding bushings for conduit terminations at panels, electrical equipment, enclosures, etc.

C. Bonding Straps and Jumpers:

1. Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
2. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
3. Bonding to Equipment Mounted on Vibrations Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
4. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
5. Bond the following components to the grounding electrode
   a. System neutral at service entrance and transformer secondaries
   b. Service equipment enclosures, exposed non-current carrying metal parts of electrical equipment
   c. Metal raceway systems, cable trays, auxiliary gutters, meter fittings, boxes, cable armor, cable sheath
   d. Ground bus in electrical rooms and IT rooms

D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Exothermic connection.
   2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Exothermic connection.
   4. Ground wire taps in pull boxes: Mechanical connection with wet location heat shrink covering.

3.6 FIELD QUALITY CONTROL

A. Grounding System Resistance: 5 ohms maximum.

B. Perform ground resistance testing
   1. Test in accordance with IEEE 142 using a test instrument equal to AEMC Model #3710 or fall-of-potential test.
   2. Provide additional grounding electrodes as required to achieve resistance listed above.
   3. Testing shall be performed when the soil is dry and there has been no rain in the past 48 hours.

C. Perform continuity testing in accordance with IEEE 142.

D. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

# SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.1 SUMMARY

A. section Includes:
   1. Conduit supports.
   2. Formed steel channel.
   3. Spring steel clips.
   4. Equipment bases and supports.

### 1.2 REFERENCES

A. FM Global:
   1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

B. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

C. Underwriters Laboratories Inc.

D. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

E. Uniform General Conditions, including Supplementary General Conditions.

F. Division 1 – General Requirements, Section 01000 – Special Conditions.

### 1.3 SUBMITTALS

A. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

B. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.

### 1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Supplier: Authorized distributor

C. Installer: A licensed electrician with documented experience installing all equipment specified here in shall directly supervise all work. Where noted in the specifications or required by the

manufacturer, installer shall be a manufacturer trained and/or certified installer of the specific product to be installed.

1.5 QUALITY ASSURANCE

A. Source Limitations: All components required for a complete functioning system as described here in shall be obtained through one source from a single manufacturer.

B. Listing and Labeling: Where required, all electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for the intended use. Testing agency shall be UL unless noted otherwise or pre-approved by owner and AHJ.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. Electroline Manufacturing Company
3. O-Z Gedney Co.
4. Thomas & Betts
5. Substitutions: With prior written engineer approval.

B. Conduit straps - general purpose:
1. One hole zinc plated steel for surface mounted conduits 1" or less.
2. Two hole zinc plated steel for surface mounted conduits greater than 1"

2.2 CABLE TIES

A. High strength nylon temperature rated to 185 degrees F.

B. Self Locking

2.3 FORMED STEEL CHANNEL

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. B-Line Systems
3. Midland Ross Corporation, Electrical Products Division
4. Thomas & Betts

5. Unistrut Corp.
6. Substitutions: With engineer approval.

B. Product Description:
1. Galvanized 12 gage thick steel.
2. Holes 1-1/2 to 2 inches on center.
3. Provide angle brackets and other accessories from the same manufacture and from the same materials with the same finish

C. Provide heavier gage channel where the weight of the equipment exceeds the ratings of the products specified above.

D. Steel Pipe Straps
1. Provide straps from the same manufacturer and of the same material and finish as channel
2. Bolt head combination slot and hex head with square nut
3. Conduit size engraved in strap for easy identifications
4. Design load of 500lbs min.

2.4 SPRING STEEL CLIPS

A. Product Description: Mounting hole and screw closure.

2.5 BOX SUPPORTS

A. Outlet boxes
1. Provide between stud box mounting brackets secured to the two adjacent studs.
2. Provide two self tapping screws on each side to secure bracket to stud
3. Where two studs are not available, provide far side box support strap

B. Pull and Junction boxes
1. Provide threaded hangers and channel supports for pull and junction boxes suspended from ceiling

PART 3 EXECUTION

3.1 PREPARATION

A. Remove incompatible materials affecting bond.

B. Obtain permission from Architect/Engineer before using powder-actuated anchors.

C. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.2 INSTALLATION - HANGERS AND SUPPORTS

A. General Requirements
1. Support raceways using galvanized steel or malleable iron straps, channel, and/or beam/pipe clamps as appropriate.

2. Install conduit and raceway support and spacing in accordance with NEC.
   a. Provide supports at all boxes, elec equipment, and loads
   b. Provide supports at code required intervals along raceways.
3. Support independent of other systems. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
4. Install multiple conduit runs on common hangers. Provide spare capacity on support elements where more than three conduits are grouped together.

B. Anchors and Fasteners:
1. Concrete Structural Elements: Provide precast inserts, expansion anchors and preset inserts.
2. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
3. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
4. Solid Masonry Walls: Provide expansion anchors and preset inserts.
5. Sheet Metal: Provide sheet metal screws.
6. Wood Elements: Provide wood screws.

C. Inserts:
1. Install inserts for placement in concrete forms.
2. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
3. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut.

D. Supports:
1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted boxes, cabinets, and panelboards with minimum of four anchors.
3. Install surface mounted device boxes with a minimum of two anchors, secure boxes in stud walls to the studs on both sides of the box
4. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
5. Support vertical conduit at every floor.

## 3.3 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of 3000 PSI concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

## 3.4 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes:
1. Conduit and tubing
2. Surface raceways
3. Wireways
4. Outlet boxes
5. Pull and junction boxes
6. Enclosures and Cabinets

B. Related Sections:
1. The requirements of this specification shall be followed when installing raceway for all mechanical, controls, electrical, and special systems work covered by other specifications.

### 1.2 REFERENCES

A. American National Standards Institute:
1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.

B. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

C. Underwriters Laboratories Inc.:
1. Products shall be listed where required by the NEC
2. Fire-stopping products shall be listed.

D. Uniform General Conditions, including Supplementary General Conditions.

E. Division 1 – General Requirements, Section 01000 – Special Conditions.

### 1.3 SUBMITTALS

A. Product Data: Submit catalog data showing all standard features, dimensions, weights, listings and product labels, and clearly indicating which optional features will be provided for the following items:

1. Metal conduit
2. Flexible metal conduit.
3. Liquidtight flexible metal conduit.
4. Nonmetallic conduit.
5. Raceway fittings and supports.
6. Conduit bodies.
7. Surface raceway.
8. Wireway.
9. Pull and junction boxes.
10. Enclosures and cabinets
11. Handholes.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents:
1. Record actual routing of all underground conduits.
2. Record actual locations and mounting heights of outlet, pull, and junction boxes larger than 4"x4".

1.5 COORDINATION

A. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: A state licensed electrician with documented experience installing all equipment specified here in shall directly supervise all work. Where noted in the specifications, required by core, or required by the manufacturer, installer shall be a manufacturer trained and/or certified installer of the specific product to be installed.

1.7 QUALITY ASSURANCE

A. Listing and Labeling: Where required, all electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for the intended use. Testing agency shall be UL unless noted otherwise or pre-approved by owner and AHJ.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space located above grade and protect from dirt, water, construction debris, traffic, freeze, and where applicable, deterioration from sun light.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to the requirements of the specifications, products by the following manufacturers may be used for raceways and boxes. UL listed substitutions that are compliant with these specifications are acceptable provided compliance with all specification requirements are clearly indicated on the submittal.
   1. Apleton
   2. Carlon Electrical Products
   3. Hubbell Wiring Devices
   4. Thomas & Betts Corp.
   5. Walker Systems Inc.
   6. The Wiremold Co.
   7. Wheatland Tube Company
   8. Allied Tube & Conduit
   9. B I A
   10. Cantex
   11. Southwire
   12. Eastern
   13. Pass & Seymour
   14. Hoffman

2.2 SYSTEM DESCRIPTION

A. Provide raceway and boxes as specified below for power and lighting.
   1. Provide raceway and boxes for all building wiring, equipment; lighting; and wiring devices shown on plans.
   2. Provide raceway and boxes at other locations as required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Underground:
   1. Provide wrapped rigid steel conduit for 1" or larger elbows and where entering and exiting slabs or ground to 6" above ground.
   2. Provide Schedule 80 nonmetallic conduit for straight runs that are buried and/or in concrete.
   3. Provide polymer concrete boxes. Coordinate with engineer.
   4. Provide boxes for utility service conduit or cabling per utility provider's specifications
   5. Provide rigid steel conduit within 5 ft of building foundation.

C. In Concrete:

1. Provide wrapped rigid steel conduit for 1" or larger elbows and where entering or exiting concrete.
2. Provide thick-wall nonmetallic conduit for straight runs in concrete.
3. Provide high-grade plastic boxes or polymer concrete boxes. Nonmetallic may be used with engineer approval.
4. Use concrete tight, masonry rated boxes and fittings were installed in concrete, stone, brick, or CMU.

D. Exterior Above Grade Locations:
1. Provide rigid steel conduit and fittings.
2. Provide cast metal outlet, junction, and pull boxes boxes, gasketed, rated NEMA 3R min.

E. Concealed Dry Interior Locations:
1. Provide electrical metallic tubing.
2. Provide sheet-metal boxes.

F. Exposed Dry Interior Locations:
1. Provide rigid steel conduit below 10 feet, and rigid steel, intermediate metal, or electrical metallic tubing above 10 feet.
2. Provide sheet-metal boxes.

## 2.3 METAL CONDUIT

A. Rigid Steel Conduit:
1. ANSI C80.1.
2. Material: galvanized tubing, manufactured from mild steel.
3. Continuously welded seems.
4. Uniform wall thickness and cross section.
5. Manufacturer applied lubricating and corrosion retarding coating applied to interior of conduit.

B. Intermediate Metal Conduit (IMC): Rigid steel.

C. Fittings and Conduit Bodies:
1. NEMA FB 1
2. Material to match conduit.
3. Couplings and connectors: threaded
4. Expansion Fittings: OZ Type DX, concrete tight, provide for ¾" movement in all directions and.or 30 degrees deflection in any direction

## 2.4 PVC COATED METAL CONDUIT

A. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.

B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.5 FLEXIBLE METAL CONDUIT

A. Product Description: Interlocked steel construction.

B. Fittings: NEMA FB 1.

C. FMC shall be used in the following locations
   1. For lighting whips
   2. For connections to vibrating equipment
   3. In applications where rigid conduit cannot be installed without extensive demolition, but only with engineer's approval.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Product Description: Interlocked steel construction with PVC jacket.

B. Fittings: NEMA FB 1.

C. Use LFMC for all exterior vibrating equipment loads and in pump rooms that contain large quantities of mechanical and plumbing piping in the vicinity of the flex conduit.

2.7 ELECTRICAL METALLIC TUBING (EMT)

A. Product Description:
   1. ANSI C80.3
   2. Material: galvanized tubing, manufactured from mild steel
   3. Continuously welded seems
   4. Uniform wall thickness and cross section
   5. Manufacturer applied lubricating and corrosion retarding coating applied to interior of conduit

B. Fittings and Conduit Bodies:
   1. NEMA FB 1
   2. Material: zinc plated steel
   3. Concrete tight
   4. Connectors and couplings: compression type.
   5. Expansion Fittings: OZ Type TX

2.8 NONMETALLIC CONDUIT

A. Product Description: NEMA TC 2; Schedule 40 and 80 PVC.
   1. Schedule 40 PVC may be used where buried or embedded.
   2. Use schedule 80 PVC conduit for any exposed exterior or interior applications requiring corrosive resistant PVC conduit such as pool pump rooms.

B. Fittings and Conduit Bodies: NEMA TC 3.

2.9 WIREWAY

A. Wireways shall be of steel construction general purpose for indoor spaces and rain tight for outdoor applications with knockouts.

B. Knockouts: Manufacturer's standard.

C. Size: as indicated on Drawings.

D. Cover: Hinged cover with full gaskets.

E. Fittings: Lay-in type with removable top, bottom, and side; captive screws.

F. Finish: Rust inhibiting primer coating with gray enamel finish.

2.10 OUTLET BOXES

A. Sheet Metal Outlet Boxes:
   1. NEMA OS 1
   2. Material: galvanized steel.
   3. 4"x4", 2" deep, unless noted otherwise
   4. Concentric knockouts
   5. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
   6. Concrete Ceiling Boxes: Concrete type.

B. Nonmetallic Outlet Boxes: NEMA OS 2.

C. Cast Boxes: NEMA FB 1, Type FD, aluminum or cast feralloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

D. Wall Plates for Finished Areas: As specified in Section 26 27 26.

E. Wall Plates for Unfinished Areas: Furnish gasketed cover.

F. Outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, mud rings extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.

G. Provide multi-gang outlets of single box design. Sectional boxes are not acceptable. Provide outlet boxes of sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NEC, and not less than 1-1/2 inch deep unless shallower boxes are required by structural conditions and are approved by the A/E.

H. Provide deep type cast metal weatherproof exterior outlet wiring boxes of the type, shape and size, including depth of box, with threaded conduit ends, cast metal face plate with spring-hinged waterproof cap suitably configured for each application, including face plate gasket and fasteners. Provide PVC type outlet boxes only in corrosive areas rated as NEMA 4X.

## 2.11 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel. Screw on cover, welded seams, stainless nuts, bolts, screws and washers.
   1. Boxes larger than 12 inches in any dimension shall be panelboard code gauze galvanized steel with hinged cover.
   2. Boxes shall be sized in accordance with NEC.

B. Hinged Enclosures: Provide hinged covers for enclosures larger than 4". Coordinate with engineer if screw type covers must be used for any reason.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:
   1. Material: Galvanized cast iron. Cast aluminum may be used with engineer approval
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

D. In-Ground Polymer Concrete Boxes
   1. Selectively graded aggregates in combination with a polymer resin reinforced with fiberglass
   2. Provide a bottom with drain and a min 12"x12" gravel sump below drain opening.
   3. Conform to all test provisions of the most current ANSI/SCTE 77 specifications for underground enclosure integrity.
   4. Cover: Diamond plate, steel cover, and stainless steel cover screws.
   5. Cover Legend: "ELECTRIC"
   6. Box shall be traffic rated unless located in a position that is physically inaccessible to vehicular traffic.
   7. Pencell Catalog # PE-30U-H-G or engineer approved equal.

E. Fiberglass Concrete composite Handholes: Die-molded, glass-fiber hand holes:
   1. 12"x8" min dimensions.
   2. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.
   3. Use only where specifically noted as allowed.

## 2.12 ENCLOSURES AND CABINETS

A. Construction: NEMA 250, Type 1 steel enclosure.
   1. Use NEMA 3R in wet locations
   2. Use NEMA 4X in corrosive locations.

B. Covers: Continuous hinge, held closed by flush latch operable by key

C. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.

D. Provide wire management systems, terminal strips, and partitions as required for complete functioning of the system.

E. Enclosure Finish: Manufacturer's standard enamel

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.

D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

E. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

A. Provide complete raceway systems from source to all loads with dedicated supports for each raceway element.

B. Provide all required back boxes and supports for wiring devices, telecommunications, fire alarm, access control, controls equipment, alarms, sensors, etc.

C. Provide pull box at appropriate locations for all power and special systems raceways whether shown on plans or not.

D. Arrange raceway and boxes to present a neat appearance; allow for future expansion; provide access where needed; and maintain headroom and clearances for equipment, egress, etc.

E. Fasten raceway and box supports to structure and finishes in accordance with all requirements of the NEC and the construction documents.

F. Ground and bond raceway and boxes in accordance with all requirements of the NEC and the construction documents.

G. Identify raceway and boxes in accordance with all requirements of the NEC and the construction documents.

H. Paint exposed raceway and boxes to match the surface to which they are attached.

3.4 INSTALLATION - RACEWAY

A. Raceway Supports

1. Support raceway using galvanized steel, malleable iron straps, or channel and pipe clamps.
2. Provide support at each junction box, panel and load.
3. Provide supports at intervals per code and manufacturer recommendations.
4. Group related raceway and support using steel channel conduit rack. Provide space on each for 25 percent additional raceways.
5. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
6. Do not attach raceway to ceiling support wires or other piping systems such as sprinkler or HVAC piping or duct work.
7. Support cables in vertical raceways per NEC 300.19.
8. Construct wireway supports from steel channel.
9. Arrange raceway supports to prevent misalignment during wiring installation.
10. Additional supporting requirements are specified in other specification sections.

B. Raceway Routing
   1. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
   2. The conduit routing shown on the construction documents is diagrammatic.
      a. Coordinate interior routing with other trades; structure; existing and new utilities, ductwork, piping; and other existing conditions as required for a complete, conflict free installation.
      b. Coordinate site routing with other trades; structure; new and existing buried utilities, new and existing paved areas, conduit sleeves, and landscaping before digging to avoid conflicts, damage, and to allow for future installations.
   3. Route raceway parallel and perpendicular to walls, floors, and ceilings.
   4. Route exposed conduit parallel to structural elements. Follow all surface contours; do not route in free air from point to point. Where physically possible, install on top side of structural elements to conceal from view. Paint to match structure to which it is attached.
   5. Route conduit in and under slab from point-to-point. Coordinate conduit installations in slab, except straight slab penetrations with structural engineer for conduits larger than 2"
   6. Maintain clearance between raceway and piping for maintenance purposes.
   7. Maintain 12 inch clearance between power raceways and communications cabling, raceways, and cable trays.
   8. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
   9. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Use factory elbows or hydraulic one-shot bender to fabricate elbows for bends in metal conduit larger than 2 inch size.

C. Install raceways so that it drains to junction and pull boxes to avoid moisture traps at low points; install junction box with drain fitting at low points in conduit system.

D. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.

E. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

F. Close ends and unused openings in surface raceways, wireways, boxes, and enclosures.

G. Maximum Size Conduit in Slab Above Grade: 3/4 inch. Do not cross conduits in slab without approval.

H. Cut conduit square using saw or pipe cutter; de-burr cut ends.

I. Bring conduit to shoulder of fittings; fasten securely.

J. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

K. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

L. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

M. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

N. All connections to motors, instruments, machines, and equipment subject to movement or vibration shall be made using liquid-tight flexible metal conduit (3ft max).

## 3.5 INSTALLATION – BOXES, ENCLOSURES, CABINETS

A. General Requirements
1. Seal all unused openings.
2. Provide flush mounted boxes in finished areas.
3. Support boxes independently of conduit.
4. Install boxes without damaging or removing insulation, cutting structural elements, or damaging finishes.
5. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

B. Wiring Device Boxes
1. Install gang box where more than one device is mounted together. Do not use sectional box.
2. Install gang box with plaster ring for single device outlets.
3. Adjust mounting locations to be flush with finished surface.
4. Secure boxes using stamped steel bridges between studs.
5. Do not install flush mounting box back-to-back in walls
   a. Install with minimum 6 inches separation.
   b. Install in separate stud bays to reduce noise transfer where ever possible.
   c. Install with minimum 24 inches separation in acoustic rated walls.
6. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings. Refer to architectural elevations for mounting heights of outlet boxes noted "above counter."
7. Orient boxes to accommodate wiring device orientation. Field verify with architect for wiring devices mounted above counters or exposed to view in lobbies, on display walls, etc.
8. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Ceiling Mounted Boxes
   1. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
   2. Install adjustable steel channel fasteners for hung ceiling outlet box.
   3. Do not fasten boxes to ceiling support wires or other piping systems.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with the fire stopping material manufacture's instructions.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation. Follow architectural details for any required roof penetrations. Obtain permission from architect for dedicated electrical rough penetrations before performing work.

C. Locate outlet boxes to allow luminaires positioned as indicated on reflected ceiling plan.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused openings in boxes.

3.8 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION

# SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Nameplates.
2. Labels.
3. Wire markers.
4. Conduit markers.
5. Stencils.
6. Underground Warning Tape.
7. Lockout Devices.
8. Operating Instrucitons
9. Nameplates
10. Warning Signs

### 1.2 REFERENCE DOCUMENTS

A. Uniform General Conditions, including Supplementary General Conditions.

B. Division 1 – General Requirements, Section 01000 – Special Conditions.

### 1.3 SUBMITTALS

A. Product Data:
1. Submit manufacturer's catalog literature for each product required.
2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

B. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

### 1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

### 1.5 QUALITY ASSURANCE

A. Perform Work in accordance with federal, state, and local codes

B. Provide all labeling as required by NFPA 70 and 70E.

### 1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept identification products on site in original containers. Inspect for damage.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.

B. Letter Size:
1. 1/4 inch high (min) letters for identifying individual equipment and loads.
2. 1/4 inch high (min) letters for identifying grouped equipment and loads.

C. Minimum nameplate thickness: 1/8 inch.

2.2 WIRE MARKERS

A. Description: Cloth tape, split sleeve, or tubing type wire markers.

B. Legend:
1. Power and Lighting Circuits: Panel name and branch circuit or feeder number.
2. Control Circuits: Control wire number as indicated on shop drawings.

2.3 UNDERGROUND WARNING TAPE

A. Description: 6 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

2.4 LOCKOUT DEVICES

A. Lockout Hasps:
1. Anodized aluminum or Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

2.5 POSTED OPERATING INSTRUCTIONS

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:
   1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
   2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
   3. Safety precautions.
   4. The procedure in the event of equipment failure.
   5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

2.6 MANUFACTURER'S NAMEPLATE

A. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.7 FIELD FABRICATED NAMEPLATES

A. ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.8 ARC FLASH HAZARD IDENTIFICATION

A. Arc Flash Warning Labels: Per ANSI Z535.4, the signal word WARNING appearing in black letters on an orange background, with second line below (Arch Flash and Shock Hazard) in black letters on white background and third line below (Appropriate PPE required) in black letters on white background.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Provide each panel with a manufacturer prepared arc flash hazard warning label.

C. Provide a typed panel directory for each panel provided or modified for this project. Directory shall identify the circuit number, loads served, and location of loads by room number. Mount on inside of each panel and file with the owner when the work is complete.

D. Nameplate Installation:
   1. Install nameplate parallel to equipment lines.
   2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners.
   3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
   4. Secure nameplate to equipment front using screws or rivets.
   5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
   6. Install nameplates for the following:
      a. Panelboards.
      b. Disconnects and starters.
      c. Lighting contactors
      d. Equipment enclosures
      e. Controls cabinets and enclosures

E. Label Installation:
   1. Install label parallel to equipment lines.
   2. Install label for identification of individual control device stations.
   3. Install labels for permanent adhesion and seal with clear lacquer.
   4. Install panel name and circuit number identification labels for the following:
      a. Junction boxes (permanent marker may be used for junction boxes in mechanical spaces or above lay in ceilings.)
      b. Receptacle cover plates

F. Wire Marker Installation:
   1. Install wire marker for each conductor at panelboards, gutters, pull boxes, at electrical equipment such as contactors and disconnects, and each load connection.
   2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
   3. Install labels at data outlets identifying patch panel and port designation.

G. Raceway Marker Installation:
   1. Install raceway marker for each raceway longer than 6 feet and rated 100A or more.
   2. Raceway Marker Spacing: provide marker in a visible location in each room where raceway passes through walls or floors.
   3. Coordinate with architect before labeling raceways in finished spaces

H. Junction and Pull Box Installation

1. Label all junction boxes with the panel, circuit number, and voltage. For boxes exposed in finished spaces, label the inside of the cover.
2. Box for communications, fire alarm, and access control shall be provided with color coded covers. Coordinate color to be used with owner.

I. Underground Warning Tape Installation:
1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

# SECTION 26 24 16 - PANELBOARDS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes
   1. Branch circuit panelboards,

### 1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
   1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
   2. NEMA FU 1 - Low Voltage Cartridge Fuses.
   3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   5. NEMA PB 1 - Panelboards.
   6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. Uniform General Conditions, including Supplementary General Conditions.

D. Division 1 – General Requirements, Section 01000 – Special Conditions.

E. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

F. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

G. Underwriters Laboratories Inc.:
   1. UL 67 - Safety for Panelboards.
   2. UL 1283 - Electromagnetic Interference Filters.
   3. UL 1449 - Transient Voltage Surge Suppressors.

### 1.3 SUBMITTALS

A. Shop Drawings: Manufacturer or contractor prepared drawings showing all relevant dimensions, weights, mounting requirements, and conduit entry points.
   1. Include dimensioned plan views and elevations.

B. Product Data: Submit catalog data showing all standard features, dimensions, weights, listings and product labels, material types, finishes and clearly indicating which optional features will be provided.
   1. Include amperage ratings, voltage, over-current protective device ratings, AIC ratings.
   2. Where multiple sizes are listed, indicate sizes to be used.
   3. Where multiple products are shown on the same page, indicate which products to be used.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of electrical equipment and record actual circuiting arrangements.

B. Operation and Maintenance Data:
   1. Provide product data as defined under submittals.
   2. Provide manufacturer's installation and maintenance instructions for normal operation, routine maintenance and testing, and emergency maintenance procedures.
   3. Submit spare parts listing; source of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
   1. Manufacturer shall maintain or certify an independently operated service center capable of providing training, support, parts, and maintenance services.

B. Supplier: Authorized distributor

C. Installer: A licensed electrician with documented experience installing all equipment specified here in shall directly supervise all work. Where noted in the specifications or required by the manufacturer, installer shall be a manufacturer trained and/or certified installer of the specific product to be installed.

1.6 QUALITY ASSURANCE

A. Source Limitations: All components required for a complete functioning system as described here in shall be obtained through one source from a single manufacturer.

B. Listing and Labeling: Where required, all electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for the intended use. Testing agency shall be UL unless noted otherwise or pre-approved by owner and AHJ.

1.7 WARRANTY

A. Provide manufacturer's standard form clearly stating that manufacturer agrees to repair or replace equipment, materials, and associated auxiliary components that fail or deteriorate within the specified warranty period.

B. Warranty Period: one(1) year from the date of substantial completion

1.8 DELIVERY STORAGE AND HANDLING

A. Store in clean, dry space located above grade and protect from dirt, water, construction debris, traffic, freeze, and where applicable, deterioration from sun light.

B. Maintain factory wrapping or provide additional canvas or plastic cover for all large electrical equipment. Follow all manufacturer recommendations for humidity and max/min temperatures for storing electrical equipment.

1.9 MAINTENANCE MATERIALS

A. Furnish four of each panelboard key. Panelboards keyed alike.

PART 2 PRODUCTS

2.1 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:
1. Cutler Hammer
2. General Electrical
3. Siemens
4. Square D
5. Substitutions: With engineer approval.

B. Product Description: NEMA PB 1, circuit breaker type, lighting and appliance branch circuit panelboard. Load center type panelboards are acceptable for panelboards rated for less than 100A.

C. Panelboard Bus:
1. Copper current carrying components, ratings as indicated on Drawings.
2. Furnish copper ground bus in each panelboard.
3. Furnish fully rated copper neutral bus in each panelboard.

D. Minimum Integrated Short Circuit Rating: 10KAIC unless higher value indicated on Drawings.

E. Molded Case Circuit Breakers: NEMA AB 1, plug-in type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as:
1. Type SWD for lighting circuits.
2. Type HACR for air conditioning equipment circuits.
3. Class A ground fault interrupter circuit breakers as indicated on Drawings.
4. UL 1699 compliant arc flash circuit interrupter for all circuits serving receptacles in every room of dwelling units.
5. Do not use tandem circuit breakers.

F. Enclosure: NEMA PB 1, Type 1 unless noted otherwise
1. 6 inches deep, 20 inches wide .
2. Cover: Flush cabinet front with continuous hinge.

3. Door: continuous hinge, metal directory frame, and flush lock keyed alike.
4. Finish in manufacturer's standard gray enamel except as noted in 5 and 6..
5. For panels on building exteriors in visible locations, paint to match surface to which they are attached.
6. Provide weather/UV resistant label for all panels that state "Danger High Voltage" in both English and Spanish.

2.2 LOAD CENTERS

A. Manufacturers:
1. Cutler Hammer
2. General Electrical
3. Siemens
4. Square D
5. Substitutions: With engineer approval.

B. Description: Circuit breaker load center, with bus ratings as indicated on Drawings.

C. Performance:
1. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical.

D. Materials:
1. Molded Case Circuit Breakers: UL 489, plug-on type thermal magnetic trip circuit breakers, with common trip handle for poles, listed as Type SWD for lighting circuits, Class A ground fault interrupter circuit breakers as indicated on drawings. Do not use tandem circuit breakers.
2. Enclosure: General Purpose

E. Box: Flush type with door, and pull ring and flush lock keyed alike.
1. Finish in manufacturer's standard gray enamel.
2. Provide weather/UV resistant label for all panels that state "Danger High Voltage" in both English and Spanish.

PART 3 EXECUTION

3.1 EXISTING WORK

A. Disconnect abandoned panelboards and remove.

3.2 INSTALLATION

A. Install panelboards:
1. In accordance with NEMA PB 1.1.
2. Plumb with adjacent walls and supports.
3. Flush with wall finishes if recessed in wall.
4. By securing all four corners to the adjacent structure using appropriate supports.
5. On concrete pads if floor mounted.

B. Provide each panel with:
   1. Filler plates for unused spaces in panelboards.
   2. Typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
   3. Engraved plastic nameplates identifying panel name, source, amperage, and voltage.

C. Mounting Requirements
   1. Exterior Free Standing: Mount to galvanized u-channel rack with minimum of two(2) horizontal supports behind panel and one(1) horizontal support below panel to secure conduits. Vertical supports shall be imbedded in concrete foundation or bolted to concrete pad. If bolted to pad, provide 45 degree angle braces attached to vertical support one foot or more above pad.
   2. Mounting Height:
      a. Interior Spaces: 6 feet to top of panelboard.
      b. Install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
      c. Exterior: To help shield from view, mount panels as low as practical. Bottom of panel shall be at least 18" AFG unless floor mounted or mounted over concrete, asphalt, etc.

D. Grounding
   1. Ground and bond panelboard enclosure according to grounding specifications and code.
   2. Connect equipment ground bars of panels in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

A. Tighten all accessible electrical connections to the manufacturer's torque specifications.

B. Remove all blocks, packing and shipping materials, and foreign materials.

C. Manually exercise all switches, circuit breakers, and other operating mechanisms to make certain they operate freely.

D. Check integrity of all electrical and mechanical interlocks and padlocking mechanisms.

E. Conduct an insulation resistance test phase to ground and phase to phase with the OCPDs in both the open and closed position. Resistance in open position shall be 1 megohm min. Remediate and retest if resistance is less. Verify that any metering or surge protection equipment that could be damaged by this testing has been disconnected and or removed as needed for testing.

F. Test all ground fault protection systems in accordance with the manufacturer's instructions.

3.4 ADJUSTING

A. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

# SECTION 26 24 20 – SURGE PROTECTION DEVICES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes surge protection devices (SPDs) for protection of electrical distribution systems, also known as transient voltage surge suppressors.

### 1.2 REFERENCES

A. Underwriters Laboratories; ANSI/UL 1449 Third Edition

B. Underwriters Laboratories; UL 1283 (complimentary listing for Type 2 locations)

C. Canadian Underwriters Laboratories (cUL)

D. American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.34, C62.41, C62.45)

E. Institute of Electrical and Electronic Engineers 1100 Emerald Book

F. Federal Information Processing Standards Publication 94 (FIPS PUB 94)

G. National Fire Protection Association (NFPA 20, 70, 75 and 780)

H. International Standards Organization (ISO) Company certified ISO 9001 for manufacturing, design and service

I. Conformité Européenne (CE)

J. Federal Communications Commission (FCC)Underwriters Laboratories Inc.

K. Uniform General Conditions, including Supplementary General Conditions.

L. Division 1 – General Requirements, Section 01000 – Special Conditions.

### 1.3 SUBMITTALS

A. Shop Drawings: Manufacturer or contractor prepared drawings showing all relevant dimensions, weights, mounting requirements, and conduit entry points.
   1. Include dimensioned plan views and elevations.

B. Product Data: Submit catalog data showing all standard features, dimensions, weights, listings and product labels, material types, finishes and clearly indicating which optional features will be provided.
   1. Include amperage ratings, voltage, over-current protective device ratings, AIC ratings.
   2. Where multiple sizes are listed, indicate sizes to be used.

3. Where multiple products are shown on the same page, indicate which products to be used.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of electrical equipment and record actual circuiting arrangements.

B. Operation and Maintenance Data:
   1. Provide product data as defined under submittals.
   2. Provide manufacturer's installation and maintenance instructions for normal operation, routine maintenance and testing, and emergency maintenance procedures.
   3. Submit spare parts listing; source of replacement parts and supplies; and recommended maintenance procedures and intervals.

C. Field Quality-Control Test Reports: Report certified by field testing agent indicating results of performance testing required in Part 3 and/or on plans.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
   1. Manufacturer shall maintain or certify an independently operated service center capable of providing training, support, parts, and maintenance services.

B. Supplier: Authorized distributor

C. Installer: A licensed electrician with documented experience installing all equipment specified here in shall directly supervise all work. Where noted in the specifications or required by the manufacturer, installer shall be a manufacturer trained and/or certified installer of the specific product to be installed.

1.6 QUALITY ASSURANCE

A. Source Limitations: All components required for a complete functioning system as described here in shall be obtained through one source from a single manufacturer.

B. Listing and Labeling: Where required, all electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for the intended use. Testing agency shall be UL unless noted otherwise or pre-approved by owner and AHJ.

1.7 WARRANTY

A. Provide manufacturer's standard form clearly stating that manufacturer agrees to repair or replace equipment, materials, and associated auxiliary components that fail or deteriorate within the specified warranty period.

B. Warranty Period: one(1) year from the date of substantial completion

1.8 DELIVERY STORAGE AND HANDLING

A. Store in clean, dry space located above grade and protect from dirt, water, construction debris, traffic, freeze, and where applicable, deterioration from sun light.

B. Maintain factory wrapping or provide additional canvas or plastic cover for all large electrical equipment. Follow all manufacturer recommendations for humidity and max/min temperatures for storing electrical equipment.

PART 2 PRODUCTS

2.1 ENVIRONMENTAL

A. General Requirements:

1. No audible noise shall be generated.

2. No appreciable magnetic fields shall be generated. System shall be capable of use directly in computer rooms in any location without danger to disc units, disk packs, or tapes.

3. Operating Conditions:

a. Operating Temperature: -40 to +60°C (-40 to +140°F)
b. Relative Humidity: 0% to 95% (non-condensing)
c. Audible Noise: less than 45dB at 5 feet (1.5m)
d. Operating Altitude: 0 to 18,000 feet above sea level

B. Enclosure: The unit shall have a heavy duty NEMA 4X, water-tight, dust-tight, drip-tight enclosure.

2.2 GENERAL REQUIREMENTS

A. Branch Panel Equipment: Rated for 240/120 volt, 60 Hertz, 1-phase, 3-wire Panelboard.

B. Quality: The manufacturer shall be ISO 9001:2000 certified, demonstrating world-class quality systems for the design and manufacture of the surge protective devices.

C. The unit shall be tested and certified by Underwriters Laboratories to the ANSI/UL 1449 Third Edition Standard for Surge Protective Devices and the resulting voltage protection ratings (VPRs) shall be permanently affixed to the SPD.

D. The system shall be constructed using multiple surge current diversion arrays utilizing metal oxide varistors (MOV) computer matched to a variance of ±1 volt and tested for manufacturing defects.

The arrays shall be designed and constructed in a manner that ensures surge current sharing. Use of gas tubes, silicon avalanche diodes or selenium cells are unacceptable unless documentation from a nationally recognized laboratory demonstrates current sharing of all dissimilar components at all surge current levels.

**E.** Each surge suppression element (MOV) shall be individually fused so that a failure of one element and/or fuse shall not affect other surge suppression elements. SPD shall have a short-circuit rating of 200kAIC. **Devices that accomplish this rating by suggesting or providing additional fusing to the SPD system will not be accepted.**

**F.** The unit shall be designed to be installed using the flexible conduit provided by the SPD manufacturer. All parallel connections to the SPD shall be kept as short as possible. The connection to the SPD shall be made using #6 AWG maximum (ring terminal shall be provided).

G. Unit shall include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status and operational integrity of the unit.

H. Unit shall have a Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of SPD status.

I. Unit shall have an audible alarm with an alarm enable/disable feature to silence the alarm.

## 2.3 MANUFACTURERS AND PRODUCT REQUIREMENTS

A. Acceptable Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows, **no substitutions**:

1. Emerson Network Power: **510 SPD (500 Series)**
2. Current Technology: **TG Series**

B. Unit shall be ANSI/UL 1449 Third Edition, Type 1 listed with a nominal discharge current rating of 20kA.

C. Unit shall provide maximum ANSI/UL 1449 Third Edition, VPRs for 208Y/120 Volt systems as follows:

1. L-N = 600V
2. L-G = 700V
3. N-G = 600V
4. L-L = 900V

D. Unit shall provide maximum ANSI/UL 1449 Third Edition, VPRs for 480Y/277 Volt systems as follows:

1. L-N = 1000V
2. L-G = 1000V
3. N-G = 900V
4. L-L = 1800V

E. The branch panel SPD will be capable of surviving 8,000 ANSI/IEEE, Category C3 (10kA) impulses per mode (16,000 per phase) without failure or degradation of original performance characteristics of more than 10%

F. Unit shall have a maximum surge current rating of 80,000 amperes L-N, 80,000 amperes L-G, and 80,000 amperes N-G, based on ANSI/IEEE C62.41 standard 8 by 20 microsecond current waveform.

G. Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of SPD status.

H. The SPD will be connected to the panelboard bus bar through a dedicated 60A breaker provided by the equipment manufacturer.

I. Warranty: Manufacturer shall provide a product warranty for a period of 10 years from date of installation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Contractor shall install suppression system immediately next to or on top of service equipment where so approved by the Engineer:

B. Conductors between suppressor and point of attachment to service equipment shall be sized in accordance with manufacturer's Shop Drawings and conductor lengths shall be as short as possible, preferably not exceeding 24"

C. Grounding: Suppressor ground shall be bonded to the equipment grounding conductor and service entrance ground

3.2 FIELD QUALITY CONTROL

A. Tighten all accessible electrical connections to the manufacturer's torque specifications.

B. Remove all blocks, packing and shipping materials, and foreign materials.

END OF SECTION

# SECTION 26 27 26 - WIRING DEVICES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes
   1. Wall switches
   2. Wall dimmers
   3. Receptacles
   4. Terminal strips
   5. Device plates and decorative box covers.
   6. Lighting contactors
   7. Occupancy sensors
   8. Photocells (Daylight sensors)
   9. Relays
   10. Push button and selector switches

### 1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA WD 1 - General Requirements for Wiring Devices.
   2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

B. Uniform General Conditions, including Supplementary General Conditions.

C. Division 1 – General Requirements, Section 01000 – Special Conditions.

### 1.3 SUBMITTALS

A. Product Data: Submit catalog data showing all standard features, dimensions, weights, listings and product labels, material types, finishes and clearly indicating which optional features will be provided.
   1. Include amperage and voltage ratings.
   2. Include color to be used for
   3. Where multiple sizes are listed, indicate sizes to be used.
   4. Where multiple products are shown on the same page, indicate which products to be used.

### 1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of each floor box and poke-through fitting.

B. Operation and Maintenance Data:
   1. Provide product data as defined under submittals.
   2. Provide manufacturer's installation and maintenance instructions for normal operation, routine maintenance and testing, and emergency maintenance procedures.

3. Submit spare parts listing; source of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Supplier: Authorized distributor

C. Installer: A licensed electrician with documented experience installing all equipment specified here in shall directly supervise all work. Where noted in the specifications or required by the manufacturer, installer shall be a manufacturer trained and/or certified installer of the specific product to be installed.

1.6 QUALITY ASSURANCE

A. Source Limitations: All components required for a complete functioning system as described here in shall be obtained through one source from a single manufacturer.

B. Listing and Labeling: Where required, all electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for the intended use. Testing agency shall be UL unless noted otherwise or pre-approved by owner and AHJ.

1.7 WARRANTY

A. Warranty Period: one(1) year from the date of substantial completion

PART 2 PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers:
   1. Cooper Wiring Devices
   2. Harvey Hubbell, Inc.
   3. Leviton Manufacturing Company.
   4. Substitutions: With engineer approval.

B. Product Description:
   1. NEMA WD 1, General-Duty, commercial grade, AC only general-use snap switch, unless noted otherwise
   2. Provide heavy duty industrial grade switches in janitor's closet, mechanical rooms, manufacturing areas, and labs.
   3. One-piece brass integral ground terminal

C. Ratings:
   1. Voltage: 120-277volts, AC.

2. Current: 20 amperes.
3. 1HP-120V, 2HP 240-277V

D. Body and Handle:
1. White nylon
2. Provide toggle switches in finished areas.
3. Provide toggle switches in un-finished areas such as janitor's closet, mechanical rooms, manufacturing areas, and labs.

2.2 RECEPTACLES

A. Manufacturers:
1. Cooper Wiring Devices
2. Harvey Hubbell, Inc.
3. Leviton Manufacturing Company.
4. Substitutions: With engineer approval.

B. Product Description:
1. NEMA WD 1, Heavy-duty, commercial grade receptacle, unless noted otherwise.
2. Provide heavy duty industrial grade receptacles in janitor's closets, mechanical rooms, manufacturing areas, and labs.
3. One-piece brass integral ground straps
4. Ground retention clips
5. Back wired ground terminals
6. Face and body: Constantly on – white nylon
7. Face and body: Switched by occupancy sensing device – grey nylon
8. All receptacles shall be tamper resistant.

C. Minimum rating: 20A, 125V

D. Configuration: NEMA WD 6, type as indicated on Drawings.

E. Convenience Receptacle:
1. Type 5-20, unless noted otherwise
2. 2 pole, 3 wire grounding

F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

A. Manufacturers:
1. Provide product by the manufacturer of the wiring device being covers by the wall plate

B. Inside Shelter Cover Plate: Stainless steel plate.

C. Weatherproof Cover Plate: Stainless steel plate with gasketed device cover.

2.4 OCCUPANCY SENSOR

A. Manufacturers:
1. Cooper
2. Douglas Lighting Controls
3. Hubbell
4. Leviton
5. Lutron
6. Watt Stopper
7. Substitutions: With engineer approval.

B. Product Description:
1. Devices shall include both infrared and ultrasonic sensing (elsewhere noted dual technology or mult-technology)
2. Separate sensitivity and time delay adjustments with LED indication of sensed movement. User adjustable time-delay: 30 seconds to 30 minutes.
3. Operation shall be silent.
4. Integral daylight sensing with automatic shutoff at field adjustable light level.
5. 1000VA at 120V, 2700VA at 277V rated
6. 2000 sq ft coverage area.
   a. 1000 sq ft coverage may be used for room 800 sq ft or less, except restrooms and cubicle areas.
   b. 500 sq ft or less coverage devices shall not be used.
7. Ceiling mounted sensors
   a. 360 degree sensing, unless noted 180 degree.
   b. Ultrasonic sensors on both side of device, unless noted 180 degree.
   c. Device shall be capable of being wired in parallel with additional occupancy sensors for large spaces.
8. Wall mounted sensors
   a. Integral on/off pushbutton
   b. 180 degree sensing

C. Programming
1. Set off delay to 15 minutes minimum.
2. Set off delay to 30 minutes in open office areas and restrooms.
3. Start in the morning and periodically check light levels throughout the day. Set daylight sensing automatic shutoff at the time when and if 40FCs are first measured at 36 inches above floor in the area controlled by the sensor.
4. Set daylight sensing as follows: switch lighting off, temporarily set off-delay to 0, verify adequate foot-candle levels, switch lighting on, and adjust dial until lights switch off
5. Any lighting within the space that is not controlled by the sensor should remain on throughout the programming process.
6. More detail procedures for daylight sensor programming are required when daylight controls are used for selective switching of specific lights within a space that are located near sources of daylight. The procedures described here apply to whole room occupancy sensors only.

D. Dual Relay devices:

1. Where occupancy sensors are indicated on the architectural, mechanical, or electrical plans to control additional equipment (exhaust fans, outside air dampers, etc), provide sensor with a second dedicated relay with appropriate voltage and power rating for the equipment to be served.
2. Electrical contractor shall coordinate with GC, mechanical contractor, and controls contractors to determine all locations where dual relays are required and insure the appropriate model device is ordered.

2.5 PHOTOCELLS (DAYLIGHT SENSORS)

A. Manufacturers:
1. Cooper
2. Douglas Lighting Controls
3. Hubbell
4. Leviton
5. Lutron
6. Watt Stopper
7. Substitutions: With engineer approval.

B. Product Description:
1. Photoelectric light level sensor
2. Separate sensitivity and time delay adjustments. User adjustable time-delay: 30 seconds to 30 minutes.
3. Operation shall be silent.
4. 1000VA at 120V, 2700VA at 277V rated
5. 2000 sq ft coverage area.
   a. 1000 sq ft coverage may be used for room 800 sq ft or less, except restrooms and cubicle areas.
   b. 500 sq ft or less coverage devices shall not be used.
6. Device shall be capable of being wired in parallel with additional sensors for large spaces.

C. Sensor Devices: Each sensor employs photo diode technology to allow linear response to daylight within illuminance range.
1. Exterior Lighting: Hooded sensor, horizontally mounted, employing flat lens, and working range 1-100 foot-candles in 10 percent increments. Entire sensor encased in optically clear epoxy resin.
2. Indoor Lighting: Sensor with Fresnel lens providing for 60 degree cone shaped response area to monitor indoor office lighting levels.
3. Atriums: Sensor with translucent dome with 180 degree field of view and respond in range of 10-1,000 foot-candles.
4. Skylights: Sensor with translucent dome with 180 degree field of view and respond in range of 10-1,000 foot-candles.

D. Programming for On/Off Daylight Control
1. Set off delay to 0 for programming, but adjust to 15 minutes after programming to avoid nuisance operation of the device.
2. Any lighting within the space that is not controlled by the sensor should remain on throughout the programming process.

3. At mid-day on a cloudless day, verify with a light meter that the required foot-candle levels are measured at the required location for each space with the lighting to be controlled by the sensor off.
4. If the required light levels are not present, instruct owner in the procedure for setting the device and advise owner to repeat programming effort the following August.
5. If required light levels are present, periodically check light levels on the following day, starting in the early morning, and program sensor when the required light levels first appear.
6. Turn lighting on and adjust dial until lights switch off.
7. Set office and work area sensor as follows
   a. Offices: 40FC measured at the working surface when the lighting controlled by the sensor is off.
   b. Open Offices: 40FC measured at the working surface of the cubicle furthest from the source of daylight (i.e. windows) and located between the source of daylight and the first row of lights not controlled by the daylight sensor.
8. Set sensors in other locations by measuring the following levels at floor level along the centerline of the space between the wall transmitting daylight and the outside edge of the first row of lights that will remain on after the daylight sensor controlled lights are switched off.
   a. Restrooms: 20FC

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify outlet boxes are installed at proper height.

B. Verify wall openings are neatly cut and completely covered by wall plates.

C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

D. Verify locations of floor boxes and outlets prior to rough in

### 3.2 PREPARATION

A. Clean debris from outlet boxes.

### 3.3 EXISTING WORK

A. Disconnect and remove abandoned wiring devices.

B. Modify installation to maintain access to existing wiring devices to remain active.

C. Clean and repair existing wiring devices to remain or to be reinstalled.

D. Maintain access to existing floor boxes remaining active and requiring access. Modify installation or provide access panel.

3.4 INSTALLATION

A. Install devices plumb and level.

B. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

C. Install boxes and fittings to preserve fire resistance rating of slabs and other elements

D. Connect wiring devices by wrapping solid conductor around screw terminal.
   1. Install stranded conductor for branch circuits 10 AWG and smaller.
   2. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations.
   3. Do not place bare stranded conductors directly under device screws.

E. Wall Plates
   1. Install wall plates on flush mounted switches, receptacles, and blank outlets.
   2. Install decorative plates with concealed screws on switches, receptacles, and blank outlets in finished areas.
   3. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
   4. Use jumbo size plates for outlets installed in masonry walls.

F. Switches
   1. Install switches with OFF position down.
   2. Where multiple switches are installed at the same location, switches shall be ganged together.

G. Receptacles
   1. Install receptacles with grounding pole on top.
   2. Provide appropriate receptacle type for the application per the requirements listed in part 2 above.

H. Occupancy and photo sensors
   1. Install ceiling mounted devices in center of area to be covered.
   2. Install wall mounted devices at the typical switch location unless gimbal mounted.
   3. Install gimbal mounted wall switches at 18" below ceiling.
   4. Install 180 degree ceiling mounted devices at locations that are exposed to adjacent spaces from which false on signals could come.
   5. Install gimbal mounted and 180 degree ceiling devices at edge of space facing towards the area to be covered and away from adjacent spaces from which false on signals could come

3.5 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes with furniture and equipment.

B. Install wall switch 48 inches above finished floor.

C. Install convenience receptacle 18 inches above finished floor.

3.6 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch and occupancy sensor with circuit energized and verify proper operation.

C. Verify each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.7 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust floor box flush with finish flooring material

3.8 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

B. Clean interior of boxes to remove dust, debris, and other material.

END OF SECTION

# SECTION 26 51 00 - LIGHTING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes luminaires, lamps, ballasts, and accessories.

### 1.2 REFERENCES

A. Uniform General Conditions, including Supplementary General Conditions.

B. Division 1 – General Requirements, Section 01000 – Special Conditions.

### 1.3 SUBMITTALS

A. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.

B. Product Data: Submit catalog data showing all standard features, dimensions, listings and product labels, material types, finishes and clearly indicating which optional features will be provided.
   1. Include ballast and lamp information.
   2. Include photometric data
   3. Where multiple sizes are listed, indicate sizes to be used.
   4. Where multiple products are shown on the same page, indicate which products to be used.

### 1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
   1. Manufacturer shall maintain or certify an independently operated service center capable of providing training, support, parts, and maintenance services.

B. Supplier: Authorized distributor

C. Installer: A State of Texas licensed electrician with documented experience installing all equipment specified here in shall directly supervise all work.

### 1.5 QUALITY ASSURANCE

A. Source Limitations: All components required for a complete functioning luminaire as described here in shall be obtained through one source from a single manufacturer.

B. Listing and Labeling: Where required, all electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for the intended use. Testing agency shall be UL unless noted otherwise or pre-approved by owner and AHJ.

1.6 WARRANTY

A. Provide manufacturer's standard form clearly stating that manufacturer agrees to repair or replace equipment, materials, and associated auxiliary components that fail or deteriorate within the specified warranty period.

B. Warranty Period:
   1. One(1) year from the date of substantial completion for luminaires
   2. Five(5) years from the date of substantial completion for all LED drivers and LED lamps.

1.7 DELIVERY STORAGE AND HANDLING

A. Store in clean, dry space located above grade and protect from dirt, water, construction debris, traffic, freeze, and where applicable, deterioration from sun light.

B. Maintain factory wrapping or provide additional canvas or plastic cover. Follow all manufacturer recommendations for humidity and max/min temperatures for storing.

1.8 MAINTENANCE MATERIALS

A. Furnish two of each plastic lens type.

PART 2 PRODUCTS

2.1 LUMINAIRES

A. Manufacturers:
   1. Manufacturers shall be as listed in the luminaire schedule
   2. Substitutions: With engineer approval.

B. Product Description: Complete luminaire assemblies, with features, options, and accessories as scheduled.

2.2 LED Drivers

A. Product Description:
   1. LED power supplies shall operate LEDs within the current limit specification of the manufacturer
   2. 60Hz input source
   3. input power factor >90%
   4. minimum efficiency of 70% at full rated load of the driver
   5. Minimum starting temperature of 0°F
   6. Maximum case temperature rating of at least 70°C
   7. Power supply output regulated to +/-5% across published load rang
   8. Class A sound rating
   9. Compliant with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47CFR part 15, non-consumer (Class A) for EMI/RFI B

10. 3 year minimum warranty from date of manufacturer against defects in material or workmanship, including a replacement, for operation at or below the maximum case temperature specification. (For LED lamps and internal power regulation components for defects resulting in a fixture lumen depreciation >30%.)
11. Dimmable power supplies shall allow the light output to be maintained at the lowest control setting (prior to off) without dropping out
12. No PCBs

2.3 LED Lamps and Luminaires

A. Manufacturers
1. Lamps:
   a. Philips
   b. Substitutions: With engineer approval.
2. Luminaire Manufacturers shall
   a. provide the manufacturer's name of the LED being used in the luminaire
   b. meet DOE's Energy Star or Design Light Consortium performance criteria
   c. registered as a DOE Quality Advocate

B. Product Description
1. 50,000 hour rated
2. Minimum CRI 80
3. The CCT shall be 3000K unless noted otherwise
4. total harmonic distortion (THD) <10%
5. power factor • 90%
6. Shall be tested in accordance with LM-79-08 electrical and photometric measurements. Provide to the owner test results of each unique lamp.
7. LED light source packages, arrays or modules used in the luminaire shall be tested in accordance with LM-80 lumen depreciation test. Provide to the owner, test results of each unique package, array or module. The L70 rated life result shall be a minimum of 50,000 hours
8. Luminaires shall be UL, or ETL, listed and be furnished complete with LEDs and power supplies
9. Minimum 3 year warranty covering all components.

C. Screw in Retrofit LED Lamps
1. Retrofit LEDs shall follow all applicable product descriptions under B.
2. Shall meet DOE's Energy Star or Design Light Consortium performance criteria for qualified screw-in or pin-based LED lamps
3. Shall have Lamp CCTs conforming to ANSI C78.377A color binning and utilize a 4 step MacAdam Ellipse Algorithm binning process (Philips Optibin or equal) within each retrofit lamp for greater CCT consistency
4. Each lamp shall have total harmonic distortion (THD) <10%
5. Shall be tested in accordance with LM-80 lumen depreciation test. Provide to the owner test results of each unique lamp. The L70 rated life result shall be a minimum of 25,000 hours for MR11, 16 and candelabra lamps; 40,000 hours for PAR 20, 30, 38 and BR30 lamps

PART 3 EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned luminaires, lamps, and accessories.

B. Extend existing interior luminaire installations using materials and methods compatible with existing installations.

C. Clean and repair existing interior luminaires to remain or to be reinstalled.

3.2 PREINSTALLATION COORDINATION

A. Refer to architectural reflected ceiling plan for exact light fixture locations.

B. Examine the area of installation to verify adequate space and mounting provisions are provided for the specified luminaire prior to order luminaires.

C. Verify that luminaires will not interfere with required clearances for equipment such as HVAC equipment filter removal clearance, NEC working space in front of HVAC equipment control panels, etc.

D. Coordinate location of exit lights with structure and other MEP systems to insure that exit signs are clearly visible.

3.3 INSTALLATION

A. Lighting Conductors and Conduit
   1. Provide ground wire and one neutral conductor per circuit in all lighting conduit.
   2. All conductors serving luminaires shall be routed in conduit.
   3. Luminare whips may be flexible metal conduit up to 6ft. Secure to structure with listed supports.
   4. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

B. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.

C. Install luminaires plumb, square, and level and aligned with ceilings, walls, and with each other and secure per manufacturer's printed instructions..

D. Recessed Luminaire Requirements
   1. Install recessed luminaires to permit removal from below.
   2. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
   3. Install clips to secure recessed grid-supported luminaires in place.
   4. Support luminaires in grid ceiling independent of ceiling framing.

E. Install wall-mounted luminaires at height as indicated on drawings

F. Install accessories furnished with each luminaire.

G. Install specified lamps in each luminaire.

3.4 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.5 ADJUSTING

A. Aim and adjust luminaires.

B. Position exit sign directional arrows as indicated on Drawings.

3.6 CLEANING

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

3.7 PROTECTION OF FINISHED WORK

A. Relamp luminaires having failed lamps at Substantial Completion.

END OF SECTION