



Industrial & Potable
Water to Yates Complex
Lead, South Dakota

WPE # BR20030

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Construction Specification

SPECIFICATIONS

FOR

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Water to Yates Complex
Lead, South Dakota

WPE # BR20030

Construction Specification

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SDSTA DIVISION ONE

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SUMMARY OF WORK

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 Project Description

The work includes a new above grade water meter facility with pre-manufactured building, approximately 2,680 linear feet (lf) of buried 12" PVC water main, 490 lf of buried 6" PVC water main, 360 lf of buried 2" HDPE water service, and 250 lf of 4" PVC water main in a utility tunnel along with associated valves, hydrants, pre-fabricated water meter building with electrical service and interior lighting and power, and incidental related work, all for the replacement of the Yates Facility Potable and Industrial Water System.

1.1.2 Location

The work is located at the Sanford Underground Research Facility, approximately as indicated near the Administration building.

1.2 EXISTING WORK

Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Project Manager. At the completion of operations, existing work must be in a condition equal to or better than that which existed before new work started.

1.3 LOCATION OF EXISTING UTILITIES

Obtain digging permits prior to start of excavation and comply with Facility requirements for locating and marking underground utilities. Contact local utility locating service a minimum of 72 hours prior to excavating, to mark utilities, and within sufficient time required if work occurs on a Monday or after a Holiday. Verify existing utility locations indicated on contract drawings, within area of work.

1.3.1 Notification Prior to Excavation

Notify the Project Manager at least 48 hours up to 15 days depending on level of excavation required prior to starting excavation work.

--- End of Section ---

ADMINISTRATIVE REQUIREMENTS

Part 1 General

1.1 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Provide monthly digital photographs showing the sequence and progress of work to clearly capture the work performed during that period, in particular areas that will be covered as part of the scope of work. Submit with the monthly invoice. Photographs provided are for unrestricted use by the SDSTA.

1.2 SUPERVISION

1.2.1 Minimum Requirements

Have at least one qualified superintendent, or competent alternate, capable of reading, writing, and conversing fluently in the English language, on the job-site at all times during the performance of contract work.

1.2.2 Superintendent Qualifications

The project superintendent must have a minimum of 10 years experience in construction with at least 2 of those years as a superintendent on projects similar in size and complexity. The individual must have experience in the areas of hazard identification and safety compliance. The individual must be capable of interpreting a critical path schedule and construction drawings. The qualification requirements for the alternate superintendent are the same as for the project superintendent. The Contracting Officer may request proof of the superintendent's qualifications at any point in the project if the performance of the superintendent is in question.

For routine projects where the superintendent is permitted to also serve as the Quality Control (QC) Manager as established in Section QUALITY CONTROL, the superintendent must have qualifications in accordance with that section.

1.2.2.1 Duties

The project superintendent is primarily responsible for managing and coordinating day-to-day production and schedule adherence on the project. The superintendent is required to attend status meetings and quality control meetings if applicable. The superintendent or qualified alternate must be on-site at all times during the performance of this contract until the work is completed and accepted.

1.2.3 Non-Compliance Actions

The Project Superintendent is subject to removal by the Contracting Officer for non-compliance with requirements specified in the contract and for failure to manage the project to insure timely completion. Furthermore, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders is acceptable as the

subject of claim for extension of time for excess costs or damages by the Contractor.

1.3 PRECONSTRUCTION CONFERENCE

After award of the contract but prior to commencement of any work at the site, meet with the Project Manager to discuss and develop a mutual understanding relative to the administration of the quality control, safety program, preparation of the schedule of prices, shop drawings, and other submittals, scheduling programming, and prosecution of the work. Major subcontractors who will engage in the work must also attend.

--- End of Section ---

PROJECT CONSTRUCTION PROGRESS SCHEDULES

Part 1 General

1.1 SUBMITTALS

Construction Schedule

Monthly Schedule Updates

1.2 ACCEPTANCE

Prior to the start of work, prepare and submit to the Project Manager for acceptance a construction schedule in the form of a Bar Chart Schedule.

The acceptance of a Baseline Construction Schedule is a condition precedent to:

- a. The Contractor starting work on the demolition or construction stage(s) of the contract.
- b. Processing Contractor's invoice(s) for construction activities.
- c. Review of any schedule updates.

Submittal of the Baseline Schedule, and subsequent schedule updates, is understood to be the Contractor's certification that the submitted schedule meets all of the requirements of the Contract Documents, represents the Contractor's plan on how the work will be accomplished, and accurately reflects the work that has been accomplished and how it was sequenced.

1.3 SCHEDULE FORMAT

1.3.1 Bar Chart Schedule

The Bar Chart must, as a minimum, show work activities, major material/equipment delivery, on-site construction, key inspections, and closeout activities. The Bar Chart must be time scaled and generated using an electronic spreadsheet program.

1.3.2 Schedule Submittals and Procedures

Submit Bar Chart Schedules and updates in hard copy and on electronic media that is acceptable to the Project Manager.

1.4 SCHEDULE MONTHLY UPDATES

Update the Construction Schedule at monthly intervals or when the schedule has been revised. The updated schedule must be kept current, reflecting actual progress and plan for completing the remaining work.

1.5 CONTRACT MODIFICATION

Submit a schedule analysis with each cost and time proposal for a proposed change. The analysis must illustrate the influence of each change or delay on the Contract Completion Date or milestones. No time extensions will be granted nor delay damages paid unless a delay occurs which consumes all available Project Float and extends the Projected

Finish beyond the Contract Completion Date. Identify types of delays as follows:

(a) Excusable Delay: Force-Majeure (e.g. unusual weather) - Contractor may receive time extension, but time will not be compensable.

(b) Inexcusable Delay: Contractor Responsibility - Contractor will not receive time extension.

(c) Compensable Delay: SDSTA Responsibility - Contractor may receive compensable time extension.

If a combination of any of the delay types outlined above occurs, it is considered a Concurrent Delay, which will require an analysis of the facts to determine compensability and entitlement to any time extension under the applicable contract clauses.

1.6 WEEKLY PROJECT STATUS MEETING AND 3-WEEK LOOK AHEAD SCHEDULE

Each week during the active construction period, a Weekly Status Meeting will be held. At a minimum, the project superintendent and QC Manager should attend representing the Contractor. Meeting minutes will be taken by the superintendent or other designated rep to capture the discussions. As part of the process, the Contractor will prepare and issue a 3-Week Look Ahead schedule to provide a more detailed day-to-day plan of upcoming work identified on the Construction Schedule. Additionally, include upcoming outages, closures, etc. The detailed work plans are to be bar chart type schedules, separate from the Construction Schedule on an electronic spreadsheet program and printed on (8-1/2 by 11 inch) sheets as directed by the Project Manager. In addition to schedule discussions, the Weekly Status Meeting should discuss status of submittal reviews and approvals, Requests For Information (RFI), outstanding change orders, and other relevant project coordination issues.

--- End of Section ---

SUBMITTAL PROCEDURES

01 3300

Part 1 General

1.1 DEFINITIONS

1.1.1 Submittal Descriptions (SD)

Submittal requirements in addition to those noted below may be specified in the technical spec sections and drawings.

Preconstruction Submittals

Submittals which are required prior to start of construction (work). These submittals are considered Action Submittals (See definition below).

- List of Proposed Subcontractors
- Construction Progress Schedule
- Submittal Register
- Schedule of Prices
- Health and Safety Plan
- Quality Control (QC) Plan
- Environmental Protection Plan

Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. Unless specified in another section, testing must have been within three years of date of contract award for the project.

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that the product, system, or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.2 SUBMITTAL REGISTER

1.2.1 Use of Submittal Register

Submit a register of submittals, arranged in chronological order by dates required by construction schedule. For this project, the Contractor is required to establish a project specific account through

Submittal Exchange for the processing of all submittals Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

Coordinate submittal register with list of subcontracts, the schedule of values, daily construction reports and Contractor's construction schedule.

Initial Submittal. Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

Submit revised submittal schedule to reflect changes in current status and timing for submittals.

Format. Arrange the following information in a tabular format. (As applicable)

- a. Scheduled date for first submittal.
- b. Specification/RFP Section number and title.
- c. Submittal category: Action; informational.
- d. Name of subcontractor.
- e. Description of the Work covered.
- f. Scheduled date for final release or approval.
- g. Scheduled date of fabrication.
- h. Scheduled dates for purchasing.
- i. Scheduled dates for installation.
- j. Activity or event number.

1.3 VARIATIONS

Variations from contract requirements require both A/E and SDSTA approval and will be considered where advantageous to SDSTA.

1.3.1 Considering Variations

Discussion with Project Manager and A/E (if applicable) prior to submission will help ensure functional and quality requirements are met and minimize rejections and re-submittals.

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the rejection and removal of such work at no additional cost to the SDSTA.

1.3.2 Proposing Variations

When proposing variation, deliver written request to the Project Manager, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to SDSTA. If lower

cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.3.3 Warranting that Variations are Compatible

When delivering a variation for approval, Contractor, including its Designer(s) of Record (if applicable), warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.3.4 Review Schedule Extension

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the A/E and SDSTA of submittals with variations.

1.4 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

- a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.
- b. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.
- c. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

1.4.1 Review Notations

Submittals will be returned to the Contractor with the following notations:

- a. Submittals marked "accepted" authorize the Contractor to proceed with the work covered.
- b. Submittals marked "accepted as noted" or "accepted as noted, resubmittal not required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.
- c. Submittals marked "revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.
- d. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and accepted, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals

returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.5 REJECTED SUBMITTALS

If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the contract is to be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the SDSTA requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.6 ACCEPTED SUBMITTALS

The acceptance of submittals is not to be construed as a complete check, and indicates only that acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work.

After submittals have been accepted, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.7 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor is to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract.

Samples of various materials or equipment delivered on the site or in place may be taken by the SDSTA for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples does not relieve the Contractor of his responsibilities under the contract.

--- End of Section ---

QUALITY CONTROL FOR CONSTRUCTION
01 4500.10 20

Part 1 General

1.1 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

QC Plan;

Submit a QC Plan within 15 calendar days after receipt of Notice of Award.

1.2 INFORMATION REQUIREMENTS

Prior to commencing work on construction, the Contractor can obtain a single copy set of the current report forms from the Project Manager. The report forms will consist of the Contractor DAILY Report, Contractor DAILY Report (Continuation Sheet), Rework Items List, and Testing Plan and Log.

Deliver the following to the Project Manager and the designated SDSTA QA Rep:

- a. DAILY Report: By 10:00 AM the next working day after each day that work is performed;
- b. Field Test Reports: One copy, within one week after the test is performed, attached to the CQC Report;
- c. QC Certifications: As required by the paragraph entitled "QC Certifications."

1.3 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Manager, a QC Plan, a Project Preconstruction Conference, Weekly Status Meeting, submittal review, testing, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this contract. The QC program shall cover on-site and off-site work and shall be keyed to the work sequence. No work or testing may be performed unless the QC Manager is on the work site.

1.3.1 Preliminary Work Authorized Prior to Acceptance

The only work that is authorized to proceed prior to the acceptance of the QC Plan is mobilization of storage and office trailers, temporary utilities, and surveying.

1.3.2 Acceptance

Acceptance of the QC Plan is required prior to the start of construction. The SDSTA reserves the right to require changes in the QC Plan and operations as necessary, including removal of personnel, to ensure the specified quality of work.

1.3.3 Notification of Changes

Notify the Contracting Officer, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes shall be subject to the acceptance by the Contracting Officer.

1.4 QC ORGANIZATION

1.4.1 QC Manager

1.4.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. In addition to implementing and managing the QC program, the QC Manager may perform the duties of project superintendent. The QC Manager is required to attend the Project Preconstruction Meeting, conduct the QC meetings (If separate from the Weekly Status Meeting), perform submittal review, ensure testing is performed and provide QC certifications and documentation required in this contract. The QC Manager is responsible for managing and coordinating documentation performed by others.

1.4.1.2 Qualifications

An individual with a minimum of 10 years combined experience as a superintendent, inspector, QC Manager, project manager, or construction manager on similar size and type construction contracts which included the major trades that are part of this contract. The individual must be familiar with and have experience in the areas of hazard identification and safety compliance.

1.4.2 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager shall be the same as for the QC Manager.

1.5 QC PLAN

1.5.1 Requirements

Provide, for acceptance by the Contracting Officer, a QC Plan that covers both on-site and off-site work and includes the following with a table of contents listing the major sections identified with tabs.

I. QC ORGANIZATION: A chart showing the QC organizational structure and its relationship to the production side of the organization.

II. NAMES AND QUALIFICATIONS: In resume format, for each person in the QC organization.

III. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL: Of each person in the QC organization.

IV. OUTSIDE ORGANIZATIONS: A listing of outside organizations such as architectural and consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.

V. APPOINTMENT LETTERS: Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for managing and implementing the QC program as described in this contract. Include in this letter the QC Manager's authority to direct the removal and replacement of non-conforming work.

VI. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER: Procedures for reviewing and managing submittals. Provide the name(s) of the person(s) in the QC organization authorized to review and certify submittals prior to approval.

VII. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraphs "Accredited Laboratories" or "Testing Laboratory Requirements", as applicable.

VIII. TESTING PLAN AND LOG: A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.

IX. PROCEDURES TO COMPLETE REWORK ITEMS: Procedures to identify, record, track and complete rework items.

X. DOCUMENTATION PROCEDURES: Use SDSTA formats or agreed upon formats with SDSTA QA Manager and Contractor.

XI. PROCEDURES FOR COMPLETION INSPECTION: See the paragraph entitled "COMPLETION INSPECTIONS".

1.6 PROJECT PRECONSTRUCTION CONFERENCE

During the Preconstruction Conference and prior to the start of construction, discuss the QC program required by this contract. The purpose is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, and the coordination of the Contractor's management, production and the QC personnel. At the meeting, the Contractor will be required to explain how quality control will be implemented for key features of work. Contractor's personnel required to attend shall include the QC Manager, project manager, and superintendent. Minutes of the meeting will be prepared by the QC Manager and signed by both the Contractor and the Project Manager. The Contractor shall provide a copy of the signed minutes to all attendees.

1.7 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this contract.

1.7.1 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the Contracting Officer immediately. Conspicuously stamp the cover sheet for each

report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results shall be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the Project Manager.

1.8 QC CERTIFICATIONS

1.8.1 Invoice Certification

Furnish a certificate with each payment request, signed by the QC Manager, attesting that as-built drawings are current and attesting that the work for which payment is requested, including stored material is in compliance with contract requirements.

1.8.2 Completion Certification

Upon completion of work under this contract, the QC Manager shall furnish a certificate attesting that "the work has been completed, inspected, tested and is in compliance with the contract."

1.9 COMPLETION INSPECTIONS

1.9.1 Punch-Out Inspection

Near the completion of all work or stated elsewhere in the specifications, the QC Manager shall conduct an inspection of the work and develop a punch list of items which do not conform to the approved drawings and specifications. Include in the punch list any remaining items of the "Rework Items List", which were not corrected prior to the Punch-Out inspection. The punch list shall include the estimated date by which the deficiencies will be corrected. A copy of the punch list shall be provided to the Project Manager. The QC Manager or staff shall make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the SDSTA that the facility is ready for the SDSTA "Pre-Final Inspection".

1.9.2 Pre-Final Inspection

The SDSTA and QC manager will perform this inspection to verify that the facility is complete and ready to be occupied. A SDSTA pre-final punch list may be developed as a result of this inspection. The QC Manager shall ensure that all items on this list are corrected prior to notifying the SDSTA that a "Final" inspection with the customer can be scheduled. Any items noted on the "Pre-Final" inspection shall be corrected in a timely manner and shall be accomplished before the contract completion date for the work or any particular increment thereof if the project is divided into increments by separate completion dates.

1.9.3 Final Acceptance Inspection

The QC Manager, the superintendent, or other Contractor management personnel and the Project Manager and SDSTA QA Rep will be in attendance at this inspection. The final acceptance inspection will be formally scheduled based upon results of the "Pre-Final Inspection".

1.10 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities. Reports are required for each day work is performed. Account for each calendar day throughout the life of the contract. The superintendent and the QC Manager (If separate) must prepare and sign the Contractor DAILY Report. The reporting of work shall be identified by terminology consistent with the construction schedule. Use the "remarks" section in this report to record pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site.

1.10.1 As-Built Drawings

The QC Manager is required to review the as-built drawings and ensure they are kept current on a regular basis and marked to show deviations, which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation, e.g. modification number, RFI number, etc. The QC Manager shall initial each deviation or revision. Upon completion of work, the QC Manager shall submit a certificate attesting to the accuracy of the as-built drawings prior to submission to the SDSTA.

Contractor is responsible for maintaining accurate as-built drawings throughout construction. The buried components shall be staked in the field by a professional land surveyor using the coordinates listed on the drawings. Any changes to the work shall be measured from the surveyors' stakes with vertical and horizontal dimensions recorded on the drawings as the work progresses. As-built information shall also include the size, material, type, and location of existing utilities that are found. The Owner may review the as-built drawings as part of the approval for any periodic progress payment requests. Changes to above grade components shall be measured both vertically and horizontally from new or existing features such as floors or corners of walls that will remain when the work is complete. A full set of clear and legible as-built drawings shall be submitted to the Owner prior to final payment.

1.11 NOTIFICATION ON NON-COMPLIANCE

The Project Manager or QA Rep will notify the Contractor of any detected non-compliance with the foregoing requirements. The Contractor shall take immediate corrective action. If the Contractor fails or refuses to correct the non-compliant work, the Contracting Officer will issue a non-compliance notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall make no part of the time lost due

to such stop orders the subject of claim for extension of time, for excess costs, or damages.

--- End of Section ---

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS

01 5000

Part 1 General

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C511 (2007) Standard for Reduced-Pressure Principle Backflow Prevention Assembly

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241 (2015) Standard for Safeguarding Construction, Alteration, and Demolition Operations

NFPA 70 (2017) National Electrical Code

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Construction Site Plan

Traffic Control Plan

Backflow Preventer Tests

Backflow Tester Certification

1.3 CONSTRUCTION SITE PLAN

Prior to the start of work, submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

1.4 BACKFLOW PREVENTERS CERTIFICATE

Certificate of Full Approval attesting that the design, size and make of each backflow preventer has satisfactorily passed performance testing and evaluation for the respective level of approval.

Part 2 Products

2.1 TEMPORARY TRAFFIC CONTROL

2.1.1 Haul Roads

Construct access and haul roads necessary for proper prosecution of the work under this contract. Construct with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic are to be avoided. Provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, must be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads are subject to approval by the Contracting Officer. Lighting must be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations.

2.1.2 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.1.3 Fencing

Provide fencing along the construction site at all open excavations and tunnels to control access by unauthorized people.

a. The safety fencing must be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 1.2 m (48 inches) high and maximum mesh size of 50 mm (2 inches), supported and tightly secured to steel posts located on maximum 3 m (10 foot) centers, constructed at the approved location. Install fencing to be able to restrain a force of at least 114.00 kg (250 pounds) against it.

Part 3 Execution

3.1 EMPLOYEE PARKING

Contractor employees will park privately owned vehicles in an area designated by the Project Manager. This area will be within reasonable walking distance of the construction site. Contractor employee parking must not interfere with existing and established parking requirements of the SDSTA installation.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

3.2.2 Sanitation

Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Project Manager and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any district or commercial sanitary sewer system. Any penalties and/or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Project Manager and follow sanitary district regulations and procedures when discharging into the sanitary sewer system. Maintain these conveniences at all times without nuisance. Include provisions for pest control and elimination of odors. SDSTA toilet facilities will not be available to Contractor's personnel.

3.2.3 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

a. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic except with written permission of the Project Manager at least 15 calendar days prior to the proposed modification date and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

b. Conduct work so as to minimize obstruction of traffic and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.

3.3.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Project Manager. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

3.3.3 Dust Control

Dust control methods and procedures must be approved by the Project Manager. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.4 CONTRACTOR'S TEMPORARY FACILITIES

3.4.1 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site. SDSTA office and warehouse facilities will not be available to the Contractor's personnel.

3.4.2 Appearance of Temporary Facilities

a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair.

b. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project.

3.4.3 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own equipment.

3.5 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store any salvageable materials resulting from demolition activities within the fenced area described above or at the supplemental storage area. Neatly stack stored materials not in trailers, whether new or salvaged.

3.6 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haul roads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore areas used by the Contractor for the storage of equipment or material, or other use to the original or better condition. Remove gravel used to traverse grassed areas and restore the area to its original condition, including top soil and seeding as necessary.

--- End of Section ---

CLOSEOUT SUBMITTALS

01 7800

Part 1 General

1.1 DEFINITIONS

1.1.1 As-Built Drawings

As-built drawings are developed and maintained by the Contractor and depict actual conditions, including deviations from the Contract Documents. These deviations and additions may result from coordination required by, but not limited to: contract modifications; official responses to Contractor submitted Requests for Information; direction from the Contracting Officer; designs which are the responsibility of the Contractor, and differing site conditions. Maintain the as-builts throughout construction as red-lined hard copies on site. These files serve as the basis for the creation of the record drawings.

1.1.2 Record Drawings

The record drawings are the final compilation of actual conditions reflected in the as-built drawings.

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Product Data

Spare Parts Data

Manufacturer's Instructions

Posted Instructions

As-Built Drawings

Final Approved Shop Drawings

2.1 AS-BUILT DRAWINGS

2.1.1 Markup Guidelines

Make comments and markup the drawings complete without reference to letters, memos, or materials that are not part of the As-Built drawing. Show what was changed, how it was changed, where item(s) were relocated and change related details. These working as-built markup prints must be neat, legible and accurate as follows:

a. Use base colors of red, green, and blue. Color code for changes as follows:

(1) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.

(2) Deletions (Red) - Over-strike deleted graphic items (lines), lettering in notes and leaders.

(3) Additions (Green) - Added items, lettering in notes and leaders.

2.1.2 As-Built Drawings Content

Show on the as-built drawings, but not limited to, the following information:

- a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the average depth below the surface of each run.
- b. The location and dimensions of any changes within the building structure.
- c. Layout and schematic drawings of electrical circuits and piping.
- d. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.
- e. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to shop drawings, fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.
- f. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.
- g. Where contract drawings or specifications present options, show only the option selected for construction on the working as-built markup drawings.
- h. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.
- i. Actual location of anchors, construction and control joints, etc., in concrete.
- j. Unusual or uncharted obstructions that are encountered in the contract work area during construction.

2.2 CLEANUP

Leave premises "broom clean." Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site.

--- End of Section ---

OPERATION AND MAINTENANCE DATA

01 78 23

Part 1 General

1.1 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Operation and Maintenance Data

Training Plan

1.2 OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data for the provided equipment, product, or system, defining the importance of system interactions, troubleshooting, and long-term preventive operation and maintenance. Compile, prepare, and aggregate O&M data to include clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal.

1.2.1 Package Quality

Documents must be fully legible. Operation and Maintenance data must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions.

1.3 OPERATION AND MAINTENANCE MANUAL FILE FORMAT

Assemble data packages into electronic Operation and Maintenance Manuals. Assemble each manual into a composite electronically indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Include a complete electronically linked operation and maintenance directory.

1.3.1 O&M MANUAL LABEL REQUIREMENTS

Provide the following information on the label:

- a. Building Number
- b. Project Title
- c. Activity and Location
- d. Construction Contract Number
- e. Prepared By: (Name, title, phone number and email address)
- f. Date

1.4 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

The following are a detailed description of the data package items required.

1.4.1 Operating Instructions

Provide specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.4.1.1 Safety Precautions and Hazards

List personnel hazards and equipment or product safety precautions for operating conditions. List all residual hazards identified in the Activity Hazard Analysis provided under Section 01 35 26 SDSTA SAFETY REQUIREMENTS. Provide recommended safeguards for each identified hazard.

1.4.1.2 Operator Prestart

Provide procedures required to install, set up, and prepare each system for use.

1.4.1.3 Startup, Shutdown and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.4.1.4 Normal Operations

Provide Control Diagrams with data to explain operation and control of systems and specific equipment. Provide narrative description of Normal Operating Procedures.

1.4.1.5 Emergency Operations

Provide Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Provide Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.4.1.6 Operator Service Requirements

Provide instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gauge readings.

1.4.1.7 Environmental Conditions

Provide a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.4.1.8 Additional Requirements for HVAC Control Systems

a. Narrative description on how to perform and apply functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

- c. Copies of checkout tests and calibrations performed by the Contractor (not Cx tests).

1.4.2 Preventive Maintenance

Provide the following information for preventive and scheduled maintenance to minimize repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.4.2.1 Lubrication Data

Include the following preventive maintenance lubrication data, in addition to instructions for lubrication required under paragraph OPERATOR SERVICE REQUIREMENTS:

- a. A table showing recommended lubricants for specific temperature ranges and applications.
- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
- c. A Lubrication Schedule showing service interval frequency.

1.4.2.2 Preventive Maintenance Plan, Schedule, and Procedures

Provide manufacturer's schedule for routine preventive maintenance, inspections, condition monitoring (predictive tests) and adjustments required to ensure proper and economical operation and to minimize repairs. Provide instructions stating when the systems should be retested. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

- a. Define the anticipated time required to perform each test (work-hours), test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize repairs.
- b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.4.3 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.4.3.1 Parts Identification

Provide identification and coverage for the parts of each component, assembly, subassembly, and accessory of the end items subject to replacement.

1.4.3.2 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components of the system.

1.4.3.3 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.4.3.4 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components. Provide final set points.

Part 2 Products

Not Used

Part 3 Execution

3.1 TRAINING

Prior to acceptance of the facility for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The training must be targeted for the building maintenance personnel, and applicable building occupants. Training must include classroom or field lectures based on the system operating requirements. The location of classroom training requires approval by the Project Manager.

3.1.1 Training Plan

Submit a written training plan to the Project Manager for approval. Training plan must be approved by the Quality Control Manager prior to forwarding to the SDSTA. Also, coordinate the training schedule with the Contracting Officer and QC. Include within the plan the following elements:

3.1.2 Training Content

The core of this training must be based on manufacturer's recommendations and the operation and maintenance information. The QC Manager is responsible for overseeing and approving the content and adequacy of the training. Include the following for each system training presentation:

- a. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms.
- b. Relevant health and safety issues.

- c. Discussion of how the feature or system is environmentally responsive. Advise adjustments and optimizing methods for energy conservation.
- d. Design intent.
- e. Use of O&M Manual Files.
- f. Review of control drawings and schematics.
- g. Interactions with other systems.
- h. Special maintenance and replacement sources.
- i. Tenant interaction issues.

--- End of Section ---

SECTION 22 0010
GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Quality Assurance
- B. Methods of Request for Approval
- C. Submittals
- D. Job Conditions
- E. Project Coordination
- F. Drawings and Measurements
- G. Workmanship
- H. Patching Materials
- I. Equipment Housekeeping Pads
- J. Equipment Clean-Up
- K. Cutting and Patching
- L. Sealing of Penetrations
- M. Excavating, Trenching and Backfilling
- N. Project Conditions
- O. Preparation
- P. General Installation Requirements
- Q. Existing Utilities
- R. Laying Out the Work
- S. Temporary Heating
- T. Progress Cleaning
- U. Protection of Installed Work
- V. System Startup
- W. Demonstration and Instruction
- X. Adjusting
- Y. Final Cleaning
- Z. Closeout Procedures
- AA. Project Record Documents
- AB. Warranty and Bonds

1.02 DEFINITIONS

- A. Contractor
 - 1. The term “Contractor” refers to the installation Contractor responsible for the furnishing and installation of all work indicated within this Specification.
- B. Furnish
 - 1. The term “furnish” is used to mean “purchase, supply, provide and deliver to the Project site, protect and provide interim storage and be ready for unloading, unpacking, assembly, installation, and similar operations in accordance with Manufacturer’s specifications.”
- C. Provide

1. The terms "provide" means to "furnish and install, complete and ready for the intended use."
- D. Install
 1. The term "install" is used to describe operations at project site including the actual "unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations".
- E. Installer
 1. The "Installer" is the Contractor, Subcontractor and/or supplier who uses their own employees for performance of all construction
- F. If Applicable:
 1. The term "if applicable" will be that work which may be required for completed construction at applicable locations, but is not necessarily shown or described in the Contract Documents.
- G. As Necessary
 1. The term "as necessary" will be that work which is required for completed construction, but is not necessarily shown or described in the Contract Documents.
- H. As Required
 1. The term "as required" will be that work which is required for completed construction and is shown on the drawings or described in the project Specification.
- I. Concealed
 1. The term "concealed" means hidden from sight, buried as in chases, furred spaces, shafts, fixed ceiling or embedded in construction.
- J. Exposed
 1. The term "exposed" means bare, open to the elements, out in the open, uncovered.
- K. Product
 1. The term "product" will mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.
- L. Substantial Completion
 1. "Substantial Completion" is deemed that the project is sufficiently complete to be utilized for its intended use as stated in the body of this written Specification.
- M. Words in the singular will also mean and include the plural, wherever the context so indicates, and words in the plural will mean the singular, wherever the context so indicates.

1.03 RELATED DOCUMENTS

- A. The attached General Conditions, Supplementary General Conditions and Special Conditions or General Requirements are hereby incorporated into and shall become a part of all sections under DIVISION 22 – PLUMBING. In certain instances where the terms of this Division of the Specifications conflict with the terms of the General Conditions, or Special Conditions, this Division of the Specifications shall govern (or the more stringent requirement shall apply).
- B. Where "Contractor" is referred to in this Specification it shall mean "Contractor, Sub-Contractor and/or Sub-Contractors under the Prime Contractor."

1.04 DESCRIPTION OF WORK

- A. The work shall include everything in this Division of the Specifications and everything indicated on the Drawings that is complementary to this Division of the Specifications. Refer to the Index of Drawings to determine what Drawings apply directly to this work.

1.05 QUALITY ASSURANCE

- A. Codes and Standards:
 1. All work shall be executed in accordance with the Local, State and other attending rules and regulations applicable to the trade affected and be subject to the inspection of these departments.

2. Materials and equipment shall be new and of best quality, of the type best suited for the purpose intended, and be made by nationally recognized and substantially established manufacturers. The type and weight of material used for each purpose shall be as herein specified, and material shall conform with the requirements of the latest standard specifications of the "ASTM" for that particular material.
 3. Fire protection materials used in this work shall be listed by the Underwriters Laboratories, Inc. where testing is provided and shall bear their label.
 4. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
 5. Where the notation of NFPA is indicated the equipment shall conform to National Fire Protection Association Standard.
 6. The following list of codes, technical societies, trade organizations and governing agencies shall set the standards by which all work shall be executed:
 - a. City Fire Protection Ordinances
 - b. State Fire Protection Laws and Statutes
 - c. NFPA 13 and 14 Current Edition
 - d. Underwriters Laboratories (UL)
 - e. International Building Code (IBC)
 - f. Uniform Plumbing Code (UPC)
 - g. International Fire Code (IFC)
- B. Fees
1. All fees, permits, licenses, etc., necessary in order to complete the work of this section shall be obtained and paid by this Contractor.
- C. Alternate Equipment
1. Where items of equipment and materials are specifically identified herein by a single manufacturer's name, or as many as three manufacturer's names, model or catalog numbers, and the words "or equal and approved" do not follow the manufacturer's names, only such specific items may be used in the base bid, except as hereinafter provided.
 2. Items of equipment of the Contractor's choice may be offered as alternates to such specified items, either in the spaces provided for same in the proposal form or if no space is provided, on the bidder's letterhead attached to each copy of the proposal form.
 3. Alternate proposal must be accompanied by full descriptive and technical data for item proposed, together with statement of amount of cost addition or deduction from the base bid if alternate is accepted. Substitutions proposed by the Contractor will not be considered in the award of the contract.
 4. The Contractor must judge that such alternate equipment is of equal quality and character to the specified equipment, and it is physically adaptable for installation within the allotted space with all required service clearances. Unless otherwise specified with this Division, the Engineer will not approve or disapprove any alternate equipment or materials before the bids are opened.
 5. The cost of any changes to other trades as a result of use of the alternate material or equipment must be borne by the Contractor submitting such material or equipment.
- D. Equipment of Substitution:
1. Where items of equipment and materials are specifically identified herein by a single manufacturer's name, or as many as three manufacturer's names, model or catalog numbers, and the words "or equal and approved" follow the manufacturer's name, such items may be substituted until such time that the "Schedule of Materials and Equipment" is submitted to the SDSTA Project Manager. The base bid and any alternate shall be based on materials only as specified or approved.
- E. Where work required by the drawings and specification is above the standard required by local regulations, it shall be done as shown and/or specified.

1.06 METHODS OF REQUEST FOR APPROVAL:

- A. Prior to the award of the contract, interested parties may request approval of substitute materials. Such requests shall be made in writing and delivered to the SDSTA Project Manager no later than ten (10) days prior to the receipt of bids. Any substitutions that the SDSTA Project Manager finds satisfactory will then be published in an addendum as "acceptable substitutions."
- B. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Division 22 Contractor to ensure that any price quotations received and submittals made are for products which meet or exceed the specifications included herein.
- C. The Contractor must judge that such items of substitution are of equal quality and character to the specified items and it is physically adaptable for installation within the allotted space with all required service clearances. This includes the following:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same (or better) warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner.
 - 4. Waives claims for additional costs or time extensions which may subsequently become apparent.
 - 5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities.
- D. The cost of any changes to other trades as a result of use of the substitution material or equipment must be borne by the Contractor submitting such material or equipment.
- E. After the award of the contract, any request for a substitution must be made in writing by the Contractor (not material supplier or Sub-Contractor). Such request shall state the name of the product specified, the name of the product proposed for substitution, the reason for requesting the substitution, and any change in contract amount resulting from the substitution. No such substitution shall be made until an appropriate Contract Modification has been issued and approved.
- F. Manufactured materials hereinafter specified or shown on the Drawings shall be installed or applied in accordance with the directions of the manufacturer unless specifically designated otherwise in the Specifications or on the Drawings.
- G. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- H. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- I. Substitution Submittal Procedure:
 - 1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
 - 3. The Architect will notify Contractor in writing of decision to accept or reject request.
 - 4. Request shall be made in writing and be delivered to A/E no later than seven days prior to receipt of bids.

1.07 SUBMITTALS

- A. Submittals for Review
 - 1. When the following are specified in individual sections, submit them for review:
 - a. Product data.
 - b. Shop drawings.
 - c. Samples for selection.
 - d. Samples for verification.

2. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.
- B. Submittals for Information
1. When the following are specified in individual sections, submit them for information:
 - a. Design data.
 - b. Certificates.
 - c. Test reports.
 - d. Inspection reports.
 - e. Manufacturer's instructions.
 - f. Other types indicated.
- C. Submittals for Project Closeout
1. When the following are specified in individual sections, submit them at project closeout:
 - a. Project record documents.
 - b. Operation and maintenance data.
 - c. Warranties.
 - d. Bonds.
 - e. Test and balance reports.
 - f. System certification as required.
 - g. Other types as indicated.
- D. Submittal of Shop Drawings:
1. All hard copy submittals shall be compiled into an indexed three ring binder prior to submittal. Any loose leaf or stapled sheets will be rejected.
 - a. Documents for Review:
 - 1) Small Size Sheets, Not Larger Than 8-1/2 x 11 inches (215 x 280 mm): Submit the number of copies that Contractor requires, plus three copies that will be retained by Architect.
 - 2) Larger Sheets, Not Larger Than 36 x 48 inches (910 x 1220 mm): Submit the number of opaque reproductions that Contractor requires, plus three copies that will be retained by Architect. A minimum of eight submittals shall be submitted.
 2. Electronic submittals shall be in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible or scanned files will be rejected.
 - a. Submittals shall be for specific equipment to be provided on the project and not an entire catalog.
 3. Major components of the system shall be submitted at one time under a protective cover with each section indexed with visible file tabs. All equipment shall be labeled per the equipment tags on the drawings, ie. Equipment names, etc.
 4. Shop drawings shall indicate manufacturer name, model number, dimensions, voltage and current characteristics, construction and rough-in connections of all materials to be used. Each shop drawing shall be certified as being checked and approved by the Contractor before submittal.
 5. Shop drawings not indicated as being approved by the Contractor will be returned without review.
 6. The Contractor shall provide approved shop drawings with the Operating and Maintenance Manual.
 7. The following wording will appear on shop drawings reviewed by the Engineer. Contractors not wishing to comply with these conditions shall not submit a bid.
"Corrections or comments made on the shop drawings during this review do not relieve Contractor from compliance with requirements of the Drawings and Specifications. This check is only for review of general compliance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting

- fabrication processes and techniques of construction; coordinating their work with that of all other trades and performing their work in a safe and satisfactory manner.”
8. The Engineer is not an error checker. Where the Contractor is submitting shop drawings that differ from the specifications, the Contractor must itemize in writing, each variance from the specifications. Failure to do so will be considered an error on the Contractors part and the specified materials shall be furnished. Shop drawings submitted in error or with errors as compared to Specifications and Drawings will be the responsibility of the Contractor to correct such error later.
 9. Shop drawings must only be those materials as specified or approved in published addendum. Others will be returned without review.
 10. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.
 11. When revised for resubmission, identify all changes made since previous submission.
 12. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
 13. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- E. Guarantee:
1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.
 2. Note that individual specification sections may indicate longer warranty periods on specific components or parts. In each case, the more stringent warranty period shall govern.
 3. For equipment or component parts of equipment put into service during construction for use by Owner, submit documents within 10 days after acceptance.
 4. Any requested use of the equipment or component parts of equipment by the contractor for the contractor, whether the General Contractor or any subcontractor, shall be the responsibility of the contractor. The equipment or components shall be cleaned to new condition prior to substantial completion. Warranty shall begin at time of the project's substantial completion.
- F. Operating and Maintenance Instructions:
1. For Each Item of Equipment and Each System:
 - a. Description of unit or system, and component parts.
 - b. Identify function, normal operating characteristics, and limiting conditions.
 - c. Include performance curves, with engineering data and tests.
 - d. Complete nomenclature and model number of replaceable parts.
 2. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 3. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 4. Provide servicing and lubrication schedule, and list of lubricants required.
 5. Include manufacturer's printed operation and maintenance instructions for each component.
 6. Include sequence of operation by controls manufacturer.
 7. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 8. Provide control diagrams by controls manufacturer as installed. (Record Drawings)
 9. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

10. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 11. Include test and balancing reports.
 12. One copy of each shop drawing shall be included in the notebooks but shall not serve in lieu of maintenance and operating instructions. Temperature control diagrams must include a description of the sequence of control.
 13. The Contractor shall submit O&M Manuals to the Engineer, not the owner, for review. The Engineer will forward the manuals to the Owner.
 14. This Contractor shall also supervise the initial operation as required to acquaint him thoroughly with the best practice.
 15. This Contractor shall furnish the Engineer with a written statement from the Owner indicating complete acceptance of the equipment data and instruction of the operator. The Engineer will not approve the request for final payment until such statement has been submitted.
 16. Additional Requirements: As specified in individual product specification sections.
 17. Assembly of Operation and Maintenance Manuals
 - a. Assemble operation and maintenance data into durable manuals for Owner's personnel use.
 - 1) Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; [3] inch ([76] mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
 - 2) Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify Contractor Name; identify Architect and Engineer Firms names; identify subject matter of contents.
 - 3) Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
 - 4) Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
 - 5) Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment. Where systems involve more than one specification section, provide separate tabbed divider for each system.
 - 6) Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
 - 7) Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
 - 8) Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
 - 9) Arrange and organize the paper and digital version in the same manner.
 - b. Prepare instructions and data by personnel experienced in maintenance and operation of described products. Prepare data in the form of an instructional manual.
 - c. Provide both an electronic version of the O&M Manuals and a hard copy.
 18. Additional Requirements: As specified in individual product specification sections.
- G. Test Reports:
1. Work which is required to be placed within the construction or concealed shall be carefully tested and inspected before being permanently concealed.
 2. Tests shall be made in the presence of the Engineer and the Owner, and shall meet with their approval. The Contractor shall notify the Engineer at a time sufficiently prior to the performance of any test to allow time for the Engineer to be present for the test.

3. Instruments for making tests shall be furnished by this Contractor.
4. The final test shall be performed as soon as possible after the work is entirely completed
5. Test reports submitted electronically shall be in standard PDF format or submitted with software to view the file.

H. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

1.08 JOB CONDITIONS:

A. General:

1. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
2. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

B. Fees and Service Charges:

1. Permits, licenses, fees and service charges required in connection with the work shall be secured and paid for by this Contractor, and upon completion of the work he shall furnish proof of acceptance from the proper Local and State Department having jurisdiction.

C. Mechanical Symbols and Abbreviations:

1. Symbols and abbreviations are as indicated in legends on the Drawings.

D. Correlation of Work:

1. This Contractor shall be responsible for close correlation of his work with that of other Contractors and shall organize his work so that it will not interfere with or delay the work of other Contractors.
2. Field verification of scale dimensions on Plans is directed since actual locations, distances and levels will be governed by actual field conditions.
3. The Division 22 Contractor shall check architectural, structural, plumbing, heating and ventilating plans to avert possible installation conflicts. Should drastic changes from original Plans be necessary to resolve such conflicts, the Sub-Contractor shall notify the Prime Contractor who in turn shall notify the SDSTA Project Manager and secure written approval and agreement on necessary adjustments before the installation is started.
4. Discrepancies shown on different Plans, or between Plans and actual field conditions, or between Plans and Specifications, shall promptly be brought to the attention of the SDSTA Project Manager for a decision.
5. Where a discrepancy exists between drawing and specifications or other disciplines the worst cost case shall be provided.
6. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate occupancy requirements.
7. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
8. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility to other installations, for maintenance, and for repairs.
9. Coordinate completion and clean-up of work of separate sections.
10. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

E. Final Inspection:

1. Upon completion of work, the Contractor shall notify the SDSTA Project Manager in writing and make arrangements for a final observation. The Contractor shall also submit the operating and maintenance manuals at this time. The Engineer will not schedule nor

- perform a final inspection without successful submittal of operating and maintenance manuals by the Contractor.
2. During the final observation, pre-final or follow-up final, the Contractor and all his Prime Sub-Contractors shall have the foreman of the project present.
 3. After the final observation is made, the Contractor will receive a list of items requiring adjustment, correction, replacement, or completion.
 4. The Contractor shall comply completely with all the listed requirements within a negotiated number of days of receipt of list. Should the Contractor fail to complete items on the list within this time limit, the Owner reserves the right to have the work completed by others and the cost deducted from the contract price, including change orders.
 5. The Contractor shall notify in writing to the Architect and/or Engineer once all punch list items are corrected, that he is ready for a follow-up final. The written notice shall contain explanations for those known items not completed and a schedule for completing them.
 6. The Architect and/or Engineer shall schedule a follow-up final to confirm completion. Repeated observation trips required of the Engineer by the Contractor's inability to complete the project satisfactorily will require the Contractor to reimburse the Engineer for all incurred costs after the follow-up final observation.

1.09 PROJECT COORDINATION

- A. Project Coordinator: Construction Manager/General Contractor.
- B. This section applies to all work performed and specified under Division 22.
- C. Cooperate with the Construction manager/General Contractor and Owner in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.
- D. During construction, coordinate use of site and facilities through the Construction Manager/General Contractor
- E. Comply with specified procedures for intra-project communications, submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- F. Comply with instructions of the Construction Manager / General Contractor for use of temporary utilities and construction facilities.
- G. Coordinate field engineering and layout work under instructions of the Construction Manager/General Contractor.
- H. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- I. Notify affected utility companies and comply with their requirements.
- J. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- K. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- L. Coordinate installation of equipment, piping, ductwork, etc. with electrical gear. Equipment shall not be located in front of panels. Ductwork and piping shall not be routed above panels. Coordinate location of fire sprinkler equipment equipment with Division 26.
- M. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- N. Coordinate completion and clean-up of work of separate sections.

- O. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
- P. Make the following types of submittals to Architect/Engineer through the Construction Manager/General Contractor.
 - 1. Requests for interpretation/information.
 - 2. Requests for substitution.
 - 3. Shop drawings, product data and samples.
 - 4. Test and inspection reports.
 - 5. Manufacturer's instructions and field reports.
 - 6. Applications for payment and change order requests.
 - 7. Progress schedules.
 - 8. Coordination drawings.
 - 9. Closeout submittals.
 - a. Warranties
 - b. Bonds
 - c. System Certification
 - d. Test and Balance Reports
 - 10. As-built Record Drawings.
 - 11. Operation and Maintenance Manuals.

1.10 DRAWINGS AND MEASUREMENTS

- A. Contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement of equipment, ducts, conduits, piping and approximate sizes and locations of equipment and outlets.
- B. Mechanical trades shall follow these drawings in laying out their work, consult general construction drawings to familiarize themselves with all conditions affecting their work, and shall verify spaces in which their work will be installed.
- C. Coordinate work with other trades as job conditions reasonably require.
- D. Where job conditions require reasonable changes in indicated locations and arrangement, make such changes without extra cost to Owner.
- E. The drawings are not intended to be scaled for roughing in measurements nor to serve as shop drawings.
- F. The Contractor shall consult the architectural, structural, mechanical, electrical, or equipment drawings for dimensions, obstructions, and location of equipment or other trades. Any discrepancies between architectural, structural, electrical, or equipment drawings and the mechanical work shown on these drawings shall be reported to the Engineers for adjustment.
- G. The installation details, instructions, and recommendations of the manufacturer of the product used, or modified to obtain the best end result, shall be the basis of attaining installation of the products for usage on this project except where definite and specific instructions are set forth herein or details are shown on the plans.

1.11 WORKMANSHIP

- A. The installation work included in this specification shall be performed in a neat workmanlike manner by people experienced and skilled in the Mechanical trade. Only the best quality workmanship will be accepted. All exposed parts of the systems such as exposed piping, plumbing fixtures, etc., shall be square and true with the building construction.

1.12 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

1.13 EQUIPMENT HOUSEKEEPING PADS

- A. Provide reinforced concrete housekeeping pads for all floor mounted plumbing equipment (i.e. water heaters, water softeners, compressors, and etc.)
- B. Provide anchor bolts, per equipment manufacturer's directions, to attach equipment to pads.

1.14 TRANSPORTATION AND HANDLING

- A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

1.15 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Prevent contact with material that may cause corrosion, discoloration, or staining.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.16 EQUIPMENT CLEAN-UP

- A. Special care must be taken for protection of panels, switches, etc. All must be kept completely protected from weather elements, painting, etc. until the building is substantially completed. Damage from rust, paint, scratches, etc. shall be corrected as directed by the A/E.
- B. Clean all plumbing fixtures, equipment, etc., thoroughly, just prior to final inspection. Plumbing fixtures, equipment, etc. shall be cleaned by an approved method.
- C. Protection of plumbing equipment during painting of the building shall be the responsibility of the Painting Contractor. This shall not relieve the Plumbing Contractor of the responsibility for checking to assure that adequate protection is being provided.

1.17 CUTTING AND PATCHING

- A. Execute cutting and patching to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.

- B. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing.
- C. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- D. In existing construction, this Contractor shall perform all cutting required and all necessary patching after completion to restore the surface to its original condition, unless otherwise indicated.
- E. Should the cutting of walls, floors, ceiling, partitions, etc., be required for proper installation of the work or apparatus of this Contractor, or be made necessary on account of his failure to give General Contractor proper information at the time required, such cutting shall be done at his own expense, restoring the work to its original condition.
- F. All cutting and patching done by this Contractor shall be subject to the direction and approval of the A/E. This Contractor shall not endanger the stability of the structure by cutting, digging, or otherwise, and shall not at any time cut or alter work of any other contractor without A/E's consent.

1.18 SEALING OF PENETRATIONS

- A. All penetrations for piping, etc. furnished under Division 22 of these specifications which penetrate fire and/or smoke walls and full height partitions (including chase walls), shall be sealed with a UL System specifically approved for the application.
- B. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified under Division 1.
- C. Sleeve pipes passing through partitions, walls, and floors.
 - 1. Floor Sleeves in Exposed Areas. Schedule 40 steel pipe, reamed, extending 2" above floor in equipment rooms and wet areas and 1/4" above the floor in all other locations.
 - 2. Masonry Wall Sleeves. Schedule 40 steel pipe reamed, and finished flush with wall.
 - 3. Gyp Wall Sleeves and Sleeves through Existing Construction: 22 gauge galvanized steel, ends terminating flush with the wall.
 - 4. Roof Sleeves and Floor Sleeves in Concealed Locations (as in chases). 22 gauge galvanized steel.
 - 5. Make pipe sleeves 1/2" larger inside diameter than the outside diameter of the pipe or pipe insulation, where insulated. Fabricate sleeves from new material, with ends cut square.
 - 6. Floor Sleeves, where water is to be kept out - fill with graphite packing and caulking compounds.
 - 7. Sleeves through bearing walls - Schedule 40 steel pipe reamed and finished flush with wall.
 - 8. Where plastic pipe passes through fire rated shaft walls and fire rated partition walls having a fire rating of 2 hours or more, provide Schedule 40 steel or cast iron pipe sleeve extending 12" or more on each side of wall.
 - 9. Provide wall plates all exposed pipe passing through walls, floors, or ceilings. Plates shall be chrome plates steel plates with set screw and concealed hinge. Cut plates to fit flush at close-spaced piping locations.

1.19 EXCAVATING, TRENCHING AND BACKFILLING

- A. This Contractor shall perform all excavation to the depths required, indicated on the drawings or specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from trench or other excavations to prevent slides or cave ins. All excavated materials not required or usable for backfilling shall be removed from the site. Necessary grading shall be done to prevent surface water from flowing into trenches or other excavations and onto adjacent property. Furnish all pumping required to keep excavated space clear of water during construction. The A/E will inspect excavation and approve soil conditions and direct procedure if unsatisfactory conditions are discovered. Provide sheeting and shoring

as may be necessary for the protection of the work and the safety of personnel. Protect bottom of excavation from frost and do not place structures or pipe on frozen ground.

- B. Except where excavations will be covered by at least 4" of concrete, this contractor shall provide electrical warning tape at least 6" above buried conduit or wire.
- C. Backfill excavations below finished grades with similar materials to that removed in excavation, free from rubbish and other unsuitable material. Backfilling shall be done to finished grades indicated on drawings. If no finished grading is to be done in excavated areas, this Contractor shall backfill to existing grades and restore the surface to its original condition. All backfill shall be compacted in 6 inch lifts to 95% maximum density.
- D. The Contractor shall be responsible for protecting trenches and provided adequate crossovers where pedestrian and vehicular traffic occurs. Guard rails, flags, lamps, etc. shall be used for such protection.
- E. This Contractor shall be responsible for the replacement of existing street pavement, curbs, sidewalks, etc. removed or damaged by him in the course of the work unless such pavement, curbs and sidewalks are to be reconstructed under the General Contract. This Contractor shall make necessary arrangements to perform such repairs and shall pay all costs in connection therewith and include it in his bid.
- F. Prior to any excavation, effort shall be made to determine whether underground installations (i.e., sewer, telephone, water, fuel, electric lines, etc.) will be encountered, and if so, where such underground installations are located. When the excavation approaches the estimated location of such installation, the exact location shall be determined and when it is uncovered, proper supports shall be provided for the existing installation. Utility companies shall be contacted and advised of proposed work prior to the start of actual excavation.

1.20 PROJECT CONDITIONS

- A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water.
- C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
- E. Erosion and Sediment Control: Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
- G. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- H. Verify that demolition is complete in alterations areas and areas are ready for installation of new work.
- I. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

- J. Verify that utility services are available, of these of the correct characteristics, and in the correct location.
- K. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions. Protect work of other trades.

1.21 PREPARATION

- A. Cut, move, or remove items as necessary for access to alterations and renovation work. Replace and restore at completion.
- B. Remove unsuitable materials not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for furnished work.
- C. Remove debris and abandoned items from area and from concealed spaces.
- D. Close openings in exterior surfaces to protect existing work and salvage items from weather and extremes of temperature and humidity. Insulate ducts and piping to prevent condensation in exposed areas.
- E. Prepare surfaces and remove surface finishes to provide for proper installation of new work and finishes.
- F. Clean substrate surfaces prior to applying next materials or substance.
- G. Seal cracks or openings of substrate prior to applying next material or substance.
- H. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

1.22 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections.
- B. Make neat transitions. Patch work to match adjacent work in texture and appearance.

1.23 EXISTING UTILITIES

- A. The plans indicate as accurately as possible the location , type and sizes of existing underground utilities at the site. It is the Contractor's responsibility to have all utilities located prior to starting work. Contractor shall contact appropriate utility company and One Call for locating utilities prior to commencement of any work. The Owner also has underground conduit and other systems in place. Contractor shall contact the Owner prior to excavation in any area to determine any items that may be impacted by excavation.
- B. This Contractor shall protect all utilities and Owner items affected by his work, and shall repair any damage caused by his forces at no additional cost to the Owner.
- C. The Owner and the Owners' of all underground facilities shall be notified at least 5 business days prior to excavation.

1.24 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect/Engineer of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly notify Architect/Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.
- F. Utilize recognized engineering survey practices.

- G. Establish elevations, lines and levels. Locate and layout by instrumentation and similar appropriate means.
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

1.25 TEMPORARY HEATING

- A. Provide all temporary heating required for the facility during construction. Install and maintain facilities in a manner that will protect the public and workmen. Coordinate requirements with Prime Contractor.
- B. Upon completion of work, remove all temporary heating from the project site.

1.26 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition per OSHA standards.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.

1.27 PROTECTION OF INSTALLED WORK

- A. Protect installed work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage. This includes the protection of the work of other trades.
- C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- D. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- E. Prohibit traffic from landscaped area.

1.28 SYSTEM STARTUP

- A. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- B. Verify that wiring and support components for equipment are complete and tested.
- C. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- D. Any irregularities, faulty equipment, etc. shall be repaired or replaced as required prior to acceptance.
- E. All equipment shall be freshly oiled, filters charged with clean media and installation completely finished prior to acceptance.

1.29 DEMONSTRATION AND INSTRUCTION

- A. Contractor shall complete all start-up and perform all intimal testing of each system prior to scheduling or requesting to schedule training. All systems shall be completely operational before training or demonstration will occur.
- B. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.
- C. Demonstrate operation and maintenance of Products to Owner's representative at a scheduled time with the Owner.
- D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner Personnel.
- F. Utilize operation and maintenance e manuals as basis for instruction. Review contents of manuals with Owner's personnel in detail to explain all aspects of operation and maintenance.

1.30 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.31 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- C. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

1.32 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect.
- B. Notify Architect when work is considered finally complete.
- C. Complete items of work determined by Architect's final inspection.

1.33 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Record information concurrent with construction progress.
- D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Changes made by Addenda and modifications.
- E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 2. Field changes of dimension and detail.
 - 3. Details not on original Contract Documents.

- F. At completion of project Contractor shall provide a minimum of two (2) sets of As-Built Record drawings. Additional sets shall be provided if required under General Requirements.

1.34 WARRANTY AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Sub-Contractors, suppliers and manufacturers, within ten days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.
- F. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Sub-Contractor, Supplier, and Manufacturer, with name address, and telephone number of responsible principal.
- G. Warranty:
 - 1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.
 - 2. Note that individual specification sections may indicate longer warranty periods on specific components or parts. In each case, the more stringent warranty period shall govern.
 - 3. For equipment or component parts of equipment put into service during construction for use by Owner, submit documents within 10 days after acceptance.
 - a. Any requested use of the equipment or component parts of equipment by the contractor for the contractor, whether the General Contractor or any subcontractor, shall be the responsibility of the contractor. The equipment or components shall be cleaned to new condition prior to substantial completion. Warranty shall begin at time of the project's substantial completion.

END OF SECTION

**SECTION 22 0510
MINOR PLUMBING DEMOLITION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mechanical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and piping arrangements are as shown on Drawings.
- B. Verify that piping and equipment to be removed serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Engineer/Engineer before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect plumbing systems in walls, floors, and ceilings which are to be removed.
- B. Coordinate utility service outages with utility company.
- C. Coordinate service outages with Owner. Notify Owner a minimum of 48 hours before any outage.
- D. Provide temporary piping and connections to maintain existing systems in service during construction.

3.03 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove exposed abandoned piping, including abandoned piping above accessible ceiling finishes. Cut piping flush with walls and floors, and patch surfaces. Firestop where necessary.
- C. Disconnect and remove abandoned water service, plumbing fixtures, and plumbing equipment.
- D. Maintain access to existing mechanical installations which remain active. Modify installation or provide access panel as appropriate.
- E. Extend existing installations using materials and methods as specified.

3.04 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.

END OF SECTION

SECTION 22 0516
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible pipe connectors.

1.02 RELATED REQUIREMENTS

- A. Section 22 1005 - Plumbing Piping.
- B. Section 23 2113 - Hydronic Piping.
- C. Section 23 2213 - Steam and Condensate Heating Piping.

1.03 REFERENCE STANDARDS

- A. EJMA (STDS) - EJMA Standards; Tenth Edition.

1.04 SUBMITTALS

- A. See Section 220010 - GENERAL PROVISIONS, for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Design Data: Indicate selection calculations.
- D. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- E. Maintenance Data: Include adjustment instructions.
- F. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

PART 2 PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.
 - 2. Metraflex Company: www.metraflex.com.
 - 3. Minnesota Flexible Corp. .
 - 4. Twin City Hose
- B. Inner Hose: Carbon steel.
- C. Exterior Sleeve: Single braided, stainless steel.
- D. Pressure Rating: 125 psi and 450 degrees F (862 kPa and 232 degrees C).
- E. Joint: As specified for pipe joints.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/4 inch (20 mm) on each side of installed center line.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.
 - 2. Metraflex Company: www.metraflex.com.
 - 3. Minnesota Flexible Corp.

- 4. Twin City Hose
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi and 450 degrees F (862 kPa and 232 degrees C).
- E. Joint: As Specified for Pipe Joints.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/4 inch (20 mm) on each side of installed center line.
- H. Application: Copper piping.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION

SECTION 22 0519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.

1.02 RELATED REQUIREMENTS

- A. 22 1005 - Plumbing Piping
- B. Section 23 2213 - Steam and Condensate Heating Piping.

1.03 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014, with Editorial Revision (2017).
- D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- B. Project Record Documents: Record actual locations of components and instrumentation.

1.05 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Ashcroft (Duragage): www.ashcroft.com
 - 2. Crosby
 - 3. Trerice: www.trerice.com
 - 4. Dwyer Instruments, Inc: www.dwyer-inst.com
 - 5. Miljoco
 - 6. Winters Instruments
 - 7. Weiss
- B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Cast aluminum with phosphor bronze bourdon tube.
 - 2. Size: 4-1/2 inch (115 mm) diameter.
 - 3. Mid-Scale Accuracy: One percent.
 - 4. Scale: Psi.
 - 5. Range: Typical range shall be 1-1/2 times the normal operating pressure of the fluid being measured unless otherwise specified.
 - 6. Provide snubbers on gauges located at pumps.

2.02 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi (1034 kPa).

- B. Needle Valve: Brass, 1/4 inch (6 mm) NPT for minimum 150 psi (1034 kPa).

2.03 STEM TYPE THERMOMETERS

- A. Manufacturers:
1. Moeller
 2. Trerice: www.trerice.com
 3. Dwyer Instruments, Inc: www.dwyer-inst.com.
 4. Miljoco
 5. Winters Instruments
 6. Weiss
- B. Scale range shall be as specified on the drawings with 2 degree division.
- C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9 inch (225 mm) scale.
 2. Window: Clear Lexan.
 3. Accuracy: 2 percent, per ASTM E77.
 4. Calibration: Degrees F.

2.04 DIAL THERMOMETERS

- A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 2. Trerice: www.trerice.com
 3. Dwyer Instruments, Inc: www.dwyer-inst.com.
 4. Miljoco
 5. Winters Instruments
 6. Weiss
- B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
1. Size: 3 inch (75 mm) diameter dial.
 2. Lens: Clear Lexan.
 3. Accuracy: 1 percent.
 4. Calibration: Degrees F.

2.05 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.06 TEST PLUGS

- A. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F (176 degrees C).
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch (60 mm) diameter pressure gauges, one gauge adapters with 1/8 inch (3 mm) probes, two 1 inch (25 mm) dial thermometers.
1. Pressure gage range: 0 to 160 PSI.
 2. Thermometer ranges: -40 deg. F to 160 deg. F and 0 deg. F to 220 deg. F.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- C. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Extend nipples and siphons to allow clearance from insulation. Provide siphon on gages in steam systems.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 0923.
- F. Coil and conceal excess capillary on remote element instruments.
- G. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- H. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- I. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.02 SCHEDULES

- A. Pressure Gauges, Location and Scale Range:
 - 1. Pumps, 0 to 100 psi (0 to 690 kPa).
 - 2. Expansion tanks, 0 to 100 psi (0 to 690 kPa).
 - 3. Pressure reducing valves, 0 to 100 psi (0 to 690 kPa).
- B. Pressure Gauge Tappings, Location:
 - 1. Major coils - inlets and outlets.
 - 2. Heat exchangers - inlets and outlets.
- C. Stem Type Thermometers, Location and Scale Range:
 - 1. Coil banks - inlets and outlets, 0 to 200 degrees F (0 to 93 Degrees C).
 - 2. Heat exchangers - inlets and outlets, 0 to 200 degrees F (0 to 93 Degrees C).
 - 3. Domestic hot water supply and recirculation, 0 to 200 degrees F (0 to 93 Degrees C).

END OF SECTION

SECTION 22 0548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vibration-isolated equipment support bases.
- B. Vibration isolators.
- C. Concrete bases.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.

1.03 SUBMITTALS

- A. See Section 220010 - GENERAL PROVISIONS, for submittal procedures.
- B. Shop Drawings - Vibration Isolation Systems:
 - 1. Provide schedule of vibration isolator type with location and load on each.
 - 2. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 - 3. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

PART 2 PRODUCTS

2.01 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

2.02 VIBRATION ISOLATORS

- A. General Requirements:
 - 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 - 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
- B. Vibration Isolators for Nonseismic Applications:
 - 1. Resilient Material Isolator Mounts, Nonseismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
 - 2. Restrained Spring Isolators, Nonseismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
 - b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.

- d. Provides constant free and operating height.
- 3. Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.03 CONCRETE BASES

- A. Provide concrete bases for mechanical equipment furnished under Division 15 unless otherwise indicated.
- B. Construct bases of 3000 PSI, 28-day strength concrete.
- C. Bases shall be plumb, smooth and shall be 4" high unless otherwise indicated.
- D. Bases shall be set a minimum of seven (7) days prior to mounting equipment.
- E. Set expansion bolts in bases for attachment of equipment and/or isolators.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 - 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 - 4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 - 5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
 - 6. Adjust isolators to be free of isolation short circuits during normal operation.
 - 7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

END OF SECTION

SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. All marking codes shall be in accordance with ANSI standards.

1.03 SUBMITTALS

- A. See Section 220010 - GENERAL PROVISIONS, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Piping: Tags.
- B. Pumps: Nameplates.
- C. Small-sized Equipment: Tags.
- D. Tanks: Nameplates.
- E. Valves: Tags.
- F. Water Treatment Devices: Nameplates.

2.02 MANUFACTURERS

- A. Brimar
- B. Brady Corporation
- C. Champion America
- D. Seton Identification Products

2.03 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/2 inch (13 mm).
 - 3. Background Color: Black.

2.04 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

2.05 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

- C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- E. Identify pumps, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify valves in main and branch piping with tags.
- H. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 22 0719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 09 9123 - Interior Painting: Painting insulation jacket.
- C. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).
- E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
- G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017.
- H. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 22 0010 - GENERAL PROVISIONS, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
- B. All products shall conform to NFPA 90A and 90B.
- C. Cold system insulation shall provide a complete vapor barrier.

2.02 GLASS FIBER

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C547; rigid molded, noncombustible.
 - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547; semi-rigid, noncombustible, end grain adhered to jacket.
 - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 650 degrees F (343 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White polymer paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
 - 1. Manufacturers:
 - a. Chicago Model 17-465.
- G. Fibrous Glass Fabric:
 - 1. Blanket: 1.0 lb/cu ft (16 kg/cu m) density.
- H. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.03 HYDROUS CALCIUM SILICATE

- A. Manufacturers:
 - 1. Johns Manville Corporation: www.jm.com.
 - 2. Knauf Insulation: www.knaufusa.com.
 - 3. Owens Corning Corp: www.owenscorning.com.
 - 4. CertainTeed Corporation: www.certainteed.com.
- B. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
 - 1. K (Ksi) Value: 0.40 at 300 degrees F (0.057 at 149 degrees C) when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 1200 degrees F (649 degrees C).
 - 3. Density: 15 lb/cu ft (240 kg/cu m).
- C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- D. Insulating Cement: ASTM C449.

2.04 JACKETS

- A. PVC Plastic.
 - 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com.
 - b. Speed-Line.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil (0.25 mm).
 - e. Connections: Brush on welding adhesive.
 - 3. Covering Adhesive Mastic: Compatible with insulation.
- B. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
 - 1. Lagging Adhesive: Compatible with insulation.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch (0.40 mm) sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - 4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- E. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- F. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
 2. Shields: ☐ between pipe hangers or pipe hanger rolls and inserts or piping on pipe diameters below 1-1/2 inch (38 mm).
 - a. 16 gauge sheet metal for pipes 4 inch (102 mm) and over.
 - b. 20 gauge sheet metal for pipes smaller than 4 inch (102 mm).
 - c. Shield length shall be as follows:
 - 1) 4 inch (102 mm) diameter and smaller: 9 inch (229 mm)
 - 2) 6 inch (153 mm) to 10 inch (254 mm) diameter: 12 inch (305 mm)
 - d. Form the shields to bear on the lower 1/3 periphery of the insulated pipe.
 3. Insert Location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.
- J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.
- K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum or field applied jacket with seams located on bottom side of horizontal piping.
- L. Items concealed within the insulation shall be clearly marked on the outside of the insulation covering.
- M. Insulation of cold surfaces where vapor barrier jackets are used, jackets shall be applied with a continuous, unbroken vapor seal (hangers on outside of insulation jacket).

3.03 SCHEDULES

- A. Plumbing Systems:
1. Domestic Cold Water:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: greater than 1/2 inch (50 mm).
 - (a) Thickness: 1 inch (25 mm).
- B. Other Systems:
1. Condensate Drain Piping:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: 1 inch (25 mm) and less.
 - (a) Thickness: 1/2 inch (12.5 mm).
 - 2) Pipe Size Range: thru 2 inch (50 mm).
 - (a) Thickness: 3/4 inch (20 mm).
 - 3) Pipe Size Range: greater than 2 inch (50 mm).
 - (a) Thickness: 1 inch (25 mm).

END OF SECTION

SECTION 22 1005
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
 - 1. Domestic water.
 - 2. Miscellaneous Drain Lines:
 - a. Condensate.
 - 3. Flanges, unions, and couplings.
 - 4. Pipe hangers and supports.
 - 5. Valves.
 - 6. Flow Control valves.
 - 7. Water pressure reducing valves.

1.02 RELATED REQUIREMENTS

- A. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.
- B. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- C. Section 22 0719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 2015.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- C. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2016.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- F. ASME B31.1 - Power Piping; 2020.
- G. ASME B31.9 - Building Services Piping; 2020.
- H. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.
- I. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).
- J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- K. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2020.
- L. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.
- M. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- N. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- P. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- Q. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- R. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.

- S. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.
- T. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
- U. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2019a.
- V. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- W. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.
- X. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2015.
- Y. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2017.
- Z. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2019.
- AA. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2020.
- AB. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2020.
- AC. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2020.
- AD. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
- AE. AWWA C606 - Grooved and Shouldered Joints; 2015.
- AF. AWWA C651 - Disinfecting Water Mains; 2014.
- AG. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2017 (Revised 2018).
- AH. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.
- AI. MSS SP-67 - Butterfly Valves; 2017.
- AJ. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.
- AK. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.
- AL. NSF 61 - Drinking Water System Components - Health Effects; 2020.
- AM. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with State of South Dakota Standards.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.05 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with State of South Dakota plumbing code.
- B. Conform to applicable code for installation of backflow prevention devices.
- C. All piping, equipment, valves, and fittings below 2" for use in systems designed for human consumption shall meet the federal lead free requirements outlined in Senate Bill S.3874. Lead free products shall not contain more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.
 - 1. Exemptions:
 - a. Pipes, pipe fittings, or fixtures, including backflow preventers that are used exclusively for non-potable services such as manufacturing, industrial processing, irrigation, outdoor water, or any other uses where the water is not anticipated to be used for human consumption.
 - b. Toilets, bidets, urinals, fill valves, flushometer valves, tub fillers, shower valves, service saddles, or water distribution main gate valves that are 2 inches in diameter or larger.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary protective coating on cast iron and steel valves.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, alloy Sn95 solder.
 - 3. Except as otherwise specified elsewhere, Type "L" soft drawn copper may be used adjacent to fixtures and equipment.
 - 4. Grooved Joints: Bolted clamp type coupling with grooved end lock, ASTM A-536. Victaulic or approved equivalent.
 - 5. Grooved Fittings: Cast bronze, grooved ends, ASTM B-584-87, or wrought copper, grooved ends ASTM B-75. Victaulic or approved equivalent.
- B. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, using one of the following joint types:
 - 1. Threaded Joints: ASME B16.4 cast iron fittings.
 - 2. Grooved Joints: AWWA C606 grooved pipe, cast iron fittings, and mechanical couplings.
- C. CPVC Pipe: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M.
 - 1. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
 - 2. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.

2.03 STORM WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Coated inside and out.
 - 2. Fittings: Cast iron.

3. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. PVC Pipe: ASTM D2665 or ASTM D3034.
 1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 1. Coated inside and out.
 2. Fittings: Cast iron.
 3. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 1. Fittings: Cast iron.
 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
 1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.
- D. Cast Iron Pipe: ASTM A74 service weight, coated inside and out, "no hub".
 1. Fittings: Cast iron.
 2. Joint Seals: Neoprene sealing sleeve with type 301 stainless steel shield and screw type clamps.

2.05 NATURAL GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 2. Joints: ASME B31.1, welded.
 3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.06 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 2. Joints: Threaded or welded to ASME B31.1.
- B. Exposed piping in equipment rooms above push-up ceiling, and at equipment connections 2" and smaller pipe, below 1 psi (7 kPa):
 1. Piping shall be black steel, Schedule 40, screw ends.
 2. Fittings black malleable iron, screwed, standard weight 150 lb (68 kg) banded. Apply aluminum paint on visible threads after assembly.

2.07 MISCELLANEOUS DRAIN LINES RECEIVING CONDENSATE, DRIP FOR HUMIDIFIER, ETC.

- A. Piping shall be Type "DWV" copper, fittings wrought copper, solder joint. Joints 50-50 solder and No. 50 flux.
- B. Piping for condensate from high efficiency furnaces, water heaters, boiler vents (flues) and other condensing type equipment shall be as directed by equipment manufacturer.
- C. Piping with in plenum ceilings shall also meet the 25/50 flame-smoke spread requirements.

2.08 FLANGES, UNIONS, AND COUPLINGS

- A. ALL MATERIALS SHALL BE ACCEPTABLE FOR USE WITH THE MEDIUM BEING CARRIED IN THE PIPING SYSTEM.
- B. Natural Gas:
 1. Piping 2 inch (51 mm) and smaller:
 - a. Malleable iron unions with ground joint brass to iron seat, 150 psi (1034 kPa) working steam pressure.
 2. Pipe sizes 2-1/2 inch (64 mm) and larger (welded):

- a. Forged steel flanges, 150 psi (1034 kPa), welding neck or slip on with raised faces and 1/16 inch (1.6 mm) cross laminated gaskets and carbon steel bolts.
 3. Pipe sizes 2-1/2 inch (64 mm) and larger (screwed):
 - a. Cast iron flanged unions, threaded, galvanized or black, 175 psi (1207 kPa) water, gasket type with carbon steel bolts.
- C. Copper Piping:
 1. All pipe sizes:
 - a. Copper, ground joint union.
- D. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 1. Dimensions and Testing: In accordance with AWWA C606.
 2. Housing Material: Provide ASTM A47/A47M malleable iron, ductile iron, or _____, galvanized.
 3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 4. When pipe is field grooved, provide coupling manufacturer's grooving tools.
- E. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.09 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 4. Vertical Pipe Support: Steel riser clamp.
- B. Plumbing Piping - Drain, Waste, and Vent:
 1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
 2. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
 3. Wall Support for Pipe Sizes to 3 Inches (80 mm): Cast iron hook.
 4. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - Water:
 1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
 2. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
 3. Hangers for Hot Pipe Sizes 2 Inches (50 mm) to 4 Inches (100 mm): Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
 5. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 6. Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
 7. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

8. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.10 BALL VALVES

- A. Manufacturers:
 1. Nibco, Inc; _____: www.nibco.com/#sle.
 2. Apollo.
 3. Watts
- B. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

2.11 BUTTERFLY VALVES

- A. Manufactured in the USA.
- B. Construction 1-1/2 Inches (40 mm) and Larger: MSS SP-67, 200 psi (1380 kPa) CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.
- C. Provide gear operators for valves 8 inches (150 mm) and larger, and chain-wheel operators for valves mounted over 8 feet (2400 mm) above floor.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 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.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. ABSOLUTELY NO PVC/ABS PLASTIC PIPING SHALL BE ALLOWED IN A RETURN AIR PLENUM.
- C. PVC or ABS piping exposed to direct sunlight shall be fully coated with synthetic latex paint to protect against UV light.
- D. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- E. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- F. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- G. Group piping whenever practical at common elevations.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 22 0516.
- I. Provide access where valves and fittings are not exposed. Doors shall be of approved dimensions with frame, brass hinges, handle, locking device and gasket for air tight joint.
- J. Provide access where valves and fittings are not exposed.
- K. Establish elevations of buried piping outside the building to ensure not less than 7 ft (2.1 m) of cover for water piping and [42] inch ([1] m) for sanitary sewer service.
- L. Provide support for utility meters in accordance with requirements of utility companies.

- M. Install bell and spigot pipe with bell end upstream.
- N. Install valves with stems upright or horizontal, not inverted. See Section 22 0523.
- O. Extend valve handles beyond insulation where necessary.
- P. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- Q. Install water piping to ASME B31.9.
- R. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- S. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- T. Sleeve pipes passing through partitions, walls, and floors.
- U. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified under Division 1.
- V. The right is reserved to authorize minor changes in pipe location to avoid conflicts with other trades at no additional cost to the Owner.
- W. All lines shall be graded where possible to facilitate drainage. Provide drain valves at bottoms of risers.
- X. Where fixtures are supplied from overhead branch lines, branch lines where possible shall connect at bottom of mains and shall pitch down toward fixtures so that branch lines and/or mains may be drained through fixture.
- Y. Branch lines shall be connected to top of mains where branches serve only fixtures located on floor above branch lines.
- Z. Install chrome plated steel plates (escutcheons) with set screw and concealed hinge at all wall penetrations. Cut plates to fit flush at close spaced piping locations.
- AA. Where waste and water piping is run in the same trench, installation shall conform to all governing codes.
- AB. All gas piping shall be installed with plugged drip pockets at low points.

3.04 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe valves for throttling, bypass, or manual flow control services.
- E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

3.05 TOLERANCES

- A. Drainage Piping: Establish invert elevations and slopes as follows:
 - 1. 1/4 inch (6.4 mm) per 1 foot (0.3 m) minimum for pipe sizes 3 inch (76 mm) and smaller. Maintain gradients.
 - 2. 1/8 inch (3.2 mm) per 1 foot (0.3 m) minimum for pipe sizes 4 inch (102 mm) and larger. Maintain gradients.
- B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.
- C. Soil, waste, vent piping and rainwater conductors, etc. shall be tested in accordance with applicable state and local codes.

3.06 PIPE TESTING

- A. Test underground pipes, or pipes in chases and walls, before piping is concealed.
- B. Test pipes before insulation is applied.

1. If insulation is applied before pipe is tested and leak(s) occur which ruins insulation, pipe installing contractor arranged and pays for replacing damaged insulation and other damaged building components.
- C. Domestic water piping shall be tested and proven water tight under a hydrostatic pressure of 100 PSIG. Pipe shall be tested with water pressure or equal inert gas such as nitrogen.
 1. Hold test pressure for minimum 8 hours.
 2. Test witnessed by Architect/Engineer or representative, if requested by University Construction Manager.
- D. Hydrostatically test soil, waste, vent, and storm piping inside of building with 15 feet head of water and allow to stand for one hour for inspection before connecting fixtures. If leaks occur, repair and retest.
- E. Water test pressurized soil mains at pressure equal to 1-1/2 times operating pump discharge pressure.
- F. Test all other piping systems to a pressure of 150 percent of normal operating pressure and hold for 1 hour without showing a drop in pressure.
 1. Test piping using water, nitrogen or air compatible with the final piping service.
- G. Natural gas piping shall be tested with an air pressure of not less than 125 PSIG. The system shall hold this pressure for 24 hours without drop.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfection of new systems shall meet all applicable Local Codes in addition to the following:
 1. Provide necessary connections to facilitate disinfection of entire system.
 2. Prior to starting work, verify system is complete, flushed and clean.
 - a. Operate flush valves, faucets and other valves as needed until flow is clean.
 - b. After flushing, remove inlet strainers, aerators and other devices, thoroughly clean and replace.
 - c. Remove valve assemblies to clean out foreign material when necessary and replace assemblies.
 3. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
 4. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
 5. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 30 percent of outlets.
 6. Maintain disinfectant in system for 24 hours.
 7. If final disinfectant residual tests less than 25 mg/L, repeat treatment until piping meets state and local bacteriological tests and is approved.
 8. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
 9. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.08 SERVICE CONNECTIONS

- A. Coordinate with Owner's Representative to make required service connections to existing systems.
- B. Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
 1. See Site Plan to verify extent of work under Division 22.
- C. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve.

1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
 2. Provide 18 gauge, 0.0478-inch (1.21 mm) galvanized sheet metal sleeve around service main to 6 inch (150 mm) above floor and 6 feet (1800 mm) minimum below grade. Size for minimum of 2 inches (50 mm) of loose batt insulation stuffing.
 3. Provide remote readout on meter where required by local Water Department
 4. See Site Plan to verify extent of work under Division 22.
- D. Provide new fire protection service complete with approved double check backflow preventer and shut-off valves with supervisory switches as indicated on the drawings.
1. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch (152 mm) above floor and 6 inch (1.8 mm) minimum below grade. Size for minimum of 2 inch (51 mm) of loose batt insulation stuffing.
 2. See Site Plan to verify extent of work under Division 22. Coordinate work requirements between Division 22 and Division 21.
- E. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 7 inch wg. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.09 SCHEDULES

- A. Pipe Hanger Spacing:
1. Metal Piping:
 - a. Pipe Size: 1/2 inches (15 mm) to 1-1/4 inches (32 mm):
 - 1) Maximum Hanger Spacing: 6.5 ft (2 m).
 - 2) Hanger Rod Diameter: 3/8 inches (9 mm).
 - b. Pipe Size: 1-1/2 inches (40 mm) to 2 inches (50 mm):
 - 1) Maximum Hanger Spacing: 10 ft (3 m).
 - 2) Hanger Rod Diameter: 3/8 inch (9 mm).
 - c. Pipe Size: 2-1/2 inches (65 mm) to 3 inches (75 mm):
 - 1) Maximum Hanger Spacing: 10 ft (3 m).
 - 2) Hanger Rod Diameter: 1/2 inch (13 mm).
 - d. Pipe Size: 4 inches (100 mm) to 6 inches (150 mm):
 - 1) Maximum Hanger Spacing: 10 ft (3 m).
 - 2) Hanger Rod Diameter: 5/8 inch (15 mm).
 - e. Pipe Size: 8 inches (200 mm) to 12 inches (300 mm):
 - 1) Maximum hanger spacing: 14 ft (4.25 m).
 - 2) Hanger Rod Diameter: 7/8 inch (22 mm).

END OF SECTION

SECTION 22 1006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Washing machine boxes and valves.
- F. Refrigerator valve and recessed box.
- G. Back water valves.
- H. Backflow preventers.
- I. Double check valve assemblies.
- J. Water hammer arrestors.

1.02 RELATED REQUIREMENTS

- A. Section 22 1005 - Plumbing Piping.
- B. Section 22 3000 - Plumbing Equipment.
- C. Section 22 4000 - Plumbing Fixtures.

1.03 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor and Trench Drains; 2019.
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2008 (Reaffirmed 2012).
- C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2017.
- D. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2009.
- E. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
- F. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).
- G. NSF 61 - Drinking Water System Components - Health Effects; 2020.
- H. NSF 372 - Drinking Water System Components - Lead Content; 2020.
- I. PDI-WH 201 - Water Hammer Arresters; 2017.

1.04 SUBMITTALS

- A. See Section 220010 - GENERAL PROVISIONS, for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- E. Operation Data: Indicate frequency of treatment required for interceptors.
- F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with State of _____ plumbing code.
- B. Conform to applicable code for installation of backflow prevention devices.

- C. All piping, equipment, and fittings shall meet the federal lead free requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 2. Mifab.
 3. Sioux Chief.
 4. Josam Company: www.josam.com/#sle.
 5. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Roof Drains:
1. Assembly: ASME A112.6.4.
 2. Body: Lacquered cast iron with sump.
 3. Strainer: Removable cast aluminum dome.
 4. Accessories: Coordinate with roofing type:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Adjustable extension sleeve for roof insulation.
- C. Roof Overflow Drains:
1. Construction shall be the same as Roof Drain; pipe extended to [2] inches above flood elevation.
- D. Downspout Nozzles:
1. Bronze round with offset bottom section.
- E. Floor Drain (FD-1):
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.
- F. Floor Drain (FD-3):
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer with polished bronze funnel or anti-splash rim.
- G. Floor Drain (FD-4):
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze extra heavy duty strainer.
- H. Provide construction and accessories necessary for installation of floor drain on substrate as specified under the architectural plans and specifications.
- I. Floor Sink (FS-2):
1. Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, nickel bronze frame, full grate.
- J. Provide construction and accessories necessary for installation of floor sink on substrate as specified under the architectural plans and specifications.

2.03 CLEANOUTS

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.

2. Josam Company: www.josam.com.
 3. Zurn Industries, LLC: www.zurn.com.
 4. MiFab.
 5. Sioux Chief.
 6. Substitutions: 220010 - GENERAL PROVISIONS.
- B. Cleanouts at Exterior Surfaced Areas (CO-1):
1. Round cast nickel bronze access frame and non-skid cover.
- C. Cleanouts at Exterior Unsurfaced Areas (CO-2):
1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.
- D. Cleanouts at Interior Finished Floor Areas (CO-3):
1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
- E. Cleanouts at Interior Finished Wall Areas (CO-4):
1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- F. Cleanouts at Interior Unfinished Accessible Areas (CO-5): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HOSE BIBBS

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 2. Watts Regulator Company: www.wattsregulator.com.
 3. Zurn Industries, LLC: www.zurn.com.
 4. Substitutions: 220010 - GENERAL PROVISIONS.

2.05 HYDRANTS

- A. Manufacturers:
1. Arrowhead Brass & Plumbing, LLC: www.arrowheadbrass.com.
 2. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 3. Zurn Industries, LLC: www.zurn.com.
 4. Woodford.
 5. Substitutions: 220010 - GENERAL PROVISIONS.
- B. Wall Hydrants:
1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, lockshield and removable key, and integral vacuum breaker.

2.06 WASHING MACHINE BOXES AND VALVES

- A. Box Manufacturers:
1. IPS Corporation/Water-Tite: www.ipscorp.com.
 2. Oatey Supply Chain Services, Inc: www.oatey.com.
 3. Guy Gray.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Plastic preformed rough-in box with brass long shank valves with wheel handles, socket for 2 inch (50 mm) waste, slip in finishing cover.

2.07 REFRIGERATOR VALVE AND RECESSED BOX

- A. Box Manufacturers:
1. IPS Corporation/Water-Tite: www.ipscorp.com.
 2. Oatey Supply Chain Services, Inc: www.oatey.com.
 3. Guy Gray.

- B. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.08 BACK WATER VALVES

- A. Cast Iron Back Water Valves: ASME A112.6.4; lacquered cast iron body and cover, brass valve, extension sleeve, and access cover.
- B. Plastic Back Water Valves: ABS body and valve, extension sleeve, and access cover.

2.09 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Conbraco Industries, Inc: www.apollovalves.com.
 - 2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com.
 - 3. Zurn Industries, LLC: www.zurn.com.
- B. Reduced Pressure Backflow Preventers:
 - 1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.10 DOUBLE CHECK VALVE ASSEMBLIES

- A. Manufacturers:
 - 1. Conbraco Industries, Inc: www.apollovalves.com.
 - 2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com.
 - 3. Zurn Industries, LLC: www.zurn.com.
- B. Double Check Valve Assemblies:
 - 1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.11 WATER HAMMER ARRESTORS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - 2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com.
 - 3. Zurn Industries, LLC: www.zurn.com.
 - 4. Sioux Chief.
- B. Water Hammer Arrestors:
 - 1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F (minus 73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

2.12 RADON FAN

- A. Fan Unit: Direct driven, external rotor type, totally enclosed PCS type motor.
- B. Electrical Connection: Integral external electrical terminal box with pre-wired terminal strip connections.
- C. Housing: UV resistant ABS-PC blend thermo plastic.
- D. Fan Failure Alarm: Fan failure audible and visual alarm via flow sensor. Mount in location that is easily viewed by occupant.

2.13 DOMESTIC WATER RECIRCULATION BALANCING VALVES

- A. Construction: Brass or bronze body with union on inlet and outlet, pressure compensating, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain. All valves shall have access capability to allow field exchange of internal components without removing valve body from piping. Valves shall have 2-32 psi operating range. Valve shall be lead free.

- B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3 psi.
- C. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
- D. Accessories: Flow control valve shall be in a union (or flanged)/flow control device/ball valve configuration.
- E. All valves shall be permanently marked to show direction of flow, flow rate and pressure range.
 - 1. Provide chain hung tags to indicate device served, service medium and flow rate.
- F. Flow for each balancing valve shall be 0.33 GPM.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. CLEANOUTS MUST BE PROVIDED IN ACCORDANCE WITH THE LOCAL CODE AND AS SHOWN ON THE DRAWINGS.
- D. Encase exterior cleanouts in concrete flush with grade.
- E. Install floor cleanouts at elevation to accommodate finished floor.
- F. Roof extension from soil, waste and vent pipes shall be extended at least 12 inches above the roof, and must be encased in frostproof jackets, each having an air space at least 1" between the outside surface of the pipe and a cap over the top of the pipe so that it will be unnecessary otherwise to plug the inside of the vent pipes at the top when the test is made.
 - 1. These plugs must be of a type readily seen until removed.
 - 2. Remove the plugs at once after the piping system has been tested.
- G. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- H. Pipe relief from backflow preventer to nearest drain.
- I. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks, washing machine outlets, or cold water supply to flush valves.
- J. Install pressure reducing valves where indicated on drawings and where domestic water service pressure is 65 PSIG or higher at the meter. Install with specialties as indicated on the plans.

END OF SECTION

SECTION 26 0010
GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

1.02 RELATED DOCUMENTS

- A. The General Conditions, Supplementary General Conditions and Special Conditions or General Requirements are hereby incorporated into and shall become a part of all sections under DIVISION 26, 27 and 28 – ELECTRICAL. In certain instances where the terms of this Division of the Specifications conflict with the terms of the General Conditions, or Special Conditions, the more stringent requirement shall apply.
- B. Where “Contractor” is referred to in this Specification it shall mean “Contractor, Sub-Contractor and/or Sub-Contractors under the Prime Contractor.”

1.03 DESCRIPTION OF WORK

- A. The work shall include everything in this Division of the Specifications and everything indicated on the Drawings that is complementary to this Division of the Specifications.

1.04 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Work, materials and manner of placing material shall conform in every respect with the latest provisions of Local, State and National Codes.
 - 2. Materials and equipment shall be new and of best quality, of the type best suited for the purpose intended, and be made by nationally recognized and substantially established manufacturers. The type and weight of material used for each purpose shall be as herein specified, and material shall conform with the requirements of the latest standard specifications of the “ASTM” for that particular material.
 - 3. Electrical materials used in this work shall be listed by the Underwriters Laboratories, Inc. where testing is provided and shall bear their label.
 - 4. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
 - 5. Where the notation of NEMA is indicated the equipment shall conform to National Electrical Manufacturers Association Standard.
 - 6. The following list of codes, technical societies, trade organizations and governing agencies shall set the standards by which all work shall be executed:
 - a. City Electrical Ordinances
 - b. State Electrical Laws and Statutes
 - c. National Electrical Code (NEC) Current Edition
 - d. National Board of Fire Underwriters (NBFU)
 - e. National Electrical Manufacturers Association (NEMA)
 - f. Underwriters Laboratories (UL)
 - g. Electrical Testing Laboratory (ETL)
 - h. International Building Code (IBC)
 - i. International Fire Code (IFC)
- B. Fees
 - 1. All fees, permits, licenses, etc., necessary in order to complete the work of this section shall be obtained and paid by this Contractor.
- C. Alternate Equipment
 - 1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” do not follow the manufacturer’s names, only such specific items may be used in the base bid, except as hereinafter provided.

2. Items of equipment of the Contractor's choice may be offered as alternates to such specified items, either in the spaces provided for same in the proposal form or if no space is provided, on the bidder's letterhead attached to each copy of the proposal form.
 3. Alternate proposal must be accompanied by full descriptive and technical data for item proposed, together with statement of amount of cost addition or deduction from the base bid if alternate is accepted. Substitutions proposed by the Contractor will not be considered in the award of the contract.
 4. The Contractor must judge that such alternate equipment is of equal quality and character to the specified equipment, and it is physically adaptable for installation within the allotted space with all required service clearances. Unless otherwise specified with this Division, the Engineer will not approve or disapprove any alternate equipment or materials before the bids are opened.
 5. The cost of any changes to other trades as a result of use of the alternate material or equipment must be borne by the Contractor submitting such material or equipment.
- D. Equipment of Substitution:
1. Where items of equipment and materials are specifically identified herein by a single manufacturer's name, or as many as three manufacturer's names, model or catalog numbers, and the words "or equal and approved" follow the manufacturer's name, such items may be substituted until such time that the "Schedule of Materials and Equipment" is submitted to the SDSTA Project Manager. The base bid and any alternate shall be based on materials only as specified or approved

1.05 METHODS OF REQUEST FOR APPROVAL:

- A. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Electrical Contractor to ensure that any price quotations received and submittals made are for products which meet or exceed the specifications included herein.
- B. The Contractor must judge that such items of substitution are of equal quality and character to the specified items and it is physically adaptable for installation within the allotted space with all required service clearances. This includes the following:
 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 2. Will provide the same (or better) warranty for the substitution as for the specified product.
 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner.
 4. Waives claims for additional costs or time extensions which may subsequently become apparent.
 5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities.
- C. The cost of any changes to other trades as a result of use of the substitution material or equipment must be borne by the Contractor submitting such material or equipment.
- D. After the award of the contract, any request for a substitution must be made in writing by the Contractor (not material supplier or Sub-Contractor). Such request shall state the name of the product specified, the name of the product proposed for substitution, the reason for requesting the substitution, and any change in contract amount resulting from the substitution. No such substitution shall be made until an appropriate Contract Modification has been issued and approved.
- E. Manufactured materials hereinafter specified or shown on the Drawings shall be installed or applied in accordance with the directions of the manufacturer unless specifically designated otherwise in the Specifications or on the Drawings.
- F. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

1.06 SUBMITTALS

- A. Submittal of Shop Drawings:
1. Major components of the system shall be submitted at one time under a protective cover with each section indexed with visible file tabs. All equipment shall be labeled per the equipment tags on the drawings, ie. Motor names, fixture types, etc.
 2. Shop drawings shall indicate catalog number, dimensions, voltage and current characteristics, wire sizes, construction and rough-in data of all materials to be used. Each shop drawing shall be certified as being checked and approved by the Contractor before submittal.
 3. Shop drawings not indicated as being approved by the Contractor will be returned without review.
 4. The following wording will appear on shop drawings reviewed by the Engineer. Contractors not wishing to comply with these conditions shall not submit a bid.
"Corrections or comments made on the shop drawings during this review do not relieve Contractor from compliance with requirements of the Drawings and Specifications. This check is only for review of general compliance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades and performing their work in a safe and satisfactory manner."
 5. The Engineer is not an error checker. Where the Contractor is submitting shop drawings that differ from the specifications, the Contractor must itemize in writing, each variance from the specifications. Failure to do so will be considered an error on the Contractors part and the specified materials shall be furnished. Shop drawings submitted in error or with errors as compared to Specifications and Drawings will be the responsibility of the Contractor to correct such error later.
 6. Shop drawings must only be those materials as specified or approved in published addendum. Others will be returned without review.
 7. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.
 8. When revised for resubmission, identify all changes made since previous submission.
 9. Contractor shall also prepare all submittal documents in digital format for posting on a document exchange site such as Submittal Exchange. This shall be provided at not additional cost to the contract.
- B. Guarantee:
1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.
- C. Operating and Maintenance Instructions:
1. One copy of each shop drawing shall be included in the binders but shall not serve in lieu of maintenance and operating instructions.
 2. The Contractor shall submit O&M Manuals to the Engineer, not the owner, for review. The Engineer will forward the manuals to the Owner.
 3. This Contractor shall also supervise the initial operation as required to acquaint him thoroughly with the best practice.
 4. This Contractor shall furnish the Engineer with a written statement from the Owner indicating complete acceptance of the equipment data and instruction of the operator. The Engineer will not approve the request for final payment until such statement has been submitted.
 5. Provide an electronic copy of the above.
- D. Test Reports:

1. Work which is required to be placed within the construction or concealed shall be carefully tested and inspected before being permanently concealed.
2. Tests shall be made in the presence of the SDSTA Project Manager, and shall meet with their approval. The Contractor shall notify the SDSTA Project Manager at a time sufficiently prior to the performance of any test to allow time for the SDSTA Project Manager to be present for the test.
3. The entire system shall be subject to a test at full operating and under normal usage conditions. This shall include voltage and current checks, resistance measurements and equipment operation. Defects in the work or workmanship which appear during these tests shall be properly remedied and a test again applied and continued to a satisfactory conclusion.
4. Electricity or other energy necessary for use in testing and adjusting and or the operation period will be supplied by the Owner.
5. Instruments for making tests shall be furnished by this Contractor.
6. After testing the apparatus, the entire system shall be operated for one week under normal conditions.
7. The final test shall be performed as soon as possible after the work is entirely completed
8. Test reports submitted electronically shall be in standard PDF format or submitted with software to view the file.

1.07 JOB CONDITIONS:

- A. Fees and Service Charges:
 1. Permits, licenses, fees and service charges required in connection with the work shall be secured and paid for by this Contractor, and upon completion of the work he shall furnish proof of acceptance from the proper Local and State Department having jurisdiction.
- B. Electrical Symbols and Abbreviations:
 1. Symbols and abbreviations are as indicated in legends on the Drawings.
- C. Correlation of Work:
 1. This Contractor shall be responsible for close correlation of his work with that of other Contractors and shall organize his work so that it will not interfere with or delay the work of other Contractors.
 2. Field verification of scale dimensions on Plans is directed since actual locations, distances and levels will be governed by actual field conditions.
 3. The Electrical Sub-Contractor shall check architectural, structural, plumbing, heating and ventilating plans to avert possible installation conflicts. Should drastic changes from original Plans be necessary to resolve such conflicts, the Sub-Contractor shall notify the Prime Contractor who in turn shall notify the SDSTA Project Manager and secure written approval and agreement on necessary adjustments before the installation is started.
 4. Discrepancies shown on different Plans, or between Plans and actual field conditions, or between Plans and Specifications, shall promptly be brought to the attention of the SDSTA Project Manager for a decision.
 5. Where a discrepancy exists between drawing and specifications or other disciplines the worst cost case shall be provided.
 6. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate occupancy requirements.
 7. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
 8. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility to other installations, for maintenance, and for repairs.
 9. Coordinate completion and clean-up of work of separate sections.

10. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
- D. Final Inspection:
 1. Upon completion of work, the Contractor shall notify the SDSTA Project Manager in writing and make arrangements for a final observation. The Contractor shall also submit the operating and maintenance manuals at this time. The Engineer will not schedule nor perform a final inspection without successful submittal of operating and maintenance manuals by the Contractor.
 2. During the final observation, pre-final or follow-up final, the Contractor and all his Prime Sub-Contractors shall have the foreman of the project present.
 3. After the final observation is made, the Contractor will receive a list of items requiring adjustment, correction, replacement, or completion.
 4. The Contractor shall comply completely with all the listed requirements within a negotiated number of days of receipt of list. Should the Contractor fail to complete items on the list within this time limit, the Owner reserves the right to have the work completed by others and the cost deducted from the contract price, including change orders.
 5. The Contractor shall notify in writing to the Architect and/or Engineer once all punch list items are corrected, that he is ready for a follow-up final. The written notice shall contain explanations for those known items not completed and a schedule for completing them.
 6. The SDSTA Project Manager shall schedule a follow-up final to confirm completion. Repeated observation trips required of the Engineer by the Contractor's inability to complete the project satisfactorily will require the Contractor to reimburse the Engineer for all incurred costs after the follow-up final observation.

1.08 PROJECT COORDINATION

- A. Project Coordinator: Construction Manager/General Contractor.
- B. This section applies to all work performed and specified under Divisions 26, 27, and 28.
- C. Cooperate with the Construction manager/General Contractor and Owner in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.
- D. During construction, coordinate use of site and facilities through the Construction Manager/General Contractor
- E. Comply with specified procedures for intra-project communications, submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- F. Comply with instructions of the Construction Manager / General Contractor for use of temporary utilities and construction facilities.
- G. Coordinate field engineering and layout work under instructions of the Construction Manager/General Contractor.
- H. Make the following types of submittals to SDSTA Project Manager through the Construction Manager/General Contractor.
 1. Requests for interpretation/information.
 2. Requests for substitution.
 3. Shop drawings, product data and samples.
 4. Test and inspection reports.
 5. Manufacturer's instructions and field reports.
 6. Applications for payment and change order requests.
 7. Progress schedules.
 8. Coordination drawings.
 9. Closeout submittals.
 10. As-built Record Drawings.
 11. Operation and Maintenance Manuals.

1.09 DEFINITIONS

- A. Contractor
 - 1. The term "Contractor" refers to the installation Contractor responsible for the furnishing and installation of all work indicated within this Specification.
- B. Furnish
 - 1. The term "furnish" is used to mean "purchase, supply, provide and deliver to the Project site, protect and provide interim storage and be ready for unloading, unpacking, assembly, installation, and similar operations in accordance with Manufacturer's specifications."
- C. Provide
 - 1. The terms "provide" means to "furnish and install, complete and ready for the intended use."
- D. Install
 - 1. The term "install" is used to describe operations at project site including the actual "unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations".
- E. Installer
 - 1. The "Installer" is the Contractor, Subcontractor and/or supplier who uses their own employees for performance of all construction
- F. If Applicable:
 - 1. The term "if applicable" will be that work which may be required for completed construction at applicable locations, but is not necessarily shown or described in the Contract Documents.
- G. As Necessary
 - 1. The term "as necessary" will be that work which is required for completed construction, but is not necessarily show or described in the Contract Documents.
- H. As Required
 - 1. The term "as required" will be that work which is required for completed construction and is shown on the drawings or described in the project Specification.
- I. Concealed
 - 1. The term "concealed" means hidden from sight, buried as in chases, furred spaces, shafts, fixed ceiling or embedded in construction.
- J. Exposed
 - 1. The term "exposed" means bare, open to the elements, out in the open, uncovered.
- K. Product
 - 1. The term "product" will mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.
- L. Substantial Completion
 - 1. "Substantial Completion" is deemed that the project is sufficiently complete to be utilized for its intended use as stated in the body of this written Specification.
- M. Words in the singular will also mean and include the plural, wherever the context so indicates, and words in the plural will mean the singular, wherever the context so indicates.

1.10 DRAWINGS AND MEASUREMENTS

- A. The extent of the system of equipment, materials, panels, conduits, wire, fixtures and connections as shown are in general diagrammatic and not for exact locations, except in certain cases, the drawings may include details giving exact location and arrangements.
- B. The drawings are not intended to be scaled for roughing in measurements nor to serve as shop drawings.
- C. The Contractor shall consult the architectural, structural, mechanical, or equipment drawings for dimensions, obstructions, and location of equipment or other trades. Any discrepancies

between architectural, structural, mechanical, or equipment drawings and the electrical work shown on these drawings shall be reported to the Engineers for adjustment.

- D. The installation details, instructions, and recommendations of the manufacturer of the product used, or modified to obtain the best end result, shall be the basis of attaining installation of the products for usage on this project except where definite and specific instructions are set forth herein or details are shown on the plans.
- E. Outlet devices, switches, panels, cabinets, fixtures and special equipment are shown on the drawings only in a schematic manner and not necessarily in their specific location. The Contractor shall be responsible for exact locations of the outlets to form a functional and aesthetic installation either by careful review of all architectural elevations, tile patterns, surface finishes, and equipment arrangements or by consultation with the Engineers and other trades involved.
- F. This contractor's bid shall allow a minimum of 10 feet variance in location of each electrical outlet, light fixture, panelboard, motor, appliance, etc. shown on the plans.

1.11 WORKMANSHIP

- A. The installation work included in this specification shall be performed in a neat workmanlike manner by people experienced and skilled in the Electrical trade. Only the best quality workmanship will be accepted. All exposed parts of the electrical wiring systems such as exposed conduits, flush plates, cabinet trim, fixtures, etc., shall be square and true with the building construction.

1.12 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

1.13 EQUIPMENT CLEAN-UP

- A. Special care must be taken for protection of panels, switches, etc. All must be kept completely protected from weather elements, painting, etc. until the building is substantially completed. Damage from rust, paint, scratches, etc. shall be corrected as directed by the A/E.
- B. Clean all light fixtures and lamps thoroughly, just prior to final inspection. Fixture globes, enclosures, shielding, etc. shall be cleaned by an approved method.
- C. Protection of electrical equipment during painting of the building shall be the responsibility of the Painting Contractor. This shall not relieve the Electrical Contractor of the responsibility for checking to assure that adequate protection is being provided.

1.14 SEALING OF PENETRATIONS

- A. All penetrations for raceway, wire, etc. furnished under Division 26, 27, 28 of these specifications which penetrate fire and/or smoke walls and full height partitions (including chase walls), shall be sealed with a UL System specifically approved for the application.

1.15 EXCAVATING, TRENCHING AND BACKFILLING

- A. This Contractor shall perform all excavation to the depths required, indicated on the drawings or specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from trench or other excavations to prevent slides or cave ins. All excavated materials not required or usable for backfilling shall be removed from the site. Necessary grading shall be done to prevent surface water from flowing into trenches or other excavations and onto adjacent property. Furnish all pumping required to keep excavated space clear of water during construction. The A/E will inspect excavation and approve soil conditions and direct procedure if unsatisfactory conditions are discovered. Provide sheeting and shoring as may be necessary for the protection of the work and the safety of personnel. Protect bottom of excavation from frost and do not place structures or pipe on frozen ground.
- B. Except where excavations will be covered by at least 4" of concrete, this contractor shall provide electrical warning tape at least 6" above buried conduit or wire.

- C. Backfill excavations below finished grades with similar materials to that removed in excavation, free from rubbish and other unsuitable material. Backfilling shall be done to finished grades indicated on drawings. If no finished grading is to be done in excavated areas, this Contractor shall backfill to existing grades and restore the surface to its original condition. All backfill shall be compacted in 6 inch lifts to 95% maximum density.
- D. The Contractor shall be responsible for protecting trenches and provided adequate crossovers where pedestrian and vehicular traffic occurs. Guard rails, flags, lamps, etc. shall be used for such protection.
- E. This Contractor shall be responsible for the replacement of existing street pavement, curbs, sidewalks, etc. removed or damaged by him in the course of the work unless such pavement, curbs and sidewalks are to be reconstructed under the General Contract. This Contractor shall make necessary arrangements to perform such repairs and shall pay all costs in connection therewith and include it in his bid.
- F. Prior to any excavation, effort shall be made to determine whether underground installations (i.e., sewer, telephone, water, fuel, electric lines, etc.) will be encountered, and if so, where such underground installations are located. When the excavation approaches the estimated location of such installation, the exact location shall be determined and when it is uncovered, proper supports shall be provided for the existing installation. Utility companies shall be contacted and advised of proposed work prior to the start of actual excavation.

1.16 PROJECT CONDITIONS

- A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water.
- C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
- E. Erosion and Sediment Control: Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
- G. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- H. Verify that demolition is complete in alterations areas and areas are ready for installation of new work.
- I. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- J. Verify that utility services are available, of these of the correct characteristics, and in the correct location.
- K. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions. Protect work of other trades.

1.17 PREPARATION

- A. Cut, move, or remove items as necessary for access to alterations and renovation work. Replace and restore at completion.
- B. Remove unsuitable materials not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for furnished work.
- C. Remove debris and abandoned items from area and from concealed spaces.
- D. Close openings in exterior surfaces to protect existing work and salvage items from weather and extremes of temperature and humidity. Insulate ducts and piping to prevent condensation in exposed areas.
- E. Prepare surfaces and remove surface finishes to provide for proper installation of new work and finishes.
- F. Clean substrate surfaces prior to applying next materials or substance.
- G. Seal cracks or openings of substrate prior to applying next material or substance.
- H. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

1.18 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections.
- B. Make neat transitions. Patch work to match adjacent work in texture and appearance.
- C. All ceiling mounted devices (i.e. smoke detectors, speakers, light fixtures, etc.) shall be installed centered in ceiling tiles (unless otherwise noted). Coordinate with ceiling installer.

1.19 EXISTING UTILITIES

- A. The plans indicate as accurately as possible the location, type and sizes of existing underground utilities at the site. It is the Contractor's responsibility to have all utilities located prior to starting work. Contractor shall contact appropriate utility company and One Call for locating utilities prior to commencement of any work. The Owner also has underground conduit and other systems in place. Contractor shall contact the Owner prior to excavation in any area to determine any items that may be impacted by excavation.
- B. This Contractor shall protect all utilities and Owner items affected by his work, and shall repair any damage caused by his forces at no additional cost to the Owner.
- C. The Owner and the Owners' of all underground facilities shall be notified at least 5 business days prior to excavation.

1.20 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect/Engineer of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly notify Architect/Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and layout by instrumentation and similar appropriate means.
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.

- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

1.21 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition per OSHA standards.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.

1.22 PROTECTION OF INSTALLED WORK

- A. Protect installed work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.
- C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- D. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- E. Prohibit traffic from landscaped area.

1.23 DEMONSTRATION AND INSTRUCTION

- A. Contractor shall complete all start-up and perform all initial testing of each system prior to scheduling or requesting to schedule training. All systems shall be completely operational before training or demonstration will occur.
- B. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.
- C. Demonstrate operation and maintenance of Products to Owner's representative at a scheduled time with the Owner.
- D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner Personnel.
- F. Utilize operation and maintenance manuals as basis for instruction. Review contents of manuals with Owner's personnel in detail to explain all aspects of operation and maintenance.

1.24 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.25 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.

- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Record information concurrent with construction progress.
- D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Changes made by Addenda and modifications.
- E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 2. Field changes of dimension and detail.
 - 3. Details not on original Contract Documents.
- F. At completion of project Contractor shall provide a minimum of two (2) sets of As-Built Record drawings. Additional sets shall be provided if required under General Requirements.

1.26 WARRANTY AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Sub-Contractors, suppliers and manufacturers, within ten days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.
- F. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Sub-Contractor, Supplier, and Manufacturer, with name address, and telephone number of responsible principal.

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Oxide inhibiting compound.
- F. Wire pulling lubricant.
- G. Cable ties.

1.02 RELATED REQUIREMENTS

- A. Section 26 0505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- B. Section 26 0513 - Medium-Voltage Cables: Cables and terminations for systems 601 V through 35,000 V.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.
- F. Section 28 4600 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011 (Reapproved 2017).
- C. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
- D. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2015).
- E. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation; 2016.
- F. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- H. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable; 2012.
- I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2009.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- M. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

- N. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- P. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Furnish products listed and classified by Underwriters Laboratories inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.
- H. VFD cable - provide for all motors with VFD's.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

G. Conductor Material:

1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
 - a. Substitution of aluminum conductors for copper is permitted only for the following:
 - 1) Services: Copper conductors size 1/0 AWG and larger.
 - 2) Feeders: Copper conductors size 1/0 AWG and larger.
 - 3) Where aluminum conductors are substituted for copper, comply with the following:
 - (a) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
 - (b) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
 - (c) Provide aluminum equipment grounding conductor sized according to NFPA 70.
 - (d) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
3. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

H. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet (46 m): 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet (46 m): 10 AWG, for voltage drop.
 - 4) Feeders conductors shall be sized for a maximum voltage drop of 3% at design load.
 - 5) Branch circuit conductors shall be sized for a maximum voltage drop of 5% at design load.
 - 6) This contractor shall derated conductor ampacity in areas of high ambient temperature per the NEC.
 - 7) Provide a separate neutral for each phase wire - NO SHARED NEUTRALS. This applies to single phase circuits only.
 - 8) Provide additional derating per NEC tables 310-16 through 310-31 note 8 for all home runs with more than 3 current carrying conductors in a raceway.
2. Control Circuits: 14 AWG.

I. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:

- 1) Phase A: Black.
- 2) Phase B: Red.
- 3) Phase C: Blue.
- 4) Neutral/Grounded: White.
- c. Equipment Ground, All Systems: Green.
- d. Travelers for 3-Way and 4-Way Switching: Pink.
- e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
- f. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
 2. Control Circuits: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation:
 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

2.04 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Wiring Connectors for Splices and Taps:
 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
 3. Connectors for Aluminum Conductors: Use compression connectors.
- C. Wiring Connectors for Terminations:
 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 6. Aluminum Conductors: Use compression connectors for all connections.
 7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
 8. Conductors for Control Circuits: Use crimped terminals for all connections.
- D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

- F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- G. Mechanical Connectors: Provide bolted type or set-screw type.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.
- I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 - 1. For the connection to any of the following: utility transformer, exterior transformer, transition cabinet, or padmount transformer, provide long barrel, 2 hole NEMA spaced, tin plated copper compression connectors with hot dipped galvanized or stainless steel hardware consisting of 1/2 inch bolts, washers, lock washers, and nuts.
 - 2. Engineer to witness installation - schedule accordingly. With engineer approval photographs may be provided in lieu of engineer oversight. Coordinate required photos with engineer.

2.05 WIRING ACCESSORIES

- A. Electrical Tape:
 - 1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
 - 2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
 - 3. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil (2.3 mm).
- B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
 - 1. Provide for ALL aluminum conductor terminations, splices, etc.
- C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
- D. All permanent splices shall be made with compression type connectors. Split bolts shall not be permitted except for temporary wiring.
- E. Solderless Pressure Connectors:
 - 1. Scotch lok brand not acceptable.
- F. Splices and taps shall be approved by owner & engineer prior to installation. When allowed for conductor sizes No. 6 and larger splicing shall be compression with heat shrink insulation.
- G. Where a circuit passes through an outlet box and is tapped, all leads should be pigtailed out to the wiring device, including the equipment ground wire. This prevents loss of neutral or ground during maintenance work.
- H. All underground splices shall be waterproof/watertight.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.

- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

- A. Circuiting Requirements:
1. Unless dimensioned, circuit routing indicated is diagrammatic.
 2. When circuit destination is indicated without specific routing, determine exact routing required.
 3. Arrange circuiting to minimize splices.
 4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location indicated.
 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install aluminum conductors in accordance with NECA 104.
- E. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- H. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.

- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- K. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
 - 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- M. Insulate ends of spare conductors using vinyl insulating electrical tape.
- N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- O. Identify conductors and cables in accordance with Section 26 0553.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 26 0010.
- Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
- R. Route wire and cable as required to meet project conditions.
 - 1. Wire and cable routing indicated is approximate unless dimensioned.
 - 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
 - 3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.
- S. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

3.04 FIELD QUALITY CONTROL

- A. See Section 26 0010 - General Provisions, for additional requirements.
- B. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.
- F. Ground enhancement material.
- G. Pre-fabricated signal reference grids.
- H. Grounding and bonding components, including grounding electrodes and conductors, equipment grounding conductors, and bonding to complete grounding system consisting of:
 - 1. Metal underground water pipe electrode.
 - 2. Metal underground water pipe.
 - 3. Metal frame of building
 - 4. Rod electrodes.
 - 5. Concrete-encased electrode
 - 6. New concrete-encased electrode (UFER ground)
 - a. Existing metal underground gas piping system.
 - b. Metal underground gas piping system.
 - c. Existing rod electrodes.
 - d. New active electrodes.

1.02 RELATED REQUIREMENTS

- A. Section 09 6500 - Resilient Flooring: Static control flooring.
- B. Section 09 6900 - Access Flooring.
- C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
 - 1. Includes oxide inhibiting compound.
- D. Section 26 0536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 3100 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.
- G. Section 26 4113 - Lightning Protection for Structures.
- H. Section 26 5600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.
- I. Section 264200 - Cathodic Protection
- J. Section 131100 - Swimming Pools.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.

- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 99 - Health Care Facilities Code; 2018.
- F. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2017.
- G. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 PERFORMANCE REQUIREMENTS

- A. Grounding system Resistance: 5 ohms maximum.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. For signal reference grids, coordinate the work with access flooring furnished in accordance with Section 09 6900.
 - 4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.06 SUBMITTALS

- A. See Section 01 3300 - Submittal Procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Shop Drawings:
 - 1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Field quality control test reports.
- F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- F. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- G. Electrical System, Lighting, Lighting Controls, Voice/Data Cabling, Sound Reinforcement Systems, Television System, Wireless GPS Clock System, Video Surveillance System and Fire

Alarm System will require commissioning. Refer to specifications section 260800 regarding requirements for commissioning.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. The State of Wyoming requires concrete-encased electrode grounding on all new buildings (Ufer Ground). Concrete-Encased Electrode: Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not smaller than #4AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70. Field coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
- F. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- G. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5 m) from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
 - 3. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
 - 4. Concrete-Encased Electrode:

- a. Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Ground Ring:
 - a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches (750 mm).
 - b. Where location is not indicated, locate ground ring conductor at least 24 inches (600 mm) outside building perimeter foundation.
 - c. Provide ground enhancement material around conductor where indicated.
 - d. Provide connection from ground ring conductor to:
 - 1) Perimeter columns of metal building frame.
 - 2) Ground rod electrodes located as indicated.
 - e. Where a pad mounted transformer is installed, the ground network shall consist of a loop ground rods, as indicated on the drawings around the transformer pad, and interconnect with #3/0 bare copper conductor. Extend separate ground conductors to the primary and secondary side of the transformer. All ground connections below grade shall be of the exothermic weld type. Ground all conduits in the transformer enclosure using grounding bushings. Ground stress cones, lightning arrestors, transformer housings, and all non current carrying metal parts to the ground network. Provide a grounding jumper, provided by the manufacturer, between the grounding network and the transformer neutral.
6. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet (3.0 m) from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet (1.5 m) outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - d. Provide ground enhancement material around electrode where indicated.
7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
8. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.
9. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
- H. Service-Supplied System Grounding:
 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

- I. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
 - 1. Provide grounding electrode system for each separate building or structure.
 - 2. Provide equipment grounding conductor routed with supply conductors.
 - 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 - 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- J. Separately Derived System Grounding:
 - 1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 - b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
 - c. Generators, when neutral is switched in the transfer switch.
 - 2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
 - 3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
 - 4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
 - 5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
- K. Bonding and Equipment Grounding:
 - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 - 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 - 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 - 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 - 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
 - c. Metal process piping.
 - 8. Provide bonding for interior metal air ducts.
 - 9. Provide bonding for metal building frame.
 - 10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.
- L. Isolated Ground System:
 1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
 2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
 3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.
- M. Communications Systems Grounding and Bonding:
 1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch (21 mm) trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
 - d. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.
- N. Signal Reference Grids:
 1. Provide signal reference grid on subfloor under access floors where indicated.
 2. Construct grid using field-welded sections of pre-fabricated signal reference grids.
 3. Unless otherwise indicated, locate grid between 6 and 18 inches (150 and 450 mm) from perimeter walls.
 4. Unless otherwise indicated, make bonding connections to signal reference grid using exothermic welded connections.
 5. Make bonding connections as short as possible, with no sharp folds or bends.
 6. Unless otherwise indicated, provide separate bonding connections from signal reference grid to each item to be bonded. Do not daisy chain items together to facilitate single point connection to signal reference grid.
 7. Provide 6 AWG bonding jumper to connect every sixth access floor pedestal in each direction to signal reference grid. Make connections to floor pedestals using exothermic welded connections.
 8. Provide 6 AWG bonding jumper to connect each steel column within and at the perimeter of room to signal reference grid. Make connections to steel columns using exothermic welded connections.
 9. Provide 6 AWG bonding jumper to connect each metal item such as conduits, pipes, ducts, etc. crossing the plane of, or within 6 feet (1.8 m) of, the signal reference grid. Make connections to conduits and pipes using listed ground clamps.
 10. Provide 6 AWG bonding jumper to connect signal reference grid to grounding point of separately derived systems serving equipment located on the signal reference grid.
 11. Provide low impedance risers to connect each equipment enclosure to signal reference grid. For each piece of equipment, provide two separate connections of different lengths connected to opposite sides of equipment and to different points on the signal reference grid. Make connections to equipment enclosures using mechanical connectors. Do not make connection to signal reference grid on the outermost grid conductor.

12. Provide transient suppression plates on floor beneath items indicated. Provide 6 AWG bonding jumper to connect transient suppression plate to signal reference grid.
 - a. Transient Suppression Plates: Constructed from 26 gauge sheet copper, 4 by 4 feet (1.2 by 1.2 m) unless otherwise indicated.
- O. Lightning Protection Systems, in Addition to Requirements of Section 26 4113:
 1. Do not use grounding electrode dedicated for lightning protection system for component of building grounding electrode system provided under this section.
 2. Provide bonding of building grounding electrode system provided under this section and lightning protection grounding electrode system in accordance with NFPA 70 and NFPA 780.
- P. Cable Tray Systems: Also comply with Section 26 0536.
- Q. Photovoltaic Systems: Also comply with Section 26 3100.
- R. Pole-Mounted Luminaires: Also comply with Section 26 5600.
- S. Static Control Flooring: Provide bonding of static control flooring provided in accordance with Section 09 6500.

2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
 2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.
- C. Connectors for Grounding and Bonding:
 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 - a. Exceptions:
 - 1) Use mechanical connectors for connections to electrodes at ground access wells.
 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 - a. Exceptions:
 - 1) Use exothermic welded connections for connections to metal building frame.
- D. Ground Bars:
 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
 2. Size: As indicated.
 3. Holes for Connections: As indicated or as required for connections to be made.
- E. Ground Rod Electrodes:
 1. Comply with NEMA GR 1.
 2. Material: Copper-bonded (copper-clad) steel.
 3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.
- F. Ground Enhancement Material:

1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
- G. Pre-Fabricated Signal Reference Grids:
 1. Description: Factory pre-fabricated grid manufactured from 2 inch wide (50 mm wide), 26 gauge, flat copper strips spaced on 24 inch (610 mm) centers, factory-welded at each crossover.
 2. Low Impedance Risers: Factory fabricated 2 inch wide (50 mm wide), 26 gauge, flat copper strips designed for connecting equipment enclosures to pre-fabricated signal reference grid.
- H. Oxide Inhibiting Compound: Comply with Section 26 0519.
- I. Motor grounding
 1. Provide field installed shaft grounding for all motors served by VFD's.
 2. Provide Aegis SGR or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify existing conditions prior to beginning work.
- E. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches (150 mm) below finished grade.
 2. Indoor Installations: Unless otherwise indicated, install with 4 inches (100 mm) of top of rod exposed.
 3. Engineer must be able to inspect installation prior to grounding being covered up or pictures must be provided of each component of the installation prior to covering up.
- D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches (750 mm).
- E. Make grounding and bonding connections using specified connectors.
 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- F. Identify grounding and bonding system components in accordance with Section 26 0553.

- G. Bond together each metallic raceway (2" and larger) , pipe, duct and other metal object entering equipment enclosures. Use 2 AWG bare copper conductor per NEC.
- H. General: Install electrical grounding systems where shown, in accordance with applicable portions of NEC, with NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.
 - 1. Neutral conductors, cable shields, metallic conduits, cable terminations, junction boxes, and other non-current-carrying metallic parts of equipment shall be grounded.
 - 2. Equipment frames of metal-enclosed equipment, medium-voltage cable shields at cable joints and terminations, metal splice boxes, and other non-current-carrying metal items, shall be grounded unless otherwise indicated. Connections to earth shall be made in the same manner as required for neutral grounding. Equipment operating at more than 750 volts to ground shall be provided with grounds separate from secondary neutral grounds.
 - 3. Coordinate with other electrical work as necessary to interface installation of electrical grounding system with other work.
 - 4. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.
- I. Equipotential Ground Plane: Bond concrete floor reinforcement and all exposed metal parts per NEC 547.10.
- J. Provide electrical service and distribution grounding system as indicated in drawings and outlined in this specification and as required by NEC.
- K. Install ground electrodes at locations as required. Install additional rod electrodes as required to achieve specified resistance to ground.
- L. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing.
- M. Provide bonding to meet requirements described in Quality Assurance.
- N. Bond the pool and pool area as outlined in 2005 NEC 680.26.
- O. Provide sacrificial anode system as outlined in Specification section 26 4200.
- P. Install ground grid under access floors where indicated. Construct grid of #2 AWG bare copper wire installed on 24 inch centers both ways. Bond each access floor pedestal to grid.
- Q. A new electrical service and distribution will be provided as part of this project. Contractor to not only provide new grounding system as indicated on drawings but Contractor to also provide bonding of existing grounding system to new grounding system. Contractor to ensure all items requiring bonding by NEC, including existing and new, shall be properly bonded.
- R. Provide isolated grounding conductors for circuits supplying isolated ground receptacles(computer receptacles).
- S. Where new isolated ground conductors are shown to be added to existing feeders to remain, isolated ground conductor may be routed on the exterior of the existing conduit. Provide bushed openings where IG conductor penetrates equipment enclosures.
- T. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit. Terminate each end on suitable lug, bus, or bushing.
- U. Equipment Grounding Conductor: Provide separate, insulated copper equipment grounding conductor in all of the following runs listed below. Terminate each end on suitable lug, bus, or bushing. Where ground conductors are specified or required, conduit sizes shall be increased as necessary to meet the NEC conduit fill requirements.
 - 1. All new feeders.
 - 2. All new feeders run in existing raceways.
 - 3. All raceways for receptacle circuits, including special power receptacles.
 - 4. All surface raceways and multi-outlet assemblies containing power receptacle devices (i.e. Wiremold).
 - 5. All feeds to light fixtures.

- 6. All motor feeders and branch circuits.
- 7. All flexible metal conduit.
- 8. All non-metallic raceways containing power conductors.
- V. Terminate each end of equipment ground conductors in an approved lug or bus or bushing.
- W. In general, equipment ground conductors are not indicated on the plans. Where ground conductors are required, conduit sizes shall be increased as required to comply with NEC conduit fill requirements.
- X. Where a pad mounted transformer is installed, the ground network shall consist of four (4) ground rods, one at each corner of the transformer pad, and interconnect with #1/0 bare copper conductor. Extend separate ground conductors to the primary and secondary side of the transformer. All ground connections below grade shall be of the exothermic weld type. Ground all conduits in the transformer enclosure using grounding bushings. Ground stress cones, lightning arrestors, transformer housings, and all non current carrying metal parts to the ground network. Provide a grounding jumper, provided by the manufacturer, between the grounding network and the transformer neutral.
- Y. Interface with lightning protection system installed under Section 26 4115.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4500.10 - Quality Control Progress Schedules, for additional requirements.
- B. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- C. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.
- B. Conduit and equipment supports.
- C. Anchors and fasteners.
- D. For communication cabling, see also specific sections.

1.02 RELATED REQUIREMENTS

- A. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- B. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- C. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- D. Section 26 5600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 25%. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Steel Spring Clips:
 - 1. Product: Caddy or equivalent.
 - 2. Use only in concealed locations (i.e. above ceilings, within walls, etc.)
- D. Supports: Fabricated of structural steel or formed steel members; galvanized or painted, as required.
- E. Roof conduit supports: Provide approved conduit supports on roof – equal to Caddy pyramid or Cooper durablock.
- F. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- G. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 - 1. Comply with MFMA-4.
 - 2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
 - 3. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
 - 5. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
 - 6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Thomas & Betts Corporation: www.tnb.com.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
- H. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
 - 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch (13 mm) diameter.
 - b. Busway Supports: 1/2 inch (13 mm) diameter.
 - c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch (6 mm) diameter.
 - d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch (10 mm) diameter.

- e. Trapeze Support for Multiple Conduits: 3/8 inch (10 mm) diameter.
- f. Outlet Boxes: 1/4 inch (6 mm) diameter.
- g. Luminaires: 1/4 inch (6 mm) diameter.
- I. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 4. Hollow Masonry: Use toggle bolts.
 - 5. Hollow Stud Walls: Use toggle bolts.
 - 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 - 7. Sheet Metal: Use sheet metal screws.
 - 8. Wood: Use wood screws.
 - 9. Plastic and lead anchors are not permitted.
 - 10. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
 - 1. Do not drill or cut structural members, unless specifically approved in writing by Structural Engineer.
- D. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- E. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- F. In wet and damp locations, use steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
- G. All supports shall be securely positioned to the structure, not equipment or ceiling tile supports. Coordinate structure load capabilities with General Contractor.
- H. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- I. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- J. Unless specifically indicated or approved by Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- K. Unless specifically indicated or approved by Engineer, do not provide support from roof deck.
- L. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- M. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

- 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- N. Conduit Support and Attachment: Also comply with Section 26 0533.13.
- O. Box Support and Attachment: Also comply with Section 26 0533.16.
- P. Interior Luminaire Support and Attachment: Also comply with Section 26 5100.
- Q. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- R. Secure fasteners according to manufacturer's recommended torque settings.
- S. Remove temporary supports.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 4500.10 - Quality Control for Construction, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 26 0533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Intermediate metal conduit (IMC).
- C. PVC-coated galvanized steel rigid metal conduit (RMC).
- D. Flexible metal conduit (FMC).
- E. Liquidtight flexible metal conduit (LFMC).
- F. Electrical metallic tubing (EMT).
- G. Rigid polyvinyl chloride (PVC) conduit.
- H. Conduit fittings.
- I. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 07 8400 - Firestopping.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- D. Section 26 0529 - Hangers and Supports for Electrical Systems.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- G. Section 27 1000 - Structured Cabling: Additional requirements for communications systems conduits.
- H. Section 31 2316 - Excavation.
- I. Section 31 2323 - Fill: Bedding and backfilling.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2015.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2015.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- F. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; 2004.
- G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2018.
- J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
- K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2016.

- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- N. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- O. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.
- P. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- Q. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- R. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- S. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- T. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

- A. There are no shop drawing submittals required for this section.
- B. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches (51 mm).

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.
- B. Protect PVC conduit from sunlight.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the

most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

- C. Underground:
 - 1. Under Slab on Grade: Use thinwall non-metallic conduit.
 - 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
 - 3. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
 - 4. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
 - 5. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches (100 mm) on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
 - 6. Through floor risers shall be rigid metal conduit.
 - 7. Ductbanks (electrical or telecom): schedule 40 PVC. Electric shall be concrete encased.
 - 8. Lightning protection down leads & individual ground conductors: schedule 40 PVC.
 - 9. Minimum Size: 3/4 inch (19 mm).
- D. Embedded Within Concrete:
 - 1. Within Slab on Grade: Not permitted.
- E. Concealed Within Masonry Walls: Use electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
 - 1. Liquid tight conduit with liquid tight fittings shall be used in pump rooms, kitchens, wells, sump pits, transformer connections, and other areas of moisture content
- I. Exposed, Interior, Not Subject to Physical Damage: Use electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.
 - b. Where exposed below 20 feet (6.1 m) in warehouse areas.
- K. Exposed, Exterior: Use galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit.
- L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit.
- M. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
 - 1. Maximum Length: 6 feet (1.8 m).
- N. Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit.
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 - 3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
- O. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

2.02 CONDUIT REQUIREMENTS

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
- B. Electrical Service Conduits: Also comply with Section 26 2100.
- C. Communications Systems Conduits: Also comply with Section 27 1000.
- D. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- E. Provide products listed, classified, and labeled as suitable for the purpose intended.
- F. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 1/2 inch (16 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
 - 3. Minimum Size: data/voice conduits - see voice & data system specification.
- G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers: Republic Steel Company, Youngstown, Triangle, Allied, Wheatland, or approved equivalent.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.
 - 4. All connectors shall have insulated throats.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

- A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers: Allied, Robroy Industries or approved equivalent.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil (1.02 mm).
- D. PVC-Coated Fittings:
 - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 - 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - 4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil (1.02 mm).

- E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil (0.38 mm).

2.06 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 - 1. AFC, Electri-flex, International Metal Hose.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 - 3. All connectors shall have insulated throats.

2.07 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers: Anaconda, Liquatite, or Electri-Flex or approved equivalent.
 - 1. AFC, Electri-flex, International Metal Hose.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 - 3. All connectors shall have insulated throats.

2.08 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. AFC, Electri-flex, International Metal Hose.
- B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 - 3. Connectors and Couplings: Use compression (gland) or set-screw type.
 - a. Do not use indenter type connectors and couplings.
 - 4. All connectors shall have insulated throats.

2.09 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 - 1. Cantex Inc: www.cantexinc.com/#sle.
 - 2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
 - 3. JM Eagle: www.jmeagle.com/#sle.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.

2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

D. Provide equipment grounding conductor. Adjust conduit size accordingly.

2.10 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil (0.51 mm).
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force (890 N).
- E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
- F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.
 1. Provide sealed fittings in conduits transitioning from conditioned areas to non-conditioned areas.
 2. Seal conduits that route from inside to outside building.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify routing and termination locations of conduit prior to rough-in.
- E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

- A. At contractor's option, existing conduit in remodeled areas may be reused for new branch circuits and feeders where practical, and as noted on the plans. Existing conduits shall meet all requirements for new conduit as specified herein, and shall be warranted as new by the contractor.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- E. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.
- F. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- G. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
- H. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- I. Install nonmetallic conduit in accordance with manufacturer's instructions.
 1. For all nonmetallic conduit runs 2 inch trade size and larger, all sweeps shall be of galvanized rigid construction. If sweeps are underground, sweeps shall be PVC coated.
- J. Cut conduit square using saw or pipecutter; de-burr cut ends.
- K. Bring conduit to shoulder of fittings; fasten securely.

- L. 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 20 minutes, minimum.
- M. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations.
- N. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate bends in metal conduit larger than 2 inch (50 mm) size. Runs that require more than three 90 degree bends shall be brought to the attention of the Engineer.
- O. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- P. Provide suitable pull string in each empty conduit except sleeves and nipples.
- Q. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- R. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conceal all conduits unless specifically indicated to be exposed.
 - 4. Unless otherwise approved, do not route conduits exposed:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
 - 5. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 6. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 7. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
 - 8. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
 - 9. Route conduits above water and drain piping where possible.
 - 10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 11. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
 - 12. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
 - 13. Group parallel conduits in the same area together on a common rack.
 - 14. Service conduits for basement gear (below grade) shall enter the building outside the footprint of the gear, shall be routed with conduits sloping up from the transformer, and shall have a pull box with weep holes located outside gear footprint. Bottom entry is not acceptable.
 - 15. Provide 1/2" (minimum) conduits at each door frame opening that is to receive electrified hardware extending from each component in the frame and its' associated power supply (Refer to Section 08710) to a junction box located approximately 18" above the ceiling line at the affected door openings.
 - 16. Conduit shall be installed as high as possible & up in joist space as tight to structure or deck as NEC allows. Verify with architect, engineer, & other trades for mounting height and routing of conduits prior to installation.

17. Route exposed conduit parallel and perpendicular to walls.
 18. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
 19. Route conduit under slab, and underground from point-to-point.
 20. No conduit shall be run within concrete slabs unless specifically noted otherwise.
 21. Maintain adequate clearance between conduit and piping.
 22. Maintain 12 inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
- S. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 6. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
 7. Use of spring steel conduit clips for support of conduits is not permitted.
 8. Use of wire for support of conduits is not permitted.
 9. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
 10. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
 11. Arrange supports to prevent misalignment during wiring installation.
 12. Group related conduits; support using conduit rack. Construct rack using steel channel ; provide space on each for 25 percent additional conduits.
- T. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
 7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- U. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.

4. Conceal bends for conduit risers emerging above ground.
 5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
 - a. Sealing shall be rubber boot system. Caulking around opening only is not acceptable.
 8. Provide metal escutcheon plates for conduit penetrations exposed to public view.
 9. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400
 10. Where conduits pass through exterior walls or roofs, Contractor shall seal penetrations with materials outlined in Section 07 9200.
 11. Where conduits pass through smoke or fire rated walls Contractor shall seal penetrations with appropriate smoke and/or fire rated materials as outlined in Section 078400 and/or Section 26 0050.
 12. Biocontainment areas: All conduits, raceways, etc. that penetrate the biocontainment barriers shall be silicone sealed (or similar) on both the inside and the outside of the penetration to minimize air leakage.
- V. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 31 2316 and Section 31 2323.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches (610 mm).
 - b. Under Slab on Grade: 12 inches (300 mm) to bottom of slab.
 3. Provide underground warning tape in accordance with Section 26 0553 along entire conduit length for service entrance where not concrete-encased.
- W. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Secure conduits to prevent floating or movement during pouring of concrete.
- X. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 3000 with minimum concrete cover of 3 inches (76 mm) on all sides unless otherwise indicated.
- Y. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.
- Z. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where conduits are subject to earth movement by settlement or frost.
- AA. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
 3. Where conduits penetrate coolers or freezers.

- AB. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.
- AC. Provide grounding and bonding in accordance with Section 26 0526.
- AD. Identify conduits in accordance with Section 26 0553.
- AE. All conduits to cable trays shall be bonded to the cable tray.
- AF. Provide conduit seals where raceway enters the building from underground. Seal in accordance with NEC requirements.
- AG. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
- AH. Provide grounding bushings on all conduits 2" and larger.
- AI. Flexible metal conduit shall not be used in lengths longer than six feet.
- AJ. Telecommunications conduit & cable tray shall not be over 300' in total distance from jack to rack. Provide report listing outlets over the 300' distance prior to pulling cable & ceiling installation.

3.03 FIELD QUALITY CONTROL

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

3.06 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 26 0050.
- B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation

END OF SECTION

SECTION 26 0533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).
- C. Wall and ceiling outlet boxes.
- D. Pull and junction boxes.

1.02 RELATED REQUIREMENTS

- A. Section 08 3100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0533.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 2726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.
 - 3. Poke-through assemblies.
 - 4. Access floor boxes.
 - 5. Additional requirements for locating boxes for wiring devices.
- G. Section 27 1000 - Structured Cabling: Additional requirements for communications systems outlet boxes.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. SCTE 77 - Specification for Underground Enclosure Integrity; 2017.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 508A - Industrial Control Panels; 2013.
- J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- K. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to preserve insulation integrity.
 - 7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
 - 8. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 26 0010 - General Provisions, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
- C. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
 - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 - 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
 - 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 - 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 - 3. Use suitable concrete type boxes where flush-mounted in concrete.
 - 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
 - 5. Use raised covers suitable for the type of wall construction and device configuration where required.
 - 6. Use shallow boxes where required by the type of wall construction.
 - 7. Do not use "through-wall" boxes designed for access from both sides of wall.

8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
9. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
10. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
11. Wall Plates: Comply with Section 26 2726.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
- D. Boxes for Biocontainment areas: All boxes used within or on perimeter of the biocontainment barriers shall be a cast type such as watertight. There shall be no opening to eliminate air leakage.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
 2. Unless dimensioned, box locations indicated are approximate.
 - a. Adjust box locations up to 10 feet (3m) if required to accommodate intended purpose without adjustment in contract amount.
 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
 - b. Communications Systems Outlets: Comply with Section 27 1000.
 - c. For equipment connected under Section 26 2717.
 4. Locate boxes so that wall plates do not span different building finishes.
 5. Locate boxes so that wall plates do not cross masonry joints.
 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.

7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) horizontal separation.
9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches (0.0103 sq m) or such that the total aggregate area of openings exceeds 100 square inches (0.0645 sq m) for any 100 square feet (9.29 sq m) of wall area.
10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
12. Install in locations as shown on Drawings and approved by owner, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA70.
13. Set wall mounted boxes at elevations to accommodate mounting heights as indicated.
14. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
15. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
16. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- I. Box Supports:
 1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.
- L. Install boxes as required to preserve insulation integrity.
- M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

- N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- O. Close unused box openings.
- P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- Q. Provide grounding and bonding in accordance with Section 26 0526.
- R. Identify boxes in accordance with Section 26 0553.
- S. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.
- T. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- U. Set floor boxes level.

3.03 ADJUSTING

- A. Adjust floor boxes flush with finish flooring material.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. install knockout closures in unused box openings.

3.04 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.05 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.
- B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Warning signs and labels.
- E. Field-painted identification of conduit.

1.02 RELATED REQUIREMENTS

- A. Section 09 9113 - Exterior Painting.
- B. Section 09 9123 - Interior Painting.
- C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 26 0534 - Conduit
- E. Section 26 0536 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
- F. Section 26 0573 - Power System Studies: Arc flash hazard warning labels.
- G. Section 26 2200 - Low Voltage Transformers
- H. Section 26 2300 - Low-Voltage Switchgear: Factory-installed mimic bus.
- I. Section 26 2413 Switchboards
- J. Section 26 2416 Panelboards
- K. Section 26 2419 Motor Control Centers
- L. Section 26 2717 Equipment Wiring
- M. Section 26 2726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
- N. Section 26 2817 - Enclosed Circuit Breakers
- O. Section 26 2818 Enclosed Switches
- P. Section 26 2913 - Enclosed Controllers
- Q. Section 27 1000 - Structured Cabling: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2018.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.05 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Switchgear:
 - 1) Identify power source and circuit number. Include location when not within sight of equipment.
 - 2) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Switchboards:
 - 1) Identify power source and circuit number. Include location when not within sight of equipment.
 - 2) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - c. Panelboards:
 - 1) Identify power source and circuit number. Include location when not within sight of equipment.
 - 2) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 3) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - d. Transformers:
 - 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify load(s) served. Include location when not within sight of equipment.
 - e. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - f. Enclosed Contactors:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
 - 4) Identify load(s) and associated circuits controlled. Include location.
 - 2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
 - c. Use identification label at each piece of service equipment to identify the available fault current and the date calculations were performed.
 - 3. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
 - 4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.

5. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
 6. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70, including but not limited to the following.
 - a. Service equipment.
 - b. Industrial control panels.
 - c. Motor control centers.
 - d. Elevator control panels.
 - e. Industrial machinery.
 7. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 4 by 4 inches (____ by ____ mm).
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
 - c. Service Equipment: Include the following information in accordance with NFPA 70.
 - 1) Nominal system voltage.
 - 2) Available fault current.
 - 3) Arc Flash Label - clearing time of overcurrent protective device option not allowed.
 - 4) Date label applied.
 8. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
 2. Identification for Communications Conductors and Cables: Comply with Section 27 1000.
 3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
- C. Identification for Cable Tray: Comply with Section 26 0536.
- D. Identification for Boxes:
1. Use voltage markers or color coded boxes to identify systems other than normal power system.
 - a. Color-Coded Boxes: Field-painted in accordance with Section 09 9123 and 09 9113 per the same color code used for raceways.
 - 1) Emergency Power System: Yellow.
 - (a) Life Safety Branch: LS hand written along with circuit and panel numbers..
 - (b) Critical Branch: C hand written along with circuit and panel numbers..
 - (c) Equipment Branch: E hand written along with circuit and panel numbers..
 - 2) Fire Alarm System: Red.
 - 3) Telecommunications System: Brown.
 - 4) Building Automation System: Blue
 - 5) Sound Systems: Gold
 - 6) Primary Distribution System: Gray
 - 7) 480/277 Volt System: Orange
 - 8) 208/120 Volt System: White

- b. For exposed boxes in public areas, do not color code.
- 2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed. Boxes containing sound, fire alarm, voice, intercom, clock system, data, etc. shall be labeled as such.
 - a. For exposed boxes in public areas, use only identification labels.
- E. Identification for Devices:
 - 1. Identification for Communications Devices: Comply with Section 27 1000.
 - 2. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
 - 3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
 - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
 - 4. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 - 1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 - 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
 - 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
 - 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
 - 5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.
- B. Identification Labels:
 - 1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
 - 1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
 - 2. Legend:
 - a. System designation where applicable:
 - 1) Fire Alarm System: Identify with text "FIRE ALARM".
 - b. Equipment designation or other approved description.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height:
 - a. System Designation: 1 inch (25 mm).
 - b. Equipment Designation: 1/2 inch (13 mm).
 - 5. Color:
 - a. Normal Power System: White text on black background.
 - b. Emergency Power System: White text on red background.

2.03 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:

1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
 3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.
- C. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.
- B. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 1. Surface-Mounted Equipment: Enclosure front.
 2. Flush-Mounted Equipment: Inside of equipment door.
 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 4. Elevated Equipment: Legible from the floor or working platform.
 5. Branch Devices: Adjacent to device.
 6. Interior Components: Legible from the point of access.
 7. Boxes: Outside face of cover.
 8. Conductors and Cables: Legible from the point of access.
 9. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Secure rigid signs using stainless steel screws.
- G. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

- A. See Section 26 0010 - General Provisions, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 2813

FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

1.02 RELATED REQUIREMENTS

- A. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 26 2816.16 - Enclosed Switches: Fusible switches.
- C. Section 26 2913 - Enclosed Controllers: Fusible switches.

1.03 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.
- E. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.
- F. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - a. Fusible Enclosed Switches: See Section 26 2816.16.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 3300 - Submittal Procedures.
- B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
 - 1. Spare Fuse Cabinet: Include dimensions.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Fuses: One set(s) of three for each type and size installed.
 - 2. Fuse Pullers: One set(s) compatible with each type and size installed.
 - 3. Spare Fuse Cabinet Keys: Two.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com.
- B. Littelfuse, Inc: www.littelfuse.com.
- C. Mersen: ep-us.mersen.com.
- D. Pre-Bid approved equal..

2.02 APPLICATIONS

- A. Service Entrance:
 - 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
 - 2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- B. General Purpose Branch Circuits: Class RK1, time-delay.
- C. Individual Motor Branch Circuits: Class RK1, time-delay.
- D. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.
- E. Primary Protection for Control Transformers: Class CC, time-delay.

2.03 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
 - 1. Class RK1, Fast-Acting, Non-Time-Delay Fuses:
- H. Class L Fuses: Comply with UL 248-10.
- I. Class CC Fuses: Comply with UL 248-4.

2.04 SPARE FUSE CABINET AND SPARE FUSES

- A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.
- B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.
- C. Provide one spare fuse cabinet Bussman "SPC" or equivalent, to be located in the main electrical room. The cabinet shall contain fuse puller and all applicable spare fuses with labels identifying type and size. Cabinet shall be provided with hinged door and latch.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet where directed by Owner.
- D. Identify spare fuse cabinet in accordance with Section 26 0553.

END OF SECTION

SECTION 26 2816.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed safety switches (both fused and non-fused).

1.02 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 2813 - Fuses.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- H. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 3300 - Submittal Procedures
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- E. Project Record Documents: Record actual locations of enclosed switches.

- F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Normal and Emergency Electrical Systems as well as Lighting and Lighting Controls will require commissioning. Refer to specification section 260800 regarding requirements for commissioning.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE; : www.geindustrial.com/#sle.
- B. Eaton Corporation; : www.eaton.com/#sle.
- C. Schneider Electric; Square D Products; : www.schneider-electric.us/#sle.
- D. Siemens Industry, Inc; : www.usa.siemens.com/#sle.
- E. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. For residential (apartments and townhouses) applications: non-fused pull-out style disconnects may be used.
- C. For fractional horsepower motor loads a toggle switch with lockable guard may be used.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
- F. Horsepower Rating: Suitable for connected load.
- G. Voltage Rating: Suitable for circuit voltage.
- H. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - 2. Minimum Ratings:
 - a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
 - b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
 - c. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.

- I. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- J. Provide with switch blade contact position that is visible when the cover is open.
- K. Conductor Terminations: Suitable for use with the conductors to be installed.
- L. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- M. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- N. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor or Wet Locations: Type 3R.
 - c. Kitchen and Laundry Locations: Type Stainless Steel 4X.
- O. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- P. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
 - a. Provide means for locking handle in the ON position where indicated.
- Q. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Hubs: As required for environment type; sized to accept conduits to be installed.
 - 2. Integral fuse pullers.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. All disconnect switches shown on drawings shall be considered fused unless specifically noted as non-fused.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Install enclosed switches plumb.
- G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
- H. Provide grounding and bonding in accordance with Section 26 0526.

- I. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- J. Identify enclosed switches in accordance with Section 26 0553.
- K. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4500.10 - Quality Control for Construction, for additional requirements.
- B. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 31 10 00

CIVIL ENGINEERING SITE WORK DEMOLITION

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of Civil Engineering Site Work Demolition work is shown on the Civil Engineering drawings or specified herein in this and other sections.
- B. Civil Engineering Site Work Demolition includes, but is not limited to, removal and disposal of concrete and asphalt materials, water lines and appurtenances, trees, bushes, stumps, and removal and demolition of other miscellaneous items as shown on the drawings and as specified herein. Contractor to verify extent of required work.
- C. Demolition includes abandonment of existing underground utilities in place as shown in the drawings or specified herein.
- D. Refer to Electrical and Mechanical drawings and specifications for additional demolition items.
- E. Refer to Earthwork specifications for excavation and backfill work required for demolition.

1.2 SUBMITTALS

- A. Submit copies of existing condition documentation required by 1.4.B
- B. Submit demolition and coordination schedule and plan as required by 1.4.C

1.3 JOB CONDITIONS

- A. Explosives: The use of explosives will not be permitted.
- B. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
- C. Protections: Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons.
- D. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to the Owner.
- E. Utility Services: Maintain existing utilities and protect against damage during demolition operations. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Owner's Project Representative. Provide temporary services during interruptions to existing utilities, as acceptable to the Owner.

1.4 GENERAL REQUIREMENTS

- A. Authorization - Do not begin demolition until authorization is received for each item of demolition.
- B. Existing Conditions Documentation - Document existing conditions with photographs prior to beginning demolition. Record existing damage and conditions of items which are to remain prior to beginning demolition.
- C. Schedule demolition work in sequence and in overall coordination with other project demolition and construction requirements. Owner's Project Representative approval of demolition sequence of operations and coordination required.

PART 2 PRODUCTS

2.1 NOT APPLICABLE

PART 3 EXECUTION

3.1 DEMOLITION

- A. Pollution Controls: Use water sprinkling and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulation pertaining to environmental protection.
- B. As indicated on the drawings, specified herein, or required to facilitate the work under this contract, the following items shall be removed from within the project limits unless otherwise noted on the plans to remain.
 - 1. Existing asphalt pavement. Straight saw cutting of edges is required.
 - 2. Portland cement concrete items. Concrete pavements, curbs, slabs, building floors, stoops, sidewalks, pads, pans, blocks, walls, foundations, and other portland cement concrete items. Curb and gutter and sidewalks to be removed to nearest joint or sawed as approved by Engineer. Footings and foundations to be removed full depth unless otherwise noted.
 - 3. Landscaping items as indicated on the drawings. Trees and shrubs shall not be removed without prior authorization from the Owner's Project Representative. Protect trees and shrubs not being removed.
 - 4. Signs, sign posts, delineators, and bollards.
 - 5. Fences and guardrails, including posts and foundations.
 - 6. Water, storm sewer, and sanitary sewer items. Underground piping is to be abandoned in place unless otherwise noted on drawings. Remove abandoned water, sewer, and sanitary sewer pipe when exposed by excavation and plug remaining ends.
 - 7. Miscellaneous items as shown on the drawings.

3.2 DISPOSAL OF DEMOLISHED MATERIALS:

- A. Unless otherwise noted for salvage, remove debris and demolished materials and dispose of at Contractor furnished waste disposal site.

END OF SECTION 31 10 00

SECTION 31 20 00

EARTHWORK

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of the earthwork is shown on the drawings and includes but is not limited to general site grading, excavation, and filling, disposal of waste excavated material if necessary, furnishing of borrow material if necessary, excavating, trenching, backfilling and compacting for water main construction, required grading and filling for demolition items, and other miscellaneous items to the lines and grades shown on the drawings.

1.2 QUALITY ASSURANCE

- A. Testing - A testing agency will be retained by the Contractor to complete the required testing as outlined in these specifications. The Contractor shall coordinate testing schedules with the testing agency. Any testing not specifically called out to be provided by the Owner shall be assumed to be the responsibility of the Contractor.
- B. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

1.3 JOB CONDITIONS

- A. Geotechnical Reports: No geotechnical exploration was completed for the project.
- B. Site Examination: The Contractor shall examine the site and drawings to familiarize himself with the work to be done and conditions to be encountered. Prior to bidding and with approval of the Owner, the Contractor may make his own subsurface investigations to satisfy himself with site and subsurface conditions.
- C. For work areas in and along the streets or parking lots, the Contractor shall furnish, install, and use traffic control signing and devices per the requirements of the Manual on Uniform Traffic Control Devices for Streets and Highways.
- D. Operate warning lights as recommended by authorities having jurisdiction.
- E. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
- F. Protection of Existing Utilities: Existing power lines, telephone lines, trees, shrubbery, fences, water mains, water service lines, gas mains, gas service lines, sewer and sewer service lines, irrigation lines, fiber optic cables, conduits, ditches, embankments, power poles, light poles, storm sewers, drop inlets and other structures in the vicinity of the work not authorized to be removed shall be supported and protected from injury by the Contractor during the construction and until completion of the work affecting them. The Contractor shall be responsible for having all utilities located prior to beginning construction. The Contractor

- shall be liable for all damages done to such existing facilities and structures as herein provided and shall save the Owner harmless from any liability or expense for injuries, damages, or repair to such facilities. The Contractor shall have all underground utilities located prior to beginning site grading or excavating.
- G. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult Owner's Project Representative immediately for directions. Repair damaged utilities to satisfaction of utility owner at no cost to the Owner.
 - H. Use of Explosives: The use of explosives is not permitted without prior authorization from the Owner and the Fire Department.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

- A. Segregation shall be performed to exclude unsatisfactory materials, organic materials, oversize rock, blocky material, or other materials as deemed by the Owner's Project Representative to be unsuitable for fill materials. Rock materials in the onsite materials used for site grading under pavements shall have a maximum particle size no larger than 6" in the maximum dimension and the rock containing materials are to be placed under the observation of the Owner's Project Representative.
- B. Satisfactory borrow materials, if necessary, shall be furnished by the Contractor and shall comply with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, SP, and CL. Maximum particle size shall be 6". The imported borrow material shall be approved by the Owner's Project Representative.
- C. Unsatisfactory soil materials are those soils not meeting the requirements of satisfactory soil materials in 2.1.A through 2.1.B. Frozen materials are considered unsatisfactory soil materials. The unsatisfactory materials shall be disposed of by the Contractor.
- D. Unstable materials consist of sand pockets, soft soils, and other soils which cannot support the improvements as determined by the Owner's Project Representative. Unstable materials also consist of materials too wet to properly support the improvements.
- E. Water for Compaction will be the responsibility of the Contractor.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Comply with the above referenced geotechnical reports and these specifications. In case of conflict between documents, the stricter requirements, as defined by the Geotechnical Engineer shall prevail.
- B. All excavation for the site grading, meter building excavation and trenching is considered Unclassified and includes excavation to subgrade elevations indicated, regardless of character

- of materials and obstructions encountered. Material excavated at the site may be considered usable for grading and backfill purposes subject to the requirements of Part 2, Paragraph 2.1.A of these specifications.
- C. Cuts and fills are not necessarily balanced. The Contractor is responsible for calculating any quantities he needs to bid and construct the project. The Contractor is required to furnish any satisfactory borrow materials that may be required. The Contractor is required to dispose of any excess materials that may result.
 - D. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Owner's Project Representative. Unauthorized excavation, as well as remedial work directed by the Owner's Project Representative shall be at Contractor's expense.
 - E. Compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Owner's Project Representative.
 - F. Stability of Excavations: Slope sides of excavations to comply with applicable codes and safety regulations. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
 - G. Maintain sides and slopes of excavations in safe condition until completion of backfilling. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
 - H. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
 - I. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
 - J. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.
 - K. All construction discharges are subject to the rules and regulations of the National Pollutant Discharge Elimination System General Permit for Construction Activities in the State of South Dakota.
 - L. Material Storage: Stockpile satisfactory excavated materials in areas approved by the Engineer until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
 - M. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.

- N. Dispose of excess soil material and waste materials as herein specified.
- O. Excavation Through Pavements: Where trenches must be excavated through existing paved areas, the paving shall be saw-cut to a depth of 1 1/2 inches minimum on all sides of the excavation and the paving shall be removed along the saw-cut lines. When sawing would occur less than three feet from an existing pavement joint, the paving shall be removed back to the existing pavement joint. Pavement shall be sawed and removed so that the opening is at least 12 inches wider than the top of the trench on each side to prevent undermining of pavement.
- P. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10' and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
- Q. Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Width of trench shall be as necessary for compliance with applicable codes and safety regulations and proper performance of work.
- R. Excavate trenches to depth indicated or required.
- S. Where rock is encountered in trenches, carry excavation 6" below required elevation and backfill with a 6" layer of bedding material in accordance with Section 33 10 00 prior to installation of pipe.
- T. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.
- U. Do not backfill trenches until tests and inspections have been made. Use care in backfilling to avoid damage or displacement of pipe systems.
- V. Cold Weather Protection: Protect excavation bottom against freezing when atmospheric temperature is less than 35oF (1oC).

3.2 COMPACTION

- A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.
- B. Percentage of Maximum Density Requirements: Compact soil to not less than the percentages shown below in the Soil Compaction Criteria.
- C. Comply with the above referenced geotechnical reports and these specifications. In case of conflict between documents, the stricter requirements, as defined by the Geotechnical Engineer shall prevail.

TABLE 1 - SOIL COMPACTION CRITERIA

<i>Placement Location</i>	<i>Soil Type</i>	<i>Moisture Content</i>	<i>Compaction Degree</i>
Scarification of Subgrade Utility Trench Backfill Foundation Subgrade Foundation/Retaining Wall Backfill Pavement Subgrade Concrete Flatwork Subgrade Engineered Fill	Free-Draining Materials (Sand and Gravels - Less Than 8% Fines)	Workable	95% (ASTM D-4253)
	Cohesive Materials (Clays and Silts)	$\pm 3\%$ of Optimum	92% (ASTM D-1557)
	Cohesionless Materials (Sands and Gravels – More Than 8% Fines)	Workable	95% (ASTM D-1557)
Site Grading Approx. 15 Feet Away from Structures	Cohesive Materials (Clays and Silts)	$+3\%$ of Optimum	85% (ASTM D-1557)
	Cohesionless Materials (Sands and Gravels – More Than 8% Fines)	Workable	90% (ASTM D-1557)

- D. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations. Soil material that is too wet to permit compaction to the specified density shall be removed and replaced or scarified and air dried. Soil material that has been removed because it is too wet for proper compaction may be stockpiled or spread and allowed to dry.

3.3 BACKFILL AND FILL

- A. General: The contractor shall perform all excavation, filling and backfilling shown on the drawings. Fill and backfill materials shall consist of satisfactory on-site excavated materials, or satisfactory materials furnished by the Contractor. Place satisfactory soil materials in layers to the required subgrade or finished grade elevations for each area classification listed below.

- B. Comply with the above referenced geotechnical reports and these specifications. In case of conflict between documents, the stricter requirements, as defined by the Engineer shall prevail.
- C. Backfill excavations as promptly as work permits, but not until completion of the following:
 - 1. Inspection, testing, approval and recording locations of underground utilities.
 - 2. Removal of concrete formwork.
 - 3. Removal of trash and debris.
- D. Cold Weather Requirements: Frozen material shall not be used in backfill and fill. When temperatures are below 40 degrees Fahrenheit and materials are being placed for pavements and structures the fill and backfill materials shall be continuously observed and tested. Fill and backfill shall not be placed on frozen subgrades.
- E. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
- F. In cut and fill areas under pavement construction areas, the Contractor shall scarify the subgrade to a depth of not less than 8", adjust the moisture content and compact the material to the requirements specified in paragraphs 3.2.B and 3.2.C of this specification section. Scarification shall result in full processing of the soil using disks, rippers, blades, or other suitable methods such that the soil is fully mixed prior to compaction.
- G. Placement and Compaction: Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.
- H. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- I. Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.
- J. Prior to placement of the aggregate base course the Engineer will visit the site and, with the assistance of the Contractor, determine if soft areas are present in the subgrade. The Contractor shall furnish heavy equipment to proof roll the areas. Soft areas shall be repaired prior to placing the aggregate base course.

3.4 GRADING AND RESTORATION

- A. General: Backfilled trenches shall be finish graded to the proper subgrade elevations shown on the drawings to match existing grades or to the satisfaction of the Owner's Project Representative.

- B. Comply with the above referenced geotechnical reports and these specifications. In case of conflict between documents, the stricter requirements, as defined by the Geotechnical Engineer shall prevail.
- C. Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grade. Grade areas adjacent to building lines to drain away from structures and to prevent ponding.
- D. Adjust all manholes frames and lids, inlets, valve boxes and other utilities as needed to match the new finished grades.
- E. Finish surfaces free from irregular surface changes, and as follows:
 - 1. Subgrade under Sidewalk, Curb and Gutter, Pavement, Slabs on Grade: Finish subgrade to within $\pm 0.05'$ of the bottom of the aggregate base course, gravel cushion, asphalt pavement or other material to be placed by paving contractor. Subgrade shall be "bluetop staked" for finish grading prior to placement of aggregate base course.
 - 2. Subgrade under turfed or unpaved areas: Finish areas to receive topsoil to within $\pm 0.10'$ of finish grade elevations allowing for placement of topsoil.
- F. Compaction: After grading, compact the subgrade surface to the depth and indicated percentage of maximum or relative density for each area classification.
- G. Topsoil materials shall be removed and replaced in kind in the same location.

3.5 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Quality control sampling and testing as outlined below will be the responsibility of the Contractor. The Contractor shall coordinate testing schedules with the testing agency.
- B. Allow testing agency sufficient time to test subgrades and fill layers before further construction work is performed.
 - 1. Pavement, Sidewalk, and Structure Areas - Make at least one field density test of subgrade for each 5,000 square feet, per 1 foot vertically.
 - 2. Areas Other Than Pavement, Sidewalk, Or Structure Areas – Make at least one field density test of subgrade for each 8,000 square feet, per 1 foot vertically.
 - 3. Trenches - Make at least one field density test of backfill for each 200 linear feet, per 3 foot vertically.
- C. If in opinion of Owner's Project Representative, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.

3.6 MAINTENANCE

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

- B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required moisture and density prior to further construction. No extra payment will be allowed for reconditioning or stabilization of previously tested and approved compaction areas. At the Contractors option, digouts with soil backfill and/or geotextile with cover material may be used with no extra payment being made for reconditioning of previously compacted and tested areas
- D. Where settling is measurable and observable during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work and eliminate evidence of restoration to greatest extent possible.

3.7 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Remove debris, trash and waste materials from the site and dispose of it in an approved manner.
- B. Excess excavated soil or unsatisfactory material shall be disposed of by the Contractor at an approved Contractor furnished disposal site.

END OF SECTION 31 20 00

SECTION 31 25 00

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Implement and follow measures that reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust generation.
- B. Contractor shall comply with requirements of the South Dakota General Permit for Storm Water Discharges Associated with Construction Activities including preparation of a Storm Water Pollution Prevention Plan (SWPPP) for the project, preparation and submittal of application documents, and preparation and submittal of closeout documents. The South Dakota General Permit is available online at the DENR website.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer technical product data and installation instructions for materials used in implementing the requirements of the SWPPP and ECP.
- B. Documents:
 - Stormwater Pollution Prevention Plan – SWPPP
 - Permit Application Documents – Include Contractor Authorization Form with Notice of Intent
 - Permit Closeout Documents

1.3 JOB CONDITIONS:

- A. The Contractor is advised that environmentally sensitive areas are located downstream of the project site and that the effective pollution controls must be fully implemented. Several agencies have authority to “stop work” if the pollution prevention controls are not implemented or effective in prevention of environmental damage. No compensation will be forthcoming for time lost due to a “stop work” order or “fines” due to environmental damage

PART 2 - PRODUCTS

- 2.1 Unless otherwise noted on the plans or specified, materials shall comply with the SDDOT approved products list.

PART 3 – EXECUTION

3.1 PERFORM WORK REQUIRED BY:

- A. South Dakota General Permit for Storm Water Discharges Associated with Construction Activities

- B. Contractor prepared Storm Water Pollution Prevention Plan - SWPPP
- 3.2 It is the Contractors responsibility to determine any additional measures, devices, and activities necessary for effective pollution control to comply with the requirements of the South Dakota General Permit for Storm Water Discharges Associated with Construction Activities, and the Contractor prepared SWPPP. No extra payment will be made for any additional measures, devices, or methods that are needed to fully comply with these requirements.

END OF SECTION 31 25 00

SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 DESCRIPTION OF WORK:

- A. Extent of aggregate base course is shown on drawings. Aggregate base course is used under asphalt concrete pavements, under portland cement concrete pavement, under portland cement concrete curb and gutter, portland cement sidewalk, and other miscellaneous features that may be indicated on the drawings.

Aggregate Base Course will also be used for Gravel Surfacing

- B. Prepared subgrade is specified in earthwork sections.

1.2 SUBMITTALS

- A. Material Certificates: Provide copies of materials certificates signed by materials producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

1.3 JOB CONDITIONS

- A. Grade Control: Establish and maintain required lines and elevations.
- B. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- C. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Material for aggregate base course shall be crushed limestone and shall conform to the requirements for Aggregate Base Course in Section 882 of the SDDOT Standard Specifications for Roads and Bridges, 2015 Edition.

PART 3 EXECUTION

3.1 METHODS AND CONSTRUCTION

- A. Surface Preparation: The subgrade for the aggregate base course shall be prepared in accordance with the earthwork specifications.

- B. Scarify and recompact subgrade prior to placement of aggregate base course. The Contractor shall scarify the subgrade to a depth of not less than 8", adjust the moisture content and compact the material in accordance with the Earthwork Specifications. Scarification shall result in full processing of the soil using disks, rippers, blades, or other suitable methods such that the soil is fully mixed prior to compaction.
- C. Prior to placing the base course, the prepared subgrade shall be proof rolled to check for unstable or soft areas. The Engineer will visit the site and, with the assistance of the Owner retained material testing agency, determine if soft areas are present in the subgrade. The Contractor shall furnish heavy equipment and operator to proof roll the areas. If soft or unstable areas are noted, remove and replace the material as required. Proof rolling is required regardless of passing compaction tests.
- D. The aggregate base course shall be placed in accordance with the SDDOT Standard Specifications. Moisture Content and Compaction of the base course shall be in accordance with the Earthwork Specifications section.
- E. Pre Base Course Placement Meeting – A Pre Base Course Placement Meeting shall be scheduled by the Contractor a minimum of 48 hours in advance of proposed base course placement to coordinate all aspects of placement and inspection, including but not limited to equipment review, construction methods, truck schedules and base course delivery to the site, truck exit from the site, placement and compaction requirements, inspection requirements, and time and personnel requirements. Attendance by Contractor's Project Superintendent, Contractor's Grading Foreman, Design Engineer, and Testing Agency Project Manager is mandatory

3.2 FIELD QUALITY CONTROL:

- A. General: All quality control sampling and testing will be the responsibility of the Contractor. The Contractor shall coordinate testing schedules with the testing agency.
- B. Make one field density test of aggregate base course for each 5,000 square feet of aggregate base course.

3.3 MAINTENANCE

- A. Protection of Base Course: Protect newly placed base course from damaging traffic, weather, and erosion. Keep free of trash and debris. Any area of base course that is damaged shall be reworked and replaced as necessary.
- B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Maintenance is required as often as necessary to keep the base course intact and to meet specifications.
- D. Reconditioning Base Course: Where completed and tested base course areas are disturbed by subsequent construction operations or adverse weather the Contractor shall reshape and rework base course to the required density and moisture prior to further construction. No extra payment will be allowed for reconditioning, reshaping, or reworking of previously completed and tested base course.

- E. Any base course that is not paved over prior to the onset of winter or any freezing conditions shall be retested to verify it still meets the requirements of the specifications before pavement is placed.
- F. Any base course that has been subjected to precipitation shall be retested as directed by the Engineer to verify it still meets the requirements of the specifications before pavement is placed.

END OF SECTION 32 11 23

SECTION 32 12 16

ASPHALT PAVEMENT

GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of asphalt concrete pavement is to be determined by the Contractor.

1.2 SUBMITTALS

- A. Material Certificates: Provide copies of materials certificates signed by materials producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.
- B. Job Mix: The Contractor shall furnish at his expense a job mix design for each Class and type of Asphalt Concrete prior to the start of work.

1.3 QUALITY ASSURANCE

- A. Testing - A testing laboratory will be retained by the Contractor to complete the required testing.
- B. Prepaving Meeting – A Prepaving Meeting shall be scheduled by the Contractor a minimum of 48 hours in advance of proposed asphalt concrete pavement placement to coordinate all aspects of paving and inspection, including but not limited to equipment review, construction methods, truck schedules and asphalt, placement and compaction requirements, inspection requirements, and time and personnel requirements. Attendance by Contractor's Project Superintendent, Contractor's Paving Foreman, Owner's Project Representative. Testing Agency Project Manager is mandatory.
- C. Base Check – Refer to Section 3.2.B of this specification.

1.4 JOB CONDITIONS:

- A. Weather Limitations: Apply tack coats when the air and surface temperature are both above 35oF. Do not apply when base is wet or contains an excess of moisture.
- B. Construct asphalt concrete surface course only when atmospheric temperature is above 40oF and when base is dry. Asphalt concrete base course may be placed when air temperature is above 35oF and rising.
- C. Grade Control: Establish and maintain required lines and elevations. Blue top staking and finishing of aggregate base course is required before asphalt is placed.
- D. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

- E. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Asphalt concrete paving materials shall be in accordance with Section 320, 321, 324, 330, 880 and 890 of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata.
- B. Asphalt Mix shall be SDDOT Class E, Type 1 or Class E, Type 2 as noted on the drawings. Fifteen percent (15%) recycled asphalt (RAP) is allowed in the mix. The final RAP materials and mix shall meet all requirements of Class E mix.
- C. Performance graded asphalt binder – PG 64-22.
- D. Tack Coat: Tack coat shall be CSS - 1h.

PART 3 - EXECUTION

3.1 METHODS AND CONSTRUCTION:

- A. Asphalt concrete pavement shall be proportioned, mixed and placed in accordance with Sections 320, 321, 324, and 330 of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata, except as modified herein.
- B. Hand placement of asphalt concrete pavement patching will be allowed in those areas where it is not practical to use a laydown machine and with approval of the Engineer.

3.2 SURFACE PREPARATION:

- A. Remove loose material from compacted subbase surface immediately before applying asphalt or tack coat.
- B. Prior to placing the asphalt concrete, the prepared aggregate base course shall be proof rolled to check for unstable areas and areas requiring additional compaction. The Contractor shall furnish equipment and an operator acceptable to the Owner's Project Representative for the proof rolling operations. Such operations shall be completed in the presence of the Owner's Project Representative. Proof rolling is required regardless of passing compaction tests. Comply with Section 321123 for reconditioning of base course.
- C. Notify Owner's Project Representative of unsatisfactory conditions. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.
- D. Tack Coat: Apply to contact surfaces of previously constructed asphalt or portland cement concrete surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.10 gallons per sq. yd. of surface.

3.3 PLACING MIX:

- A. Asphalt Concrete Pavement Work: The asphalt concrete pavement shall consist of the materials laid in successive lifts above the prepared subgrade or existing asphalt as shown on the typical sections in the drawings.
- B. The asphalt concrete base course and asphalt surface course shall be compacted to a minimum density of 92% of the maximum specific gravity (Rice) of the test specimens prepared in accordance with SD 312 when referenced to the like material.

3.4 FIELD QUALITY CONTROL:

- A. General: All quality control sampling and testing will be the responsibility of the Owner. The Contractor shall coordinate testing schedules with the testing agency.
- B. Asphalt Concrete Material shall be sampled and tested by the testing firm hired by the Contractor. Density tests taken with a nuclear density gauge of the compacted asphalt concrete base course and surface course shall be taken at intervals of not less than one test for each 5,000 square feet of surface area. The asphalt concrete base course and asphalt surface course shall be compacted to a minimum density of 92% of the maximum specific gravity (Rice) of the test specimens prepared in accordance with SD 312 when referenced to the like material.
- C. Test finished surface of each asphalt concrete course for smoothness using 10' straight edge applied parallel with, and at right angles to center line of paved area. Surfaces will not be acceptable in exceeding the following tolerances for smoothness.
 - 1. Base Course Surface: 1/4"
 - 2. Wearing Surface Course 1/4"

END OF SECTION 32 12 16

SECTION 32 16 13

PORTLAND CEMENT CONCRETE CURBS AND GUTTERS

GENERAL

1.1 DESCRIPTION OF WORK

- A. The work includes all construction of Portland Cement Concrete Curbs and Gutters on a prepared surface as shown on the drawings and specified herein.
- B. Prepared subgrade materials and aggregate base course materials are specified in the earthwork sections and aggregate base course sections of these specifications.
- C. Portland Cement Concrete Pavement and Asphalt Pavement adjacent to the Portland curbs and gutters are as specified in the Portland Cement Concrete Pavement sections of these specifications.

1.2 SUBMITTALS

- A. Material Certificates: Provide copies of materials certificates signed by materials producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.
- B. Manufacturer's Certifications and data certifying that the following materials conform to the requirements specified:
 - 1. Concrete and concrete materials
 - 2. Reinforcing Steel
 - 3. Curing Materials
 - 4. Joint Fillers
 - 5. Joint Sealers
- C. Hot and Cold Weather Plan – Submit detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during hot or cold weather.

1.3 QUALITY ASSURANCE

- A. Testing - A testing laboratory will be retained by the Contractor to complete the required testing.
- B. Base Check – Refer to Section 3.2.B of this specification.

1.4 JOB CONDITIONS:

- A. Grade Control: Establish and maintain required lines and elevations. Blue top staking and fine grading of aggregate base course required.
- B. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities..
- C. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

- A. Portland Cement Concrete and materials shall comply with requirements for Class M6 Concrete in Section 462 of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata.
- B. Reinforcing steel shall be epoxy coated, grade 60.

2.2 MISCELLANEOUS ITEMS

- A. Forms, joint fillers, joint sealers, curing compounds, reinforcement, and all other projects used with the Portland Cement Concrete for Curb and Gutter shall comply with applicable requirements for curb and gutter of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata.

PART 3 - EXECUTION

3.1 METHODS AND CONSTRUCTION:

- A. CURBS AND GUTTERS – Methods of construction of Curb and Gutter shall comply with construction requirements of Sections 650.1 through 650.3 of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata and as noted on the drawings.

3.2 SURFACE PREPARATION:

- A. Remove loose material from compacted gravel cushion surface immediately before placing the concrete.
- B. Prior to placing the concrete, the prepared aggregate base course shall be proof rolled to check for unstable areas and areas requiring additional compaction. The Contractor shall furnish equipment acceptable to the Engineer for the proof rolling operations. Such operations shall be completed in the presence of the Engineer or his representative. Proof rolling is required regardless of passing compaction tests. Comply with Section 32 11 23 for reconditioning of base course.

- C. Notify Owner's Project Representative of unsatisfactory conditions. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.

3.3 FIELD QUALITY CONTROL:

- A. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C94.
- B. Slump: ASTM C143; one test for each set of compressive strength test specimens; additional test when concrete consistency seems to have changed.
- C. Air Content: ASTM C231 pressure for normal weight concrete; one for each set of concrete test specimens.
- D. Concrete Temperature: Test hourly when air temperature is 40o F (4oC) and below and when 80o F (27oC) and above and each time a set of compression test cylinders is made.
- E. Compressive Test Specimen: ASTM C 32; one set of 4 standard cylinders for each compressive strength test. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
- F. Compressive Strength Tests: ASTM C39; one set for each days pour exceeding 5 cubic yards plus additional sets for each 100 cu. yds. placed in any one day; one specimen tested at 7 days, and two specimens tested at 28 days, and one specimen retained in reserve.

3.4 REPAIRS AND PROTECTIONS:

- A. Repair or replace broken or defective concrete as directed by Owner's Project Representative.
- B. Drill test cores where directed by Owner's Project Representative when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland Cement Concrete bonded to pavement with epoxy resin grout.
- C. Protect concrete from damage until acceptance of work. Exclude traffic from Portland cement concrete during specified cure time. The Contractor shall provide adequate barriers, warning signs, or warning lights, etc., as required. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.

END OF SECTION 32 16 13

SECTION 32 16 23

PORTLAND CEMENT CONCRETE SIDEWALKS

GENERAL

1.1 DESCRIPTION OF WORK

- A. The work includes all construction of Portland Cement Concrete Sidewalks on a prepared surface as shown on the drawings and specified herein.
- B. Prepared subgrade materials and aggregate base course materials are specified in the earthwork sections and aggregate base course sections of these specifications.
- C. Portland Cement Concrete Pavement and Asphalt Pavement adjacent to the Portland curbs and gutters are as specified in the Portland Cement Concrete Pavement sections of these specifications.

1.2 SUBMITTALS

- A. Material Certificates: Provide copies of materials certificates signed by materials producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.
- B. Manufacturer's Certifications and data certifying that the following materials conform to the requirements specified:
 - 1. Concrete and concrete materials
 - 2. Reinforcing Steel
 - 3. Curing Materials
 - 4. Joint Fillers
 - 5. Joint Sealers
- C. Hot and Cold Weather Plan – Submit detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during hot or cold weather.

1.3 QUALITY ASSURANCE

- A. Testing - A testing laboratory will be retained by the Contractor to complete the required testing.
- B. Base Check – Refer to Section 3.2.B of this specification.

1.4 JOB CONDITIONS:

- A. Grade Control: Establish and maintain required lines and elevations. Blue top staking and fine grading of aggregate base course required.
- B. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities..
- C. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

- A. Portland Cement Concrete and materials shall comply with requirements for Class M6 Concrete in Section 462 of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata.
- B. Reinforcing steel shall be epoxy coated, grade 60.

2.2 MISCELLANEOUS ITEMS

- A. Forms, joint fillers, joint sealers, curing compounds, reinforcement, and all other projects used with the Portland Cement Concrete for Curb and Gutter shall comply with applicable requirements for curb and gutter of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata.

PART 3 - EXECUTION

3.1 METHODS AND CONSTRUCTION:

- A. SIDEWALKS – Methods of construction of Sidewalk shall comply with construction requirements of Sections 651.1 through 651.3 of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata and as noted on the drawings.

3.2 SURFACE PREPARATION:

- A. Remove loose material from compacted gravel cushion surface immediately before placing the concrete.
- B. Prior to placing the concrete, the prepared aggregate base course shall be proof rolled to check for unstable areas and areas requiring additional compaction. The Contractor shall furnish equipment acceptable to the Engineer for the proof rolling operations. Such operations shall be completed in the presence of the Engineer or his representative. Proof rolling is required regardless of passing compaction tests. Comply with Section 32 11 23 for reconditioning of base course.

- C. Notify Owner's Project Representative of unsatisfactory conditions. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.

3.3 FIELD QUALITY CONTROL:

- A. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C94.
- B. Slump: ASTM C143; one test for each set of compressive strength test specimens; additional test when concrete consistency seems to have changed.
- C. Air Content: ASTM C231 pressure for normal weight concrete; one for each set of concrete test specimens.
- D. Concrete Temperature: Test hourly when air temperature is 40o F (4oC) and below and when 80o F (27oC) and above and each time a set of compression test cylinders is made.
- E. Compressive Test Specimen: ASTM C 32; one set of 4 standard cylinders for each compressive strength test. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
- F. Compressive Strength Tests: ASTM C39; one set for each days pour exceeding 5 cubic yards plus additional sets for each 100 cu. yds. placed in any one day; one specimen tested at 7 days, and two specimens tested at 28 days, and one specimen retained in reserve.

3.4 REPAIRS AND PROTECTIONS:

- A. Repair or replace broken or defective concrete as directed by Owner's Project Representative.
- B. Drill test cores where directed by Owner's Project Representative when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland Cement Concrete bonded to pavement with epoxy resin grout.
- C. Protect concrete from damage until acceptance of work. Exclude traffic from Portland cement concrete during specified cure time. The Contractor shall provide adequate barriers, warning signs, or warning lights, etc., as required. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.

END OF SECTION 32 16 23

SECTION 32 17 23

PAVEMENT MARKINGS AND TRAFFIC SIGNS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Work covered by this section consists of Pavement Marking and Traffic Signs as required to complete the contract work as shown on the drawings.

1.2 SUBMITTALS

- B. Material Certificates: Provide certifications, signed by suppliers or manufacturer, and contractor that each material item complies with, or exceeds, specified requirements.

1.3 JOB CONDITIONS:

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 - PRODUCTS

- 2.1 Pavement Marking Paint: Comply with Section 633, Section 980, and Section 981 of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata.
- 2.2 Glass bead reflective media is not required for parking lot striping.
- 2.3 Traffic Control and Parking Lot Signs and Posts: Comply with the Section 632 and 982 of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata and the latest edition of the Manual on Uniform Traffic Control Devices. Posts shall be square perforated tubes with breakaway bases per SDDOT standards.

PART 3 - EXECUTION

- 3.1 Pavement Striping shall be completed per the requirements of the Sections 633, Section 980, and Section 981 of South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata.
- 3.2 New asphalt pavements shall be allowed to age a minimum of seven (7) days prior to painting of new stripes and markings. Pavements shall be cleaned prior to painting. Do not paint without prior authorization of the Engineer.

- 3.3 Traffic Control and Parking Lot Signs and Posts shall be installed per the requirements of the South Dakota Department of Highways STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, 2015 Edition including Errata and the latest edition of the Manual on Uniform Traffic Control Devices.

END OF SECTION 32 17 23

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of water system work is shown on drawings.
- B. The work covered in this section includes, but is not limited to, the following:
 - 1. Hydroseeding
 - 2. Mulch
 - 3. Tackifier
 - 4. Fertilizer

1.2 SUBMITTALS

- A. Material Certificates: Provide copies of materials certificates signed by materials producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

1.3 DELIVERY AND STORAGE

- A. Deliver grass seed in original unopened containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging and location of packaging. Damaged packages are not acceptable.

Deliver fertilizer to the site in the original, unopened containers bearing the manufacturer's guaranteed chemical analysis, name, trade name, or trademark, and in conformance to state and federal law.

During delivery, protect seed from drying out and contamination.

- B. Keep seed and fertilizer in dry storage away from contaminants.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Seed Mix: Seed mixtures for the areas disturbed during construction not to be covered with paving or gravel shall be as follows:

Forest Service North Zone Mix (As Percentage of Pure Live Seed)

30%	Rosana Western Wheatgrass
30%	Mandan Canadian Wildrye
25%	Pryor Slender Wheatgrass
10%	Gulf Annual Ryegrass

5% Prairie Juengrass

Application Rate: 100# per acre

- B. Fertilizer: Fertilizer shall be 18-46-0 and shall be applied at a rate of 200# per acre.
- C. Mulch: Fiber Mulching shall contain no germination or growth inhibiting factors and shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover, which will readily absorb water and allow infiltration to the underlying soil without restricting emergence of seedlings. Weight specification from suppliers, and for all applications, shall refer only to air dry weight of the fiber, considered to be 10 percent moisture. Rate of application shall be 2,000# per acre. Excessive thickness of mulch, which will smother grass seedlings, shall be avoided.
- D. Hydroseeding Tackifier Amendment: Hydro seeding tackifier amendment shall be a safe, non-toxic polymer that can be used with any paper or fiber mulch products. The anionic high molecular weight polymer binds the hydroseeding media to the soil particles. The tackifier shall be hydrophobic and allow water into the mulch matrix. The tackifier shall be a synthetic material that is free of weed seed and any organic containments. It shall be compatible with biostimulants, fertilizers and surfactants. It shall not clump in the tank and clog the spray nozzle. The tackifier lubricates the slurry mix and tightens the slurry stream and will increase the shooting distance. The tackifier will break down from UV light in 5-6 weeks. When using as a tackifier with paper or fiber mulch, add 3# per acre.

PART 3 EXECUTION

3.1 Seasonal Limitations

- A. Seeding shall not be done between June 15 and August 31 without written authorization from the Owner's Project Representative. Seeding may be done when the ground is not frozen and condition of the soil permits preparation of a satisfactory seedbed. Seeding shall not be done without authorization from the Owner's Project Representative.

3.2 Hydroseeding

- A. The specified seed mixture shall be hydro seeded uniformly, using a hydro seeder.
- B. The hydro seeder shall be equipped with a gear-driven pump and a paddle agitator. Agitation by re-circulation from the pump will not be allowed. Agitation shall be sufficient to produce homogeneous slurry of seed and fertilizer in the designated proportions.
- C. Fertilizer of the specified formulation shall be included at the specified rate.
- D. Specified seed mixtures shall be included at the specified rate. No seed shall be added to the slurry until immediately prior to beginning the seeding operation.

3.3 Watering

- A. After seed, fertilizer and mulch have been placed, it shall be watered to provide a moist condition through the mulch as well as into the underlying soil bed. For a period of three weeks after seeding and initial watering, the Contractor shall apply adequate water to insure proper germination of the seed and growth of the grass. The Owner's Project Representative may waive watering requirements if adequate natural moisture has been present. At the end of the three (3) week watering period, the Engineer will make an inspection to determine if the grass is alive and growing. If seed has not satisfactorily rooted into the soil and is not alive and growing, the Engineer will determine if new seed and/or additional watering, at the Contractor's expense, are required. Replaced seed shall be watered as required for the original.

END OF SECTION 32 92 19

SECTION 33 10 00

WATER SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of water system work is shown on drawings.
- B. The water system work includes, but is not limited to, the following:
 - 1. PVC Water Main
 - 2. Ductile Iron Fittings
 - 3. Connections to Existing Mains
 - 4. Gate Valve and Valve Boxes
 - 5. Check Valves
 - 6. Air Release Valves
 - 7. Pressure Reducing/Pressure Sustaining Valves
 - 8. Dismantling Joints
 - 9. HDPE Service Line
 - 10. Concrete Thrust Blocks and Joint Restraints
 - 11. Tracer Wire
 - 12. Water Main Flushing, Testing and Disinfection

Water piping and appurtenances for service lines within the Admin and E&O Building and water main in the tunnel are covered in the Mechanical Specifications.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, warranties and installation instructions.
- B. Granular Materials: Submit supplier certification that granular materials used for bedding meet specifications.
- C. Record Drawings: At project closeout, submit record drawings of installed water system work
- D. Inspection Results: Provide results of Contractor inspections and Owner provided testing required under Part 3 – Field Quality Control.

1.3 QUALITY ASSURANCE

- A. Installer: A firm specializing and experienced in water main construction work.
- B. Comply with the regulations of the SD Department of Environment and Natural Resources, the SD Department of Health, and the Standards of the American Water Works Association.

1.4 CONTINUED WATER SERVICE

- A. The Contractor shall coordinate his construction activities with the Owner to minimize interruption of water service. The Contractor shall advise the Owner at least 48-hours in advance of shutting off water service to any facility.
- B. All tie-ins of the new water main may be accomplished during normal working hours Monday through Thursday. No tie-ins will be permitted to be started after 11:00 a.m. on Fridays or the day before a holiday. Each tie-in, including flushing shall be accomplished within a single working day.

PART 2 PRODUCTS

2.1 MATERIALS

- A. PVC Water Main (Buried): 4"-12" water mains and service lines shall be PVC pipe complying with AWWA C900 DR-18.
- B. HDPE Service Line (Buried): 2" water service lines shall be SDR9 CTS HDPE color blue for water.
- C. Ductile Iron Water Main (Meter Building): Above grade ductile iron pipe shall be Ductile Iron, AWWA C-151, Class 53 with Cement Mortar Lining, AWWA C-104, Epoxy Coating with Flanged Joints, AWWA C-110.

Piping and appurtenances will receive a top coat of epoxy paint when all components are assembled.

- D. Fittings (Buried): All fittings 4" and larger shall be ductile iron fittings of the size shown on the drawings with 350-psi pressure rating and rubber gasket joints meeting all applicable requirements of the latest edition of AWWA C110, C111, and/or C153 Specifications. All internal and external ferrous surfaces shall be coated with a fusion bonded epoxy coating applied electrostatically and at a minimum shall meet the requirements of AWWA C116. Fittings shall be mechanical joints.

All bolts and nuts shall conform to the requirements of AWWA C111 and ASTM-A325 Type 3. The bolts and nuts shall be fluoropolymer coated, fusion bonded epoxy, Series 300 stainless steel or approved equal.

- E. Fittings (Meter Building): All above grade fittings 4" and larger shall be ductile iron fittings of the size shown on the drawings with 350-psi pressure rating and rubber gasket joints meeting all applicable requirements of the latest edition of AWWA C110, C111, and/or C153 Specifications. All internal and external ferrous surfaces shall be coated with a fusion bonded epoxy coating applied electrostatically and at a minimum shall meet the requirements of AWWA C116. Fittings shall be flanged joints.

Piping and appurtenances will receive a top coat of epoxy paint when all components are assembled.

All bolts and nuts shall conform to the requirements of AWWA C111 and ASTM-A325 Type 3. The bolts and nuts shall be fluoropolymer coated, fusion bonded epoxy, Series 300 stainless steel or approved equal. All bolts for piping and appurtenances in the building shall be the same material.

- F. Water Main Joint Restraint: All fittings shall be provided with thrust blocks, joint restraining devices, and polyethylene encasement as specified herein.

All vertical bends and horizontal fittings on the water main shall be restrained using the EBBA, or equal, joint restraining systems in addition to concrete thrust blocks. All joint restraining devices shall be coated with a fusion bonded epoxy coating applied electrostatically and at a minimum shall meet the requirements of AWWA C116. The restraint system bolts and nuts shall be fluoropolymer coated, fusion bonded epoxy, Series 300 stainless steel or approved equal.

- G. Polyethylene Encasement: All Ductile Iron fittings shall be wrapped with 8 ml thickness polyethylene meeting the requirements of ANSI/AWWA C105/A21.5-82.
- H. Couplings: Straight couplings between pipes with the same outside diameter shall be a long barrel ductile iron sleeve meeting the requirements of 2.1.C. Transition couplings for pipes with different outside pipe diameters shall be Romac Style 501 as manufactured by Romac Industries, Inc., or equal and shall have ductile iron center ring meeting ASTM A536-80, Grade 65-45-12. Center rings shall be epoxy coated. Gaskets shall be SBR compounded for water service.

All bolts and nuts shall conform to the requirements of AWWA C111 and ASTM-A325 Type 3. The bolts and nuts shall be Cor-Blue, fusion bonded epoxy, Series 300 stainless steel or approved equal.

- I. Gate Valves (Typical Buried): The gate valves shall be iron-body, non-rising stem, resilient seated wedge type valves meeting the requirements of AWWA C509 or C515. The stems shall be one piece cast, forged or rolled bronze. Stem seals shall be double "O" ring seals designed so that the seal above the stem collar can be replaced with the valve under pressure in full open position. The valves shall have a two (2) inch operating nut and shall open left. Joints for the gate valves shall be mechanical joint.

Each valve must be accompanied with a compatible valve box. The valve box shall be two piece screw type construction with 5-1/4" riser and extensions as necessary so that the valve box lid is nearly flush with the finished grade. Each box shall have a lid marked "WATER".

Each valve box shall be furnished with a Valve Box Adaptor II, or equal, centering device as manufactured by Adaptor Inc.

- J. Gate Valves (Future Post Indicator Buried): The gate valves shall meet all the requirements of typical buried gate valves, but shall be provided with the post indicator style bonnet to allow future installation of a post indicator. This project will install a typical valve box.
- K. Gate Valves (Meter Building): The above grade gate valves shall meet the requirements of typical buried valves, but shall be flanged and be provided with a hand wheel operator.

Piping and appurtenances will receive a top coat of epoxy paint when all components are assembled. All bolts for piping and appurtenances in the building shall be the same material.

L.

M. 12" Dual Check Valve (Meter Building): The 12" dual check valve assembly shall be Watts Series 774 or approved equal meeting the requirements of AWWA C510, rated for 175 psi. All bolts for piping and appurtenances in the building shall be the same material.

N. 2" Reduced Pressure Backflow Preventer (Tunnel): The 2" RPZ Backflow Preventer shall be Watts LF009QT or approved equal. Valve shall be lead free supplied with 2 quarter turn ball isolation valves on either side.

O. 8" Pressure Reducing/Pressure Sustaining Valve (Meter Building): The 8" combination PRV/PSV shall be Cla-Val Model 92-01 with optional CV Flow Control (Closing Speed Control) and a Valve Position Indicator. The PRV Setting from the South Lead Tank to Yates shall be set at 40 psi. The PSV from West Lead Reservoir to South Lead Tank shall be set at 35 psi. All bolts for piping and appurtenances in the building shall be the same material.

P. Dismantling Joint (Meter Building): Dismantling Joints shall be Romac style DJ400 or approved equal with factory epoxy coating, NSF 61 certified, and gaskets for water application. All bolts for piping and appurtenances in the building shall be the same material.

Q. Curb Stops and Ball Valves: Curb stops and valves for 2" and smaller diameter pipe shall be ball valves. The ball valves shall be Minneapolis Pattern of heavy cast bronze body construction, bronze tee-head and stem with double Buna-N O-Rings in the stem, molded Buna-N rubber seats. The valves have joints compatible with the type of pipe being used. The valves shall be Ford Ball Valves as manufactured by the Ford Meter Box Company, or equal.

Each ball valve shall be furnished complete with extension type curb boxes for the Minneapolis Pattern valves. The curb box shall be cast iron, telescope to a length of six feet (6') and a screw type lid marked "WATER". Risers shall be a minimum 1-1/2" diameter.

R. Service Saddles: The tapping saddles shall install as a single unit with no loose parts to assemble around the pipe. The body shall be of brass alloy per ASTM B-62 and AWWA C800 and be equipped with a Buna-N rubber O-ring. The upper and lower castings shall be hinged together with silicon bronze pin. The tapping saddles shall be brass saddles Model S70 as manufactured by the Ford Meter Box Company or approved equal.

S. Corporation Stops: The corporation stops shall be brass corporation stops conforming with AWWA Standard C800. The corporation stops shall be compatible with the tapping saddles, couplings and type of pipe being used.

T. Epoxy Paint: All piping and appurtenances in the meter building except for stainless steel, brass or copper shall receive a top coat of blue epoxy paint after assembly. Paint is based on Sherwin Williams products and shall be Modified Epoxy Phenalkamine, DuraPlate 235 Multi Purpose Epoxy, B67W-235 Series or approved equal.

- U. Tracer Wire: No. 10 AWG copper tracer wire shall be UL listed single conductor, stranded copper wire with 600-volt HMWPE insulation. Acceptable single wire for open cut pipe trench and in-conduit type insulation are:
1. Agave Copper PE Traer Wire 45-mil (APUT-1019) from Agave wire, LTD.
 2. 45-mil HMWPE Copper Tracer Wire from Kris-Tech (K-T) Wire.
 3. Pro-Trace Type CU HDPE Copper Tracer Wire 45-mil (Copper PE45-Stranded) from Pro-Line Safety Products.
 4. Or Approved Equal.
- V. Concrete Thrust Blocks: Portland Cement Concrete: Concrete materials and mixes for concrete thrust blocks shall produce normal-weight concrete consisting of Portland Cement, aggregate, air-entraining admixture, and water to produce the following properties.

Compressive Strength: 4,000 psi minimum @ 28 days
Slump Range: 1"-2" machine placed; 1"-3" hand placed
Air Content: 5% to 7%

- W. Pipe Bedding and Foundation Material: Pipe bedding shall be free from dirt, vegetable matter, cinder, ashes, refuse, organics or other unsuitable matter. Frozen material may not be used. Pipe bedding and foundation shall be granular material and meet the following gradation requirements by dry weight:

TYPE 1 BEDDING MATERIAL

Passing 1 inch sieve	100%
Passing 3/4 inch sieve	90-100%
Passing 3/8 inch sieve	20-55%
Passing #4 sieve	0-10%
Passing #8 sieve	0-8%

TYPE 2 FOUNDATION MATERIAL

Passing 3 inch sieve	100%
Passing 3/4 inch sieve	50-70%
Passing #4 sieve	20-40%
Passing #200 sieve	0-8%

TYPE 3 FOUNDATION MATERIAL

Passing 3 inch sieve	100%
Passing 1 inch sieve	0-15%
Passing #4 sieve	0-8%

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILLING

- A. Water System excavation and backfilling shall be in accordance with these specifications and as noted on the drawings.
- B. Backfill compaction shall comply with Section 31 20 00 Earthwork of these Specifications.

- C. Trenches shall be excavated to a width sufficient to allow for proper jointing of the pipe and thorough compaction of the bedding and backfill material under and around the pipe. Where soil type allows, trench walls to be vertical to an elevation atop the pipe.
- D. Trench excavation in rock may be encountered. Blasting and the use of explosives is not allowed. No extra payment will be made for trench excavations in rock.
- E. The complete trench bottom shall be firm for its full width and length. The foundation for each type of bedding shall be adequate to furnish a uniform stable support. Removal and replacement of unstable material or rock shall be at no extra cost to the Owner.

3.2 INSTALLATION OF PIPE AND FITTINGS

- A. The Contractor shall expose and determine elevations of existing underground utilities, culverts and other underground obstacles far enough in advance of pipe laying that the proposed water main can be installed without the use of fittings at or near the points of crossing. The Engineer shall be notified prior to any change in grades or elevations of the water main.
- B. Tracer wire shall be installed with all PVC piping.
- C. Valve boxes greater than 8' in depth shall be supplied with a nut extension and centering device to allow operation with a standard water valve key.
- D. Bedding: The pipe bedding shall be in accordance with Paragraph 2.1.M. Type I Bedding Material shall be used unless otherwise directed by the Engineer.
- E. Water Main: All pipe shall be laid true to the line and grade shown or established by the Engineer. Fittings and appurtenances shall be placed at required locations. The interior of all water pipe and fittings shall be kept free from all dirt, cement, or other foreign material and, if required by the Engineer, the inside of all pipe and fittings shall be thoroughly cleaned before the next pipe is joined to it. Each pipe length shall be inspected for defects prior to being lowered into the trench. The gasket shall be inserted correctly, the pipe shoved home and joint restraints fastened in the manner recommended by the manufacturer. Once in place, the exposed end of the pipe shall be plugged to prevent soil, water, or other matter from entering the pipe.
 - 1. Deflection of pipe joints shall conform to the applicable AWWA or Uni-Bell specifications and/or the manufacturer's recommendations, whichever are more conservative.
 - 2. All cast iron and ductile iron fittings shall be wrapped with 8 mil thickness polyethylene.
 - 3. The water mains shall be installed such that the minimum depth of cover over the top of the pipe will be six feet (6').
- F. Thrust Blocks: Concrete thrust blocks shall be constructed at all bends, tees, crosses, reducers, valves and dead ends and as shown on the drawings. These blocks shall have a thickness equal to at least half the diameter of the pipe being installed but shall not be less than six inches (6") thick under any circumstances. They shall be made with 4,000 PSI concrete and shall extend from the fitting to the undisturbed wall of the excavation. The

Contractor shall insure that the concrete does not cover or render inoperable nuts or bolts on the fittings.

Concrete thrust blocks are required in addition to the joint restraining devices.

Thrust restraints shall be completed in accordance with ANSI/AWWA C605-94/5.7, ANSI/AWWA 907-91, AWWA Manual M23 and the recommendation of the manufacturer.

Concrete thrust blocks do not require field or lab testing to verify material properties or cured strength. However, thrust blocks must be allowed to cure to a strength sufficient to support a person walking over the concrete before it is backfilled.

- G. Epoxy Paint (Meter Building): A top coat of epoxy paint shall be placed in accordance with manufacturer's recommendations to a dry film thickness of 4-8 mils over the factory epoxy coating for all pipe and appurtenances after assembly. Color shall be Blue.
- H. Water Meter (Meter Building): The Contractor shall install the 8" Sensus Combination water meter provided by the Owner. The Contractor shall coordinate with the City of Lead for additional installation requirements for mounting of remote reading equipment for the meter. This may include conduit from the meter to an exterior wall of the building including a penetration and sealing of the exterior wall.

3.3 FILLING AND FLUSHING

- A. The Contractor shall flush all water mains thoroughly prior to disinfection until all traces of construction materials and solid or other foreign matter have been removed. If needed, the Contractor shall install temporary fittings and valves for the purpose of testing and flushing. Damages caused by water carried deleterious materials to other facilities shall be the responsibility of the water main contractor.

3.4 PRESSURE TESTING

- A. Hydrostatic Pressure Testing: All water mains shall be tested with water to 125% of normal operating pressure at the lowest elevation of the system, or at the pressure class rating of the pipe, whichever is less.

The leakage test shall be done in accordance with AWWA C605 where leakage is defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. The Contractor shall furnish and install additional corporation stops, including the necessary tapping saddles, as necessary to assist in expelling air from the lines. At the conclusion of the testing, the corporation stops shall be left in place.

After the line is filled, the Contractor shall pump water into the segment being tested through a pit, hydrant, air release valve assembly, or temporary tap and bring the line to the appropriate test pressures, corrected for the lowest point of the line being tested. The test pressure shall be observed and recorded at the beginning and at the end of two (2) hours.

Maintenance of the test pressure without loss for the specified time shall be acceptable. If test section does not hold the test pressure after the specified time, the line shall be repressured by pumping water from a measured container into the pipeline to bring the pressure back to the test pressure and record the quantity of water used.

No pipe installation will be accepted if the leakage is greater than that determined by the following formula where "L" is the allowable leakage in gallons per hour, "N" is the number of joints in length of pipe being tested, "D" is the nominal diameter of the pipe in inches and "P" is the average test pressure in psi gauge.

$$L = \frac{ND \sqrt{P}}{7400}$$

ALLOWABLE LEAKAGE PER 50 JOINTS OF PVC PIPE (gph)

PIPE DIAM. (in.)	AVERAGE TEST PRESSURE (PSI)				
	50	100	150	200	250
4	0.19	0.27	0.33	0.38	0.43
6	0.29	0.41	0.50	0.57	0.64
8	0.38	0.54	0.66	0.76	0.85
10	0.48	0.68	0.83	0.96	1.07
12	0.57	0.81	0.99	1.15	1.28

Acceptance of the pressure test shall be determined on the basis of the allowable leakage. If any test of installed pipe disclosed leakage greater than that specified, the Contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance.

Any damaged or defective pipe, fittings, valves, hydrants, or joints discovered following the pressure test shall be repaired or replaced with approved material at the Contractor's expense, and the test shall be repeated until it is satisfactory to the Contracting Officer.

The use of repair sleeves on new mains will not be permitted.

3.5 DISINFECTION OF WATER MAINS

- A. All new water mains and appurtenances shall be disinfected before they are placed in service. All water mains taken out of service for inspecting, repairing, or other activity that might lead to contamination of water shall be disinfected before they are returned to service. Disinfection shall comply with the requirements of the ANSI/AWWA Standard C651, Tablet Method.

New water mains connected to existing active water mains shall be kept isolated until bacteriological tests described in ANSI/AWWA C651/Sec7 are satisfactorily completed.

The Contractor may propose other methods of disinfection, but such other methods must be approved by the Engineer before using them.

- B. Following the retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is not over 1 ppm as determined by the Contractor. Flushing shall be accomplished at full line pressure. Flushing shall be conducted in such a way as to prevent contamination of existing water mains and/or water service lines and to minimize traffic and pedestrian hazards and nuisance conditions.
- C. For making the tie ins to existing mains, the Contractor shall clean all the pipe and fittings before installing them and shall disinfect the mains and fittings by swabbing with a hypochlorite solution. The interior of all pipe and fittings shall be swabbed with a five percent (5%) hypochlorite solution before they are installed. The Contractor shall then take precautions against contaminating material entering the pipe and fittings during the installation. The disinfection procedure shall be in accordance with the latest revision of ANSI/AWWA C651.
- D. The discharge of heavily chlorinated water from the flushing operations shall be in compliance with SD Department of Environment and Natural Resources requirements. Dechlorination may be necessary prior to discharge.
- E. After final flushing and before the water main is placed in service, two (2) samples, taken 24 hours apart, shall be collected from the end of the line and from each hydrant or cleanout. These samples must be submitted to the State Health Laboratory in Pierre, or other laboratory acceptable to DENR. These samples must be free from coliform bacteria before the system is placed into service. The Contractor shall be responsible for the sampling and testing.

If the initial disinfection fails to produce satisfactory samples, the Contractor shall repeat the disinfection until satisfactory samples are obtained.

3.6 SEPARATION OF WATER MAINS AND SEWER MAINS

- A. Parallel Installation: Water mains shall be laid at least 10 feet horizontally from any existing or proposed sanitary sewer, storm sewer or sewer manhole: the distance shall be measured edge to edge. When conditions prevent a horizontal separation of 10 feet, specific approval from South Dakota Department of Environment and Natural Resources (DDENR) shall be obtained. Approval may be granted if the following is provided.
 - 1. The water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer line and at such an elevation that is at least 18 inches above the top of the sewer line.
 - 2. When it is impossible to obtain this horizontal (10 feet) separation or vertical (the water main 18 inches above the sewer main), the sewer line must be relaid and constructed with ductile iron pipe with mechanical compression joints and/or other pipe equivalent to water main standards of construction and should be pressure tested to assure water tightness before backfilling.
 - 3. Water mains shall be laid to provide a horizontal separation of 25 feet from any existing or proposed septic tank, seepage pit, absorption field, stabilization pond or lagoon. When conditions prevent a horizontal separation of 25 feet, specific approval from South Dakota Department of Environment and Natural Resources (DDENR) shall be obtained. Approval may be granted if the following is provided.
 - a. The water line must be encased in PVC, cast iron or 6-inches of concrete for whatever distance necessary to obtain the 25 feet of separation. If PVC or ductile

iron is used as encasement material, the ends shall be adequately sealed with rubber boots.

4. Vertical Separation at Crossings: Water mains may cross above the sanitary sewer and storm sewer with a minimum of 18 inches between the invert of the water main and the top of the sewer. In these cases where the water main is above the sewer and there is at least 18 inches of separation, then at the crossing, one full 20 foot section of water pipe shall be centered at the crossing.

A water main may cross above the sewer main with a vertical separation of less than 18 inches or below the sewer main if either the water main or sewer main is encased in PVC, ductile iron or 6" of concrete for at least 10 feet each side of the crossing. If PVC or ductile iron is used as encasement material, the ends shall be adequately sealed with rubber boots.

3.7 METER BUILDING START-UP

- A. The meter building contains a combo PRV/PSV that shall be adjusted and demonstrated by a Cla-Val certified representative. The water meter will also be observed during start-up for general operation. The Owner's Project Representative and the City of Lead shall be present at the start-up. At a minimum, a hydrant or multiple hydrants in the Yates complex will be flowed to a sufficient volume to activate the PRV and allow water from the South Lead Tank into the Yates Complex. The PSV setting shall be temporarily adjusted to send water from the West Lead Reservoir to the South Lead Tank. The closing speed control shall be adjusted by the Cla-Val Representative. The Contractor shall prepare a start-up procedure including the vales to be operated and the hydrants to be flowed for approval by the Owner's Project Representative.

3.8 FIELD QUALITY CONTROL

- A. Water main pressure and disinfection testing shall be completed by the Contractor in accordance with Sections 3.4 and 3.5 of this specification. Submit test results to Engineer.
- B. Compaction testing will be the responsibility of the Owner retained testing agency. The Contractor shall coordinate testing schedules with the testing agency. Frequency of compaction testing of trench backfill is one field density test for every 150 feet horizontally and every 24 inches vertically.

END OF SECTION 33 10 00