

SECTION 01 10 00

SUMMARY OF WORK

PART 1 -GENERAL

1.1 SECTION INCLUDES

- A. Summary of Work
- B. OWNER Supplied Products
- C. Work Sequence

1.2 SUMMARY OF WORK

Municipal water system improvements including construction of pre engineered metal building pump station, pumps, VFDs, HVAC, electrical wiring, electrical controls, installation of 6" and 8" diameter water supply line, and associated improvements.

This pump station will ultimately be on the City's SCADA system. The Owner will separately contract for moving existing SCADA equipment to the new pump station. All equipment must operate manually at the end of the project. Equipment and Wiring not shown specific to SCADA controls will be installed

1.3 OWNER SUPPLIED PRODUCTS

A. OWNER's Responsibilities

- 1. Owner will provide geotechnical testing services.
- 2. Owner will separately contract for moving existing SCADA equipment to the new pump station.

1.4 WORK SEQUENCE

A. Construct work in the following stages:

- 1. The Work may be accomplished as the CONTRACTOR chooses based on availability of supplies and subcontractors schedules. A suggested Construction Sequence is included in the drawings. Deviation from this should be coordinated with the City. All work must be completed before any segment is tied to the system.

END OF SECTION

SECTION 01 40 00

QUALITY CONTROL

PART 1 – GENERAL

1.1 SECTION INCLUDES

1. Quality assurance and control of installation.
2. References.
3. Field samples.
4. Inspection and testing laboratory services.
5. Manufacturers' field services and reports.
6. Tolerances

1.2 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarifications from ENGINEER before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent specified tolerances, codes, or requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce workmanship of specified quality.
- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
- G. Document and keep records of quality assurance/ control of installation.

1.3 REFERENCES

- A. Conform to reference standard by date of issue current on date of Contract Documents. Dates specified in individual Sections supersede all other dates of issue.

- B. Should specified reference standards conflict with Contract Documents, request clarification from ENGINEER before proceeding.
- C. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.4 FIELD SAMPLES

- A. Install field samples at the site as required by individual Specification Sections for review.
- B. Acceptable samples represent a quality level for the Work.
- C. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by OWNER.

1.5 TESTING LABORATORY SERVICES

- A. OWNER will provide inspection service for this project.
- B. CONTRACTOR will select, pending approval by the OWNER, employ, and pay for services of an independent firm to perform testing.
- C. The independent firm will perform tests and other services specified in individual Specification Sections and as required by the OWNER.
- D. Reports will be submitted by the independent firm to the OWNER, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- E. CONTRACTOR shall cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
 - 1. Notify OWNER and independent firm 8 hours prior to expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for CONTRACTOR's use.
- F. A partial list of field tests required on this project, parties responsible for conducting the tests, and parties responsible for payment of the tests is presented below. Where tests specified in other sections of these specifications are not listed below, the CONTRACTOR will request additional testing information from the OWNER.

1. Water line backfill density tests:
 - a. compaction test: Independent Testing Laboratory
 - b. payment: Contractor

2. Backfill for structures density tests:
 - a. compaction test: Independent Testing Laboratory
 - b. payment: Contractor

3. Concrete tests:
 - a. slump test: Independent Testing Laboratory
 - b. air test: Independent Testing Laboratory
 - c. unit weight test: Independent Testing Laboratory
 - d. prepare test cylinders: Independent Testing Laboratory
 - e. protect test cylinders: Contractor
 - f. perform cylinder test: Independent Testing Laboratory
 - g. payment: Contractor

4. Water Line:
 - a. Pressure and Bacteria test: Contractor
 - b. witness: Owner
 - c. payment (or cost): Contractor

5. Valves:
 - a. operation: Contractor
 - b. witness: Owner
 - c. payment (or cost): Contractor

I. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the OWNER. Payment for retesting will be charged to the CONTRACTOR by deducting testing charges from the Contract Sum/Price.

1.6 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up

of equipment, test, adjust, and balance of equipment as applicable, and to initiate instructions and training of OWNER's personnel when necessary.

- B. CONTRACTOR to report to OWNER material or product supplier's or manufacturer's observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Submit report in duplicate within 14 days of observation to OWNER and ENGINEER for review.

1.7 TOLERANCES

- A. Monitor tolerance control of installed Products to produce acceptable work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturer's tolerances conflict with Contract Documents, request clarification from ENGINEER before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used

PART 4 - MEASUREMENT AND PAYMENT

Work covered in this Section of the Specifications and associated costs therewith shall be included in the contract price for the item to which the work applies. No separate payment shall be made.

END OF SECTION

SECTION 01 70 00
CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Adjusting.
- D. Project record documents.
- E. Operation and maintenance data.
- F. Spare parts and maintenance materials.

1.2 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for ENGINEER's review.
- B. Provide submittals to ENGINEER that are required by governing or other authorities. C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.
- C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- D. Clean filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.

- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.4 ADJUSTING

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

1.5 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. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. 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. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish [main] floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract drawings.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit data bound in 8-1/2 x 11 inch text pages, binders with durable plastic covers.
- B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed.
- D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, typed on 20 pound white paper, in three parts as follows:
 1. Part 1: Directory, listing names, addresses, and telephone numbers of ENGINEER, CONTRACTOR, Subcontractors, and major equipment suppliers.
 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for [special] finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties and bonds
- E. Submit 1 draft copy of completed volumes 15 days prior to final inspection. This copy will be reviewed and returned after final inspection with ENGINEER comments. Revise content of all document sets as required prior to final submission.
- F. Submit two sets of revised final volumes, within 20 days after final inspection.

1.7 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.
- B. Deliver to Project site, obtain receipt prior to final payment.

END OF SECTION

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in place concrete with shoring, bracing and anchorage
 - 2. Openings for other work
 - 3. Form stripping.
 - 4. Form accessories

- B. Related Sections:
 - 1. Section 03 20 00 - Concrete Reinforcing.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Formwork (Vertical Structures):
 - 1. Basis of Measurement: By the cubic yard.
 - 2. Basis of Payment: Includes form materials, placement, placing accessories, stripping.

1.3 REFERENCES

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.

- B. ACI 347 – Recommended Practice For Concrete Formwork.

- C. PS-1 – Construction and Industrial Plywood.

1.4 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing to conform to applicable code requirements to achieve and hold concrete shape, line and dimension as indicated on Drawings.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 318.

- B. Maintain one copy of each document on site.

- C. Special inspections shall be performed as required by the 2015 International Building Code and as outlined on sheet S2 of the contract documents.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.7 COORDINATION

- A. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 - PRODUCTS

2.1 WOOD FORM MATERIALS

- A. Lumber Forms:
 - 1. Application: Use for edge forms and unexposed finish concrete.
 - 2. Lumber: Hem-Fir #2 with grade stamp clearly visible.
- B. Plywood: Douglas Fir species; solid one side. Sound undamaged sheets with clean, true edges.

2.2 PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes required.
- C. Other Preformed Forms: Proprietary systems of inter-locking panels, form ties, fastening devices, etc. that are tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

2.3 FORMWORK ACCESSORIES

- A. Form Ties: Snap-off type, galvanized metal, fixed length, cone type.
- B. Form Release Agent: Colorless mineral oil that will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.
- C. Corners: Chamfer, wood strip type; $\frac{3}{4}$ " x $\frac{3}{4}$ " size; maximum possible lengths.
- D. Flashing Reglets: Galvanized steel, 22 gage thick, longest possible lengths, with alignment splines for joints, release tape sealed slots, anchors for securing to concrete formwork.
- E. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- B. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Engineer before proceeding.

3.2 INSTALLATION

- A. Earth Forms: (only when approved by the Engineer)
 - 1. Trench earth forms neatly, accurately, and at least 2 inches wider than footing widths indicated on Drawings.
 - 2. Trim sides and bottom of earth forms.
 - 3. Construct wood edge strips at top of each side of trench to secure reinforcing and prevent trench from sloughing.
 - 4. Form sides of footings where earth sloughs.
 - 5. Tamp earth forms firm and clean forms of debris and loose material before depositing concrete.

- B. Formwork - General:
 - 1. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations. Comply with requirements of ACI 301.
 - 2. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
 - 3. Complete wedging and bracing before placing concrete.
 - 4. Provide bracing to ensure stability of formwork and as required to hold formwork in position and shape for the final intended concrete dimensions. Shore brace and strengthen formwork that may be subject to over-stressing by construction loads.
 - 5. Align joints. Keep form joints to a minimum.
 - 6. Place neatly shaped blocks to be used for keyways with draft securely in formwork where cold-joints are required between concrete placements and cold joints there in. See details in the structural plans.

- C. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

- D. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores. Formwork may be left on surfaces for curing of those surfaces.

- E. Obtain Architect/Engineer's approval before framing openings in structural members not indicated on Drawings.

3.3 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

- C. Do not apply form release agent where concrete surfaces will receive, concrete, special finishes or applied coverings which are effected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Install formed openings for items to be embedded in or passing through concrete work.

- B. Locate and set in place items required to be cast directly into concrete.

- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, sleeves, bolts, anchors, plates, other inserts, and components of other Work.
- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement. Items to be exposed and flush, when finished, to the exposed finished formed surface of concrete shall be fastened tightly and directly to the formwork.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning, air escape, concrete consolidation and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- G. Form Ties:
 - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
 - 2. Place ties at least 2 inches away from finished ends and surfaces of concrete.
 - 3. Leave inner rods in concrete when forms are stripped.
 - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- H. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete. Sequence form erection to allow for timely observation / inspection of reinforcement without having to disassemble formwork in the event changes are required.
- I. Embedded Items:
 - 1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, dowels, and other features as indicated in the plans.
 - 2. Do not embed wood or uncoated aluminum in concrete.
 - 3. Obtain installation and setting information for embedded items furnished under other Specification sections.
 - 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
 - 5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.
- J. Cleanouts and Access Panels:
 - 1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
 - 2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Architect/Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.
- E. Repair damage to concrete caused by form removal.

3.7 ERECTION TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

3.8 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- B. Notify Architect/Engineer after placement of reinforcing steel and forms are set to one side only of wall for reinforcing steel inspection.
- C. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bars, welded wire fabric for cast-in-place concrete.
 - 2. Reinforcement accessories.

- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Bar Reinforcement:
 - 1. Basis of Measurement: By the cubic yard.
 - 2. Basis of Payment: Includes reinforcement, placement, and accessories.

1.3 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete.
 - 3. ACI SP-66 - ACI Detailing Manual.

- B. ASTM International:
 - 1. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 2. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

- C. American Welding Society:
 - 1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

- D. Concrete Reinforcing Steel Institute:
 - 1. CRSI - Manual of Standard Practice.
 - 2. CRSI - Placing Reinforcing Bars.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate bar sizes, spacings, locations and quantities of reinforcing steel bending and cutting schedules and supporting and spacing devices.

- B. Certificates: Submit AWS qualification certificate for welders employed on the Work when reinforcement is to be welded.

- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements if requested by Architect or Engineer.
 - 1. Submit certified copies of mill test report of reinforcement materials analysis unless waived by the Architect or Engineer.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 318.
- B. Prepare shop drawings in accordance with ACI SP-66.
- C. Maintain one copy of each document on site.
- D. Special inspections shall be performed as required by the 2015 International Building Code and as outlined on sheet S2 of the contract documents.

1.6 QUALIFICATIONS

- A. Welders: AWS qualified or re-qualified within previous 12 months.

1.7 COORDINATION

- A. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

- A. Deformed Reinforcement: ASTM A615/A615M; 40 ksi yield strength for #4 bars and 60 ksi yield strength for #5 bars and larger unless noted otherwise, steel bars, unfinished.
- B. Welded Wire Fabric (WWF): ASTM A185. In flat sheets. For use in project only where specifically called for in plans.

2.2 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom of chairs for placement on earth.
- C. Special Chairs, Bolsters, Bar supports, Spacers adjacent to weather exposed concrete surfaces: plastic tipped steel type; size and shape to meet project specifications.

2.3 FABRICATION

- A. Fabricate concrete reinforcement in accordance with ACI 318 and CRSI Manual of Practice.
- B. Form reinforcement bends with minimum diameters in accordance with ACI 318.
- C. Weld reinforcement in accordance with AWS D1.4.
- D. Locate reinforcement splices not indicated on Drawings, at point of minimum stress.
- E. Reinforcing shall not be heated to be bent. All reinforcing shall be cold bent to ACI allowable bend diameters. Hooks and laps shall be of minimum lengths specified by ACI.

PART 3 EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Locate splices so they are staggered unless indicated otherwise in the plans and details.
- B. Accommodate placement of formed openings. Add reinforcement around openings as indicated in plan and details.
- C. Space reinforcement bars with minimum clear spacing in accordance with ACI 318.
 - 1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.
- D. Maintain concrete cover around reinforcement in accordance with drawings.
- E. Splice reinforcing where indicated on Drawings and in accordance with ACI 318.
- F. Maintain minimum concrete cover around reinforcing as follows:

<u>Item</u>	<u>Coverage</u>
*Reinforcement in concrete cast to earth:	3"
*Foundation concrete cast against formwork	1 ½"
*Slabs on Grade	1 ½"

(Note: specific dimensions and clearances shown in the plans shall govern over minimums shown in this schedule.)

- G. Wire tie splices together.
- H. Lap Welded Wire Fabric 6" (when applicable in the plans).
- I. Chair Welded Wire Fabric on 1" chairs as described in the plans.

3.2 FIELD QUALITY CONTROL

- A. Field observations will be performed at the discretion of the Architect / Engineer. Special Inspections shall be provided by an approved special inspector as required in the special inspection schedule indicated in the plans. The Special Inspector and Engineer shall be notified of all concrete placements for observations and special inspections. Notification shall be provided a minimum of 48 hours in advance of the pour. The Architect and Engineer shall be advised on a regular and frequent basis for all subsequent work to choose appropriate observation times.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete for the following:
 - 1. Footings, stemwalls, grade beams and other foundations.
 - 2. Slabs-on-grade.
 - 3. Slabs on metal deck.

- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories: Formwork and accessories. Placement of joint device anchors in formwork.
 - 2. Section 03 20 00 - Concrete Reinforcing.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Concrete - Vertical in Forms and horizontal in foundations and slabs-on-grade.
 - 1. Basis of Measurement: By the cubic yard.
 - 2. Basis of Payment: Includes concrete, placement accessories, consolidating, curing.

1.3 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 305 - Hot Weather Concreting.
 - 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 - 4. ACI 308.1 - Standard Specification for Curing Concrete.
 - 5. ACI 318 - Building Code Requirements for Structural Concrete.
 - 6. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

- B. ASTM International:
 - 1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 2. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
 - 5. ASTM C150 - Standard Specification for Portland Cement.
 - 6. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
 - 7. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - 8. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - 9. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 10. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
 - 11. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Concrete.

12. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
13. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
14. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
15. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
16. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

1.4 SUBMITTALS

- A. Product Data: Submit data on joint devices, attachment accessories, admixtures and anchorages.
- B. Concrete Design Data:
 1. Submit concrete mix designs for each use and concrete strength. Submit separate mix designs when admixtures are required for the following:
 - a. Hot and cold weather concrete work.
 - b. Air entrained concrete work.
 2. Identify mix ingredients and proportions, including admixtures.
 3. Identify each location and type of finished product that each mix is submitted for use in.
- C. Submit all truck batch tickets to the Architect or Engineer and identify where the batch was place in the project.
- D. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.
- E. Accurately record actual locations of embedded utilities and components which are concealed from view.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.
- B. Conform to ACI 305 when concreting during hot weather.
- C. Conform to ACI 306.1 when concreting during cold weather.
- D. Acquire cement and aggregate from one source for Work.
- E. Maintain one copy of each document on site.
- F. Special inspections shall be performed as required by the 2015 International Building Code and as outlined on sheet S2 of the contract documents.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days. Maintain job site environmental record of maximum and minimum daily temperatures.

1.7 COORDINATION

- A. Coordinate placement of joint devices, sleeves, block-outs, etc. with erection of concrete formwork and placement of form accessories.
- B. Coordinate work with all other trades related to the concrete placement and embedments.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type II.
- B. Normal Weight Aggregates: ASTM C33. Coarse aggregate maximum size: 3/4 inches and in accordance with ACI 318.
- C. Water: ACI 318; potable, without deleterious amounts of chloride ions.
- D. Synthetic Fiber Reinforcement (when specified in the plans): ASTM C948; For use at limited exterior slabs-on-grade locations with the approval of the Architect / Engineer and at other locations as specified in the contract documents. The synthetic fiber reinforcement shall be batched integrally in the concrete mix.

2.2 ADMIXTURES

- A. Air Entrainment: ASTM C260.
- B. Chemical: ASTM C494/C494M: Type A - Water Reducing. Approval by engineer required. Other admixtures may be allowed for specific uses when specifically requested for approval.
- C. Fly Ash: ASTM C618 Class F. See general notes for additional requirements.
- D. Plasticizing: ASTM C1017/C1017M Type II, plasticizing and retarding. Approval by Engineer required.
- E. Fly Ash: ASTM C618, Class 'F'; 25% maximum, 10% minimum of total cementitious content of the mix. Fly ash shall be used at a ratio of 1.0 lb for each 1.0 lb. of Portland Cement which it replaces.

2.3 CONCRETE MIX

- A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.
- B. Select proportions for normal weight concrete in accordance with ACI 301 and 318 or from successful historical performance of previously used mix designs.
- C. Provide concrete to the following criteria – 4000 psi:
 - 1. Minimum Compressive Strength (7 days): 2500 psi.
 - 2. Minimum Compressive Strength (28 days): 4000 psi, see plans for specific strength for specific uses.

3. Minimum Cement Content: 564 lbs. per c.y.
 4. Slump: 2 ½ to 4 ½ inches.
 5. Maximum Water/Cementitious Ratio: 0.46.
 6. Synthetic Fiber Reinforcement: approved rate as recommended by mfr. (when specified in the plans).
- D. Provide concrete to the following criteria – 3000 psi:
1. Minimum Compressive Strength (7 days): 2100 psi.
 2. Minimum Compressive Strength (28 days): 3000 psi, see plans for specific strength for specific uses.
 3. Minimum Cement Content: 519 lbs. per c.y.
 4. Slump: 2 ½ to 4 ½ inches.
 5. Maximum Water/Cementitious Ratio: 0.52.
 6. Synthetic Fiber Reinforcement: approved rate as recommended by manufacturer (when specified in the plans).
- E. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.
1. Use accelerating admixtures in cold weather only when approved by Architect / Engineer. Use of admixtures will not relax cold weather placement requirements.
 2. Do not use calcium chloride nor admixtures containing calcium chloride.
 3. Use set retarding admixtures during hot weather only when approved by the engineer.
 4. Add air entraining agent to normal weight concrete mix for work permanently exposed to exterior and for work exposed to a freezing environment in the first 7 days after pour. Entrained air shall be 4% to 8% by volume.
- F. Average Compressive Strength Reduction: Not permitted.
- G. Ready Mixed Concrete: Mix and deliver concrete in accordance with ASTM C94/C94M.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.
- C. Verify site conditions meet plan requirements.
- D. Verify formwork and all locations for concrete placement are clean.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. All debris and loose material shall be cleaned or washed off of reinforcing, formwork and existing work before placing concrete.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete and clean the holes by wire brushing and flushing out with compressed air. Insert steel dowels in Hilti Hit Adhesive Anchor System or approved equivalent. Verify wall contraction joint chamfers are in place in appropriate locations.

- C. Remove debris and ice from formwork, reinforcement, earth and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301. All concrete shall be placed against formwork. All construction joints shall be cast against straight and secure bulkheads with block-outs to key the two placements together.
- B. Notify Architect/Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, etc. are not disturbed during concrete placement.
- D. Place joint filler in wall pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- E. Consolidate all concrete by mechanical vibration, including flat work.
- F. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- G. Place concrete continuously between predetermined expansion, contraction and construction joints.
- H. Temporary anchors, shotpins, anchor bolts, expansion anchors, etc. shall not be used for anchorage in areas of slabs which shall be exposed.
- I. When required by the plans and details, separate slabs from vertical and / or horizontal surfaces with 30# building paper. See plans.
- J. Install contraction joints and construction joints in pattern and locations shown on plans. Install top of construction joint form to required elevations. Secure to resist movement by wet concrete.
- K. Thoroughly vibrate all concrete, including flat work, immediately behind placement. Do not over-vibrate concrete. Do not move concrete by vibration. Do not cause segregation. The workman operating the vibration equipment shall be experienced in proper techniques and procedures. He shall be familiar with and follow ACI recommendations. The Engineer may inspect, evaluate and reject. At least one spare vibrator shall be available at each concrete placement.
- L. Saw cut slab contraction joints within 3 hours after placing concrete. Use Soft-Cut saw system. Cut approximately 5/8" of depth into slab thickness.
- M. Screed flat floor slabs level, maintaining surface flatness of 1/8 inch maximum variation from specified elevation. Also, the surface shall not vary more than 1/8" in any 8'-0" length. Screed sloping slabs according to elevations given in the plans. Sloping flatwork shall maintain the plane of intended slope within 1/8" in any 8'-0" in any direction.
- N. Slope concrete surfaces where and as required in the plans.

3.4 CONCRETE FINISHING

- A. Provide formed concrete surfaces where they will be left exposed.

- B. Finish concrete floor surfaces in accordance with ACI 301.
- C. Wood float surfaces which will receive tile with full bed setting system.
- D. Steel trowel surfaces which will receive carpeting, resilient flooring, seamless flooring or thin set tile.
- E. Steel trowel surfaces which are scheduled to be exposed.
- F. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly down to drains at 1/8 inch per foot unless indicated differently on Drawings.
- G. Provide light broom finish on exposed exterior slabs.
- H. Provide a dust-proof sealer on all interior exposed concrete surfaces. The sealer product information and instructions for its use shall be submitted to the Architect for approval.

3.5 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure concrete in accordance with ACI 308.1. Cure slab surfaces with a wet cure method. The concrete shall be maintained in a moist condition for 7 days. No area shall be allowed to dry out before the 7 days. Slabs shall not be cured with curing compound unless specifically approved by the Architect / Engineer.
- D. Concrete other than slabs shall be cured with approved curing compound as soon as the sheen has gone or when the forms are removed. Do not apply curing compound to surfaces which will receive future concrete pours.

3.6 FIELD QUALITY CONTROL

- A. Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Field inspection and testing will be performed in accordance with ACI 301 and 318.
- C. Provide free access to Work and cooperate with appointed observation / testing firm. A testing laboratory technician shall be present for all concrete placement.
- D. Submit proposed mix design of each type of concrete to the Engineer and testing firm for review and approval a minimum of 14 days prior to commencement of Work.
- E. Three concrete test cylinders shall be taken for every 75 or less cu. yds. of each type of concrete placed. A minimum of 1 set of 3 cylinders shall be taken for any concrete placed in one day. Record location of concrete placed for each set of concrete tests.
- F. One additional test cylinder shall be taken during cold weather concreting for each 75 cu. yds. or less.

- G. Cylinders shall be cured for 3 days minimum under the same field conditions as that of the concrete they represent.
- H. One slump test shall be taken for each set of test cylinders taken and for every 24 c.y. placed. Concrete to be slumped shall be sampled from the middle 1/3 of the load. A slump shall be taken anytime the concrete appears to have a slump greater than 4". Excessive slump shall be sufficient cause for rejection of concrete. The location of concrete placement for all concrete with excessive slump or otherwise out of specification shall be recorded. The Architect / Engineer shall be immediately notified of out-of-specification concrete.
- I. Air entrainment shall be tested when each set of cylinders are made.
- J. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.7 PATCHING

- A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.
- C. Patch imperfections as directed by Architect/Engineer and in accordance with ACI 301.

3.8 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Architect/Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.
- D. Concrete slabs out of vertical tolerance shall be repaired or replaced under the specific direction of the Architect / Engineer.
- E. Repair or replacement of defective concrete shall be done at no expense to the owner.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Structural steel framing members.
- B. Base plates, anchor bolts, embed plates, shear stud connectors.
- C. Grouting under base plates.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Anchors for casting into concrete.

1.3 RELATED SECTIONS

- A. Section 05 21 00 - Steel Joists.
- B. Section 05 31 10 - Steel Roof Deck.
- C. Section 05 40 00 - Cold Formed Metal Framing
- D. Section 05 50 00 - Metal Fabrications
- E. Section 09 90 00 – Painting and Coating

1.4 REFERENCES

- A. ASTM A992 and A36 - Structural Steel.
- B. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
- C. ASTM A123 - Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.
- E. ASTM A325 - High Strength Bolts for Structural Steel Joints.
- F. ASTM A490 - Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints.
- G. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- H. AWS D1.1 - Structural Welding Code.
- I. AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
- J. ASTM A588 - High-Strength Low-Allow Structural Steel with Atmospheric Corrosion Resistance.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate sizes, spacing, grades of materials, finishes, locations of structural members and fasteners.
 - 2. Connections; connector types, sizes, bolts, washers, holes, slots, plates, angles and all other pertinent criteria.
 - 3. Indicate welded connections with size and net weld lengths, weld returns, grinding where required, and all other descriptions required to properly describe the connection.
 - 4. Indicate all information shown in the structural drawings, and otherwise required for proper description of materials to be fabricated and erected.
 - 5. Shop drawings shall provide all information necessary for fabrication and erection/assembly.
 - 6. Shop drawings shall be detailed and dimensioned according to AISC standards.
 - 7. Provide shop drawings in electronic format (pdfs) and two full size hard copy's to the Structural Engineer for review.
- B. Manufacturer's Mill Certificate and Mill Test Reports: Submit when requested by the Architect/Engineer.
- C. Welders' Certificates: Submit Certificates certifying welders that are employed on the Work, verifying AWS qualifications within the previous 12 months. Welders shall be certified for all the types of welding which they will be doing.

1.6 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
- B. Special inspections shall be performed as required by the 2015 International Building Code and as outlined on sheet S2 of the contract documents.

1.7 QUALIFICATIONS

- A. Fabricator: Company specializing in performing the work of this Section with minimum 5 years documented experience.
- B. Erector: Company specializing in performing the work of this Section with minimum 5 years documented experience.
- C. Design connections not detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the state where the project is located.

1.8 FIELD MEASUREMENTS

- A. The General Contractor shall verify that field measurements are as shown on the Drawings or that they are different from the plan dimensions in which case they shall be communicated to the Architect/Engineer and the structural steel fabricator.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel Members: ASTM A992 for all wide flange beams and A36 as applicable

to miscellaneous and other steel shapes.

- B. Structural Tubing: ASTM A500 Grade B.
- C. Pipe: ASTM A53, Grade B.
- D. Shear Stud Connectors: forged steel, headed, un-coated.
- E. Bolts, Nuts, and Washers: ASTM A325.
- F. Anchor Bolts: ASTM A307.
- G. Welding Materials: AWS D1.1; type required for materials being welded.
- H. Grout and Drypack: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 7,000 psi at 7 days.
- I. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

2.2 FABRICATION

- A. Fabricate steel according to details and AISC requirements.
- B. Fabricate members as described in the drawings as required for the type of connections intended. When weld sizes and length are not specifically detailed, weld members to be connected all-around with a fillet weld. The fillet size shall be 5/16" or of the size equal to the thickness of the thinnest member being joined, governed by whichever is smaller.
- C. Holes for bolted fasteners shall not be flame cut.

2.3 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP-2.
- B. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, or will receive cementitious fireproofing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.2 ERECTION

- A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent support.
- B. Field weld components indicated on Drawings. Provide fillet welds when welding is required but not described in the drawings. Fillet size shall be 5/16" or equal to the thickness of the thinnest member being connected when not indicated otherwise.
- C. Do not field cut or alter structural members without approval of Architect/Engineer.

- D. Install and connect all roof edge and ledger angles straight, true, and equidistant from walls for their full length. Locate them at dimensions indicated in plans for attachment of fascias and roof decks. Butt-weld splice points all around. Each section of angle shall have a minimum of two supports. Discontinue and do not butt-weld roof ledger angles at building expansion joints. Ledger angles shall be connected either with welds or anchor bolts unless detailed otherwise in plans. Expansion anchors are not acceptable for connection of ledger angles.
- E. Grout under complete area of base plates with a commercially manufactured grout or dry-pack with a minimum compressive strength of 3000 psi at 2 days of age and 7000 psi minimum at 7 days. Follow manufacturers instructions. Grouting and dry-packing shall be done before roof loads are in place
- F. Holes for bolted fasteners shall not be flame cut in the field.
- G. All bolts shall be tightened by "Snug Tightened Joint" method, unless noted otherwise.

3.3 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Alignment: 1/4 inch.

3.4 FIELD / SHOP QUALITY CONTROL

- A. Field observation will be performed as described in the plans and at the discretion of the Architect and Engineer. Contractor shall advise Architect / Engineer of progress of work to observe work at critical times. Notice given shall be a minimum of 48 hours for Architect/Engineer observations and for Special Inspections.
- B. The Contractor shall advise the Architect and Engineer of the progress of construction to provide the opportunity for observations to occur before work is covered. A final observation shall be called for before the steel erector leaves the job, and before deck installation is complete.
- C. All field erection problems and errors shall be brought to the attention of the Engineer for review and direction before proceeding with the work. Failure to do so may mean the Contractor shall be responsible for disassembly of the work to the point that repairs can be made.
- D. Special inspections shall be performed as required by the 2015 International Building Code and as outlined on sheet S2 of the contract documents.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes shop fabricated ferrous metal items.
- B. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete: Execution requirements for embedded anchors and attachments for metal fabrications.
 - 2. Section 05 12 00 – Structural Steel: Column anchor bolts
 - 3. Section 05 21 00 – Steel Joists: Bearing plates, including anchorage.
 - 4. Section 09 90 00 – Painting and Coating: Field applied paint finish.
- C. Aluminum Association:
 - 1. AA DAF-45 - Designation System for Aluminum Finishes.
- D. ASTM International:
 - 1. ASTM A36/A36M - Carbon Structural Steel.
 - 2. ASTM A53/A53M - Pipe, Steel, Black and Zinc-Coated, Welded and Seamless.
 - 3. ASTM A123/A123M – Zinc Coating (Hot-Dip) on Iron and Steel Products.
 - 4. ASTM A153/A153M – Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 6. ASTM A276 – Stainless Steel Bars and Shapes.
 - 7. ASTM A297/A297M – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application.
 - 8. ASTM A283/283M – Low and Intermediate Tensile Strength Carbon Steel Plates.
 - 9. ASTM A307 – Carbon Steel Externally Threaded Standard Fasteners.
 - 10. ASTM A312/A312M – Seamless and Welded Austenitic Stainless Steel Pipes.
 - 11. ASTM A325 – Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 12. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
 - 13. ASTM B210 - Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
- E. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
 - 2. AWS D1.6 - Structural Welding Code - Stainless Steel.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.3 QUALIFICATIONS

- A. Welder's Certificates: Submit under provisions of Section 01 33 00, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.4 FIELD MEASUREMENTS

Verify field measurements are as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS – STEEL

- A. Steel Sections: ASTM A36/A36M and ASTM A992.
- B. Steel Plate: ASTM A36.
- C. Hollow Steel Sections: ASTM A500, Grade B.
- D. Steel Pipe: ASTM A53/A53M, Grade B
- E. Fasteners: ASTM A325.
- F. Bolts, Nuts and Washers: ASTM A325.
- G. Welding Materials: AWS D1.1, type required for materials being welded.
- H. Sheet Steel: ASTM A653/A653M, Grade 33 Structural Quality with galvanized coating.
- I. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

2.2 MATERIALS - ALUMINUM

- A. Extruded Aluminum: Alloy 6063.
- B. Sheet Aluminum: Alloy 6063.
- C. Aluminum-Alloy Drawn Seamless Tubes: Alloy 6063 .
- D. Aluminum-Alloy Bars: Alloy 6063.
- E. Welding Materials: AWS D1.1; type required for materials being welded.

2.3 ANCHOR BOLTS

- A. Anchor Rods: ASTM A307, TYPE C
 - 1. Shape: as shown
 - 2. Furnish with nut and washer.

2.4 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.

- B. Fabricate items with joints tightly fitted and secured.
- C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.5 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify field conditions are acceptable and are ready to receive Work.
- B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.
- B. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.
- C. Field weld components indicated on drawings or shop drawings.
- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain approval of Architect/Engineer prior to site cutting or making adjustments not scheduled.

- F. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

3.4 ERECTION TOLERANCES

- A. Maximum variation from plumb: 1/4 inch.
- B. Maximum offset from true alignment: 1/4 inch.

3.5 SCHEDULE

- A. The schedule is a list of example items, some of which may not be used in the project. Refer to drawing details for items not specifically scheduled.
- B. Ladder: Steel, 3/8 x 2 side rails spaced at 20 inches, rungs of one inch diameter tubular rod spaced 12 inches on center, space rungs 7 inches from wall surface with steel mounting brackets and attachments spaced not more than 4'-0" on center, prime paint finish.
- C. Bumper posts and guard rails: as detailed, prime paint finish.
- D. Bollards: Steel pipe, concrete filled, crowned cap, as detailed, prime paint finish.
- E. Ledge angles: Angles and plates attached or not to structural framing: for support of metal decking, joists and masonry, prime paint finish.
- F. Lintels: As detailed, prime paint finish.
- G. Foot scrapers and mud and foot grilles, as detailed, galvanized finish.
- H. Toilet partition suspension members: Angle section, prime paint finish.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Thermally insulated hollow metal doors with frames.
- D. Hollow metal borrowed lites glazing frames.
- E. Accessories, including glazing.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 91 13 - Exterior Painting: Field painting.
- D. Section 09 91 23 - Interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. NFPA: National Fire Protection Association.
- C. SDI: Steel Door Institute.
- D. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.
- I. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- M. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

- N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- O. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - 4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 5. Southwestern Hollow Metal; Raton, New Mexico

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Manufacturers standard for application indicated.
 - 5. Typical Door Face Sheets: Flush.
 - 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.

7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Type A, Exterior Doors: Thermally insulated.
 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
 2. Door Core Material: Vertical steel stiffeners with fiberglass batts.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 3. Door Thermal Resistance: R-Value of 6.0.
 4. Door Thickness: 1-3/4 inch, nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Full profile/continuously welded type.
 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
 3. Weatherstripping: Separate, see Section 08 71 00.
- F. Mullions for Pairs of Doors: Fixed, with profile similar to jambs.
- G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- H. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- I. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inch high to fill opening without cutting masonry units.
- J. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 08 80 00, factory installed.

- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
 - 1. Manufacturers:
 - a. ITW Commercial Construction North America; ITW CCNA-Buildex Tek's Select Series: www.ITWBuildex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
- E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- D. Install door hardware as specified in Section 08 71 00.
- E. Comply with glazing installation requirements of Section 08 80 00.
- F. Coordinate installation of electrical connections to electrical hardware items.
- G. Touch up damaged factory finishes.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 33 23
OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Overhead coiling doors and shutters, operating hardware, non-fire-rated and exterior; manually operated.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 08 71 00 - Door Hardware: Cylinder cores and keys.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide general construction and component connections and details.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- D. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
- E. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Overhead Coiling Doors:
 - 1. Clopay Building Products; Model CESD20: www.clopaydoor.com/#sle.
 - 2. Cornell Iron Works, Inc: www.cornelliron.com/#sle.
 - 3. The Cookson Company: www.cooksondoor.com/#sle.
 - 4. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COILING DOORS

- A. Exterior Coiling Doors: Steel slat curtain.
 - 1. Capable of withstanding positive and negative wind loads of 20 psf, without undue deflection or damage to components.
 - 2. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 8.1.
 - 3. Nominal Slat Size: 2.65 inches wide x required length.
 - 4. Thickness: 15/16 inch.
 - 5. Finish: Factory painted, color as selected.
 - a. GlavaNex Coating System and phosphate treatment followed by baked-on polyester coat; color as selected from manufacturer's standard color range.
 - b. Minimum 2.5 mils cured film thickness; ASTM D-3363 pencil hardness; H or better.
 - 6. Guides, Formed Sheet Metal: Galvanized steel.

7. Hood Enclosure: Manufacturer's standard; primed steel.
8. Manual hand chain lift operation.
9. Mounting: As indicated on drawings.
10. Locking Devices: Lock and latch handle on inside.

2.03 MATERIALS AND COMPONENTS

- A. Curtain Construction: Interlocking slats.
 1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
 3. Weatherstripping: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
- B. Steel Slats: Minimum thickness, 20 gage, 0.0359 inch; ASTM A653/A653M galvanized steel sheet.
- C. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.
- D. Guides - Sheet Metal: Formed from sheet metal, 7 gage, 3/16 inch thick; ___ inch wide.
 1. Hot-Dip Galvanizing: Minimum G90 coating, in compliance with ASTM A653/A653M.
 2. Prime paint, and manufacturer's standard light gray baked-on polyester finish.
- E. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.
 1. Minimum thickness; 24 gage, 0.040 inch.
 2. Manufacturer's standard light gray baked-on polyester finish.
- F. Lock Hardware:
 1. Cylindrical Locking Mechanism: Latchset lock cylinder, specified in Section 08 71 00.
 2. Latch Handle: Manufacturer's standard.
 3. Manual Chain Lift: Provide padlockable chain keeper on guide.
- G. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Install enclosure and perimeter trim.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION

SECTION 13 34 19

PRE-ENGINEERED METAL BUILDINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications sections apply to work specified in this section.

1.2 RELATED SECTIONS:

- A. Section 03 10 00 – Concrete Forming and Accessories: Anchor bolts
- B. Section 03 30 00 – Cast-in-place Concrete

1.3 DESCRIPTION OF WORK:

- A. Clear span rigid frame pre-engineered metal framing and metal roof and wall panels, with "X" bracing and portal frames, with gutter, downspouts and insulation as shown on the drawings. Bay width, eave height and roof pitch as indicated on the drawings.
- B. The Metal Building Systems manufacturer shall be a single source manufacturer, in that all components of the metal building system shall be designed and manufactured by the same company. Manufacturer's standard components may be used, providing components, accessories, and complete structure conform to the architectural design appearance shown and to specified requirements.
- C. Manufacturer's standard components may be used, providing components, accessories, and complete structure conform to architectural design appearance shown and to specified requirements.
- D. Concrete floor and foundations and installation of anchor bolts are specified in Division 03.

1.3 QUALITY ASSURANCE:

- A. Manufacturer Certification: The metal building system manufacturer shall be a certified by the American Institute of Steel Construction (AISC) in category Metal Buildings(MB).
- B. Warranties: Provide manufacturer's written weather tightness warranty of twenty (20) years against leaks in roof panels. Both the metal roofing system manufacturer and the contractor shall sign warranty.
- C. Provide manufacturer's standard paint film written warranty for twenty (20) years against cracking, peeling, chalking and fading of the coating on painted roof panels.
- D. Design Criteria: For structural steel members, comply with AISC-MB "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings".
- E. For light gauge steel members, comply with AISI "Specification for the Design of Cold-Formed Steel Structural Members".
- F. Design primary and secondary members and covering for applicable loads and combination of loads in accordance with Metal Building Manufacturer's Association (MBMA) "Recommended Design Practices Manual".
- G. For Welded connections, comply with AWS "Structural Welding Code".

1.4 DESIGN LOADS

- A. The design loads shall be as follows:
1. Dead Load: Weight of structure as determined by Metal Building Manufacturer
 2. Collateral Load = 3 psf.
 3. Roof Live Load = 20 psf
 4. Roof (Flat) Snow Load = 45 psf
 5. Wind Load: 90 mph exposure "B" as per 20015 IBC.
 6. Seismic Design Category B.

1.5 DEFLECTION CRITERIA

The building shall be designed for the following deflection criteria.

- A. Primary Framing: Vertical Deflection in all buildings shall not exceed $L/240$.
- B. Horizontal Deflection: Non-crane buildings shall not exceed lateral drift of $H/200$.
- C. Secondary Framing: Vertical Deflection of roof purlins shall not exceed $L/240$.
- D. Horizontal Deflection of wall members shall not exceed $L/360$.
- E. All columns shall be designed as a pinned base.
- F. The application and combination of design loads shall be in accordance with MBMA standard practice.
- G. Dead load of the building is the weight of all specified permanent construction such as floor, roof framing and covering members.
- H. Roof live loads are all loads, including snow, exerted on a roof, except dead, wind and lateral loads.
- I. Wind load is the load caused by the wind blowing from any horizontal direction.
- J. Seismic load is the assumed lateral load acting in any horizontal direction on the structural system due to the action of earthquakes.
- K. A letter certifying that the building will conform to the required loading and deflection specification shall be signed by a registered engineer in the State of New Mexico and submitted as part of the bidding and shop drawing documents.
- L. Design calculations, proposed drawings consisting of frame cross sections, roof and wall framing plans, anchor bolt plans and bracing drawings, shall be furnished with the bid and shop drawing documents.
- M. Anchor bolts are to be sized to resist the governing reactions induced by the design loads on the structure and are not to be less than the sizes and strengths shown on the contract drawings. All anchor bolts are to be unpainted so as to bond with the concrete and are to be set in strict accordance with the anchor bolt shop drawings. Foundation reactions shall be furnished by the metal building manufacturer as required for its building systems. Design of the load transfer of anchor bolts into the foundation is provided by the Engineer of record.

1.6 FABRICATION CRITERIA

- A. Provide prefabricated metal buildings as produced by a manufacturer who is regularly engaged in fabrication and erection of pre-engineered metal structures of type and quality Indicated. The manufacturer shall be a member of the MBMA.

- B. Structural members of welding plate sections have the flanges and webs joined by a continuous automatic submerged arc welding process. Shop welding shall be performed by certified welders.
- C. Workmanship and fabrication tolerances shall be in accordance with AISC quality control standards.
- D. Clearly and legibly mark each piece and part of assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
- E. The size and weight of the building components be prepared, packaged and shipped with permitted transportation by common carrier, unless stipulated otherwise in the contract documents.

1.7 SUBMITTALS

- A. **Product Data**
Submit manufacturer's product information, specifications and installation instructions for building components and accessories.
- B. **Shop Drawings**
Submit complete erection drawings showing anchor bolt setting plan with bolt sizes, sidewall, end wall, and roof framing, transverse cross sections, covering and trim details, and accessory installation details to clearly indicate proper assembly of building components. The drawings shall be sealed and signed by the M.B. engineer.
- C. **Certification**
Submit written Certification prepared and signed by a Professional Engineer, registered to practice in the State where building is to be erected, verifying that building design meets indicated loading requirements and codes of authorities having jurisdiction.
- D. **Samples**
Submit samples of the following. Architect's review will be for color and texture only. Compliance with other requirements is responsibility of Contractor.
 - 1. 12" long by actual width of roofing panels, with required finishes.
 - 2. Fasteners for application of roofing and siding panels.

1.8 MAINTENANCE STOCK

- A. Furnish at least 5% excess over required amount of nuts, bolts, screws, washers, and other required fasteners for each building. Pack in cartons and store on site where directed.

1.9 DELIVERY, STORAGE AND HANDLING:

- A. Deliver and store prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal sheets or panels so that water accumulations will drain freely. Do not store sheets or panels in contact with other materials, which might cause staining.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Butler Manufacturing Company (Specified)
- B. Varco-Pruden Buildings, Inc.

- C. Alliance Steel Building Systems
- D. American Steel Building Co., Inc.
- E. Other manufacturer of equal or better quality will be considered for approval as specified in section 01 63 00 – Product Substitution Procedures.

2.2 MATERIALS

- A. Hot-Rolled Structural Shapes: ASTM A 36 or A 529.
- B. Tubing or Pipe: ASTM A 500, Grade B; ASTM A 501; or ASTM A 53.
- C. Members Fabricated from Plate or Bar Stock: 42 ksi minimum yield strength: ASTM A 529, A 570, or A 572.
- D. Structural Steel intended for use in roll formed or pressed broken secondary members: 55,000 psi minimum yield strength; ASTM A 570.
- E. Members Fabricated by Cold Forming: ASTM A 607, Grade 50.
- F. Galvanized Steel Sheet: ASTM A 446 with G 90 coating; "Class" to suit building manufacturer's standards.
- G. Galvalume steel coil used in roll formed or press broken roof covering: ASTM A792.
- H. Structural bolts and nuts used with primary framing: ASTM A 325.
- I. Structural bolts and nuts used with secondary framing: ASTM A 307.

2.3 STRUCTURAL FRAMING COMPONENTS

- A. Rigid Frames: Hot rolled structural steel. Factory welded and shop painted built-up "I" shape or open web rigid frame consisting of tapered or parallel flange beams and tapered or parallel flange columns. Furnish complete with attachment plates, bearing plates, and splice members. Factory drilled for bolted field assembly.
- B. Provide rigid frame at end walls when indicated so in plans.
- C. Provide length of span and spacing of frames as indicated in the plans, slight variations may be acceptable to meet manufacturer's standard.
- E. End Wall Columns: Factory welded, built-up "I" shape or cold formed sections. Fabricate of minimum 14 ga. material. Shop painted.
- F. Wind Bracing: Portal frames and 'X'-bracing shall be designed for the lateral deflection criteria.
- G. Secondary Framing: Purlins, eave struts, end wall beams, flange and sag bracing; minimum 14 ga. rolled formed sections. Shop painted.
- H. Base channel, purlin spacers; minimum 14 ga. cold formed steel, galvanized.
- I. Bolts: ASTM A 307 or A 325 as necessary for design loads and connection details. Shop painted, except provide zinc or cadmium-plated units when in direct contact with panels.
- J. Fabrication: Shop fabricate to the indicated size and section, complete with base plates, bearing plates, and other plates as required for erection, welded in place, and with all

required holes for anchoring or connections shop drilled or punched to template dimensions.

- K. Shop connections power riveted, bolted, or welded. Field connections bolted.
- L. Shop Painting: Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of SSPC-SP3 for power tool cleaning, SSPC-SP7 for brush-off blast cleaning.
- M. Prime structural steel primary and secondary framing members with manufacturer's standard rust-inhibitive primer having over 50% rust-inhibitive pigment, such as red-lead mixed pigment alkyd varnish (FS TT-P-86, Type II) or zinc chromate iron-oxide alkyd (TT-P-636).
- N. Prime galvanized members, after phosphoric acid pretreatment, with zinc dust-zinc oxide primer (FS TT-P-641).

2.4 ROOFING AND SIDING

- A. General: Provide roofing and siding sheets as indicated. Provide flashings, closers, fillers, metal expansion joints, ridge covers, fascias and other sheet metal accessories, factory formed of same material and finish as roofing and siding.
- B. Approved Roof Panels: MR 24 Standing Seam Roof System by Butler Manufacturing Company.
- C. Panels: Rolled formed panels, 24 inches wide, 24 gage steel coated both sides with a layer of Galvalume aluminum zinc alloy (approximately 55% aluminum, 45% zinc) applied by continuous hot dip method. Minimum 0.55 ounce coated weight per square foot as determined by the triple spot test per ASTM A 792.
- D. Panels shall be of maximum possible lengths to minimize end laps.
- E. Ridge assembly shall be designed to allow roof panels to move lengthwise with expansion/contraction as the roof panel temperature changes. Parts shall be factory pre-punched for correct field assembly. Panel closures and interior reinforcing straps shall be installed to seal the panel ends.
- F. Panel Design: Roof panels shall be designed in accordance with AISI "Specifications for the Design of Light-Gage, Cold Formed Steel Structural Members, latest edition."
- G. The paneling system shall be designed to support design live and snow loads.
- H. End wall trim and roof transition flashings shall allow the roof panel to the end wall panels and /or the parapets as the roof expands and contracts with temperature changes.
- I. Fasteners: All connections of the roof panels to structural members, except at eave, shall be made with clips with movable tabs that are seamed members. Fasteners shall contain a metal backed rubber washer torque indicator.
- J. Panel to panel connections shall be made with a positive, field formed standing double-lock seam, formed by a seaming machine. All side sealant shall be factory applied.

2.5 APPROVED WALL PANELS

- A. Butler Rib II System by Butler Manufacturing Company. Rolled formed panels, 36 inches wide with four major corrugations, 1-1/2 inches high 12 inches on center with two minor corrugations between the major corrugation the entire length of the panel, 24 gage steel,

galvanized, per ASTM A-653 and painted with a full strength, 70% Kynar 500 & Hylar 5000 fluoropolymer coating system from manufacturers standard exterior colors.

- B. Flashings, trim closures and similar items shall be as detailed on drawings as supplied by the manufacturer of the panel.

2.6 SHEET METAL ACCESSORIES

- A. General: Accessories shall be coated with similar materials as steel roofing panels.
- B. Gutters: Formed in sections not less than 20 twenty feet in length, complete with end pieces, outlet tubes, and special pieces that may be required. Join sections with riveted and soldered or sealed joints. Unless otherwise indicated, provide expansion-type slip joint at center of runs. Furnish gutter supports spaced at 36" o.c, constructed of same metal as gutters. Provide standard bronze, copper, or aluminum wire ball strainers at each outlet.
- C. Downspouts: Formed in sections approximately 10 feet long, complete with elbows and offsets. Join sections with minimum 1-1/2" telescoping joints. Provide fasteners for top, bottom, and 5' o.c. intermediately between, designed to securely hold downspouts not less than one inch away from walls. Finish to match wall panels.
- D. Flashing Cones: Flexible material to fit snugly around pipe or conduit penetration, Buildex "Dektite" sized for pipe or conduit or similar multi-pipe flashing by Portals Plus or equal.

2.7 THERMAL INSULATION

- A. Glass Fiber Blanket Insulation: Glass fiber blanket insulation, shall be a factory laminated composite of facing material and a glass fiber insulation blanket of odorless, neutral colored, long filament, flexible resilient, 0.6 pcf density material. Conductivity of blanket insulation is $k=0.29$ for 40 degree F mean temperature and 0.31 for 70 degree F mean temperature. Blanket insulation shall not cause or accelerate corrosion with steel or aluminum nor breed or promote fungi or bacterial growth.
- B. Blanket insulation shall be provided in widths required and thickness, or layers, required for R30 in roof assemblies.
- C. One unfaced and one faced batt, with facing on room side, is acceptable. Facing to be reinforced vinyl to provide OSHA approved fall protection. "Simple Saver System" by Thermal Design, Inc. or approved equal.
- D. Secure insulation permanently in place to avoid sags, according to manufacturers recommended installation requirements.

PART 3 - EXECUTION

3.1 ERECTION

- A. Framing: Erect structural framing true to line, level and plumb, rigid and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use a non-shrinking grout to obtain uniform bearing and to maintain a level base line elevation. Moist cure grout for not less than seven days after placement.
- B. Purlins: Provide rake or gable purlins with tight fitting closure channels. Secure purlins to structural framing and hold rigidly to a straight line by sag rods.
- C. Install wind girts to bypass frame metal building rigid frame columns and flush frame endwall columns.

3.2 ROOFING

- A. General: Apply panels and associated items for neat and weather tight enclosure. Pre-punched or field drill purlins for roof panel clip fasteners in order to avoid "panel creep" or application not true to line. Protect factory finishes from damage.
- B. Provide weather seal under ridge cap; flash and seal roof panels at eave and rake with rubber, neoprene, or other closures to exclude weather.
- C. Roof Panels: All panel clips shall be positioned by matching the holes in the clip with the pre-punched holes in the secondary members.
- D. Panels shall be positioned and properly aligned by matching the pre-punched holes in the panel end with the pre-punched holes in the eave or ridge structural member and by aligning the panel with the panel clip.
- E. Panel sidelaps shall be field seamed by a lock-seaming machine.
- F. Panel endlaps, when required, shall be sealed at least 6 inches with manufacturer's standard sealant. Panel laps shall be joined by a two-piece clamped connection with a bottom-reinforced plate and a top panel strip. Panel endlaps shall be located directly over, but not fastened to, a supporting secondary roof structural member and be staggered so as to avoid a four-panel lap splice condition.
- G. Roof panels shall not be considered to be a safe work platform until completely secured to the structural system. The contractor to provide worked safety during panel installation shall provide Walkboards or other safety equipment as required by safety standards.

3.3 WALL SHEETS

- A. Apply elastomeric sealant continuous between metal base channel and elsewhere as necessary for waterproofing. Handle and apply sealant and back-up in accordance with sealant manufacturer's recommendations.
- B. Align bottoms of wall panels and fasten panels with blind rivets, bolts, or self-tapping screws. Fasten flashings, trim around openings, etc. with self-tapping screws.
- C. Install screw fasteners with power tool having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

3.4 SHEET METAL ACCESSORIES:

- A. Install gutters, downspouts, and other sheet metal accessories in accordance with manufacturer's recommendations for positive anchorage with manufacturer's recommendations for positive anchorage to building and weather tight mounting. Adjust operating mechanism for precise operation.

3.5 THERMAL INSULATION:

- A. Install in accordance with manufacturer's published directions, performed concurrently with installation of roof panels. Install blankets straight and true in one-piece lengths of both sets of tabs sealed to provide a complete vapor barrier.

3.6 DISSIMILAR MATERIALS:

- A. Where aluminum surfaces come in contact with ferrous metal or other incompatible materials, keep aluminum surfaces from direct contact by applications to the other material as follows:

- B. One coat of zinc chromate primer, FS TT-P-645, followed by two coats of aluminum paint, SSPC-Paint 101.
- C. In lieu of two coats of aluminum paint, apply one coat of high-build bituminous paint, SSPC-Paint 12, applied to a thickness of 1/16" over zinc chromate primer.
- D. Back paint aluminum surface where impracticable to paint other surface.

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SCOPE

- A. This section includes administrative items related to submittals, permits, substitutions, owner training, project closeout, and general requirements for performance of work by the Division 26 contractor. Reference Division 1 for other requirements.

1.2 SUBMITTAL REQUIREMENTS – DIVISION 26

- A. Engineer will commence review only when all Division 26 submittals have been received, due to interrelations between different sections. Review may be delayed if certain other related divisions have not been received, for example elevators or HVAC equipment.
- B. Organize submittals by section and name files with section number and title.
- C. All data required for review must be contained in the files provided to the Engineer. Links to manufacturer's websites will not be accepted.
- D. Re-submittals must contain markups that clearly delineate the changed items. Engineer will not re-review the entire submittal package in order to find the changes.
- E. Electronic submittals (pdf format) are preferred and can be reviewed faster. Paper submittals will also be accepted, but mixed format submittals are not acceptable.
- F. No fabrication or work which requires submittals shall begin until submittals are returned with the Engineer's approval.
- G. The Contractor shall coordinate each submittal with the requirements of the Work and of the Contract Documents. In the event that significant deviations are necessary between the submittals and the Contract Documents, he shall notify the Engineer in writing at the time of submission.
- H. The Contractor shall visit the project site, verify dimensions and existing conditions as far as possible without beginning work, and coordinate submittals accordingly. In the event that significant deviations are found between the existing conditions and the Contract Documents, he shall notify the Engineer in writing at the time of submission.
- I. Engineer's review does not constitute acceptance or responsibility for accuracy of dimensions, and will not relieve the Contractor from responsibility for errors or omissions in the Shop Drawings.
- J. Engineer's review does not relieve the Contractor of any requirements in the Contract Documents, nor shall it constitute approval of any deviation from the Contract Documents, unless such deviations are specifically stated by the Engineer in the submittal review.

1.3 PERMITS

- A. Permits necessary for the performance of the work under this contract shall be secured and paid for by the Contractor. Final inspection by the Engineer will not be made or certificate of final payment issued until certificates of satisfactory inspection from the inspection authorities are delivered. Reference Division 1 for permit requirements.

1.4 SUBSTITUTIONS

- A. All proposed product substitutions must be submitted for approval prior to bidding. Refer to Division 1 for substitution request deadline.
- B. Substitution reviews will be issued in Addenda to all bidders, no later than final Addendum before bid due date.
- C. Refer to the appropriate specification section for detailed requirements for each type of product.
- D. Bidder is required to document each substitution request with complete data substantiating compliance of proposed substitution with Contract Documents.

- E. Equipment and materials indicated in the Contract Documents form the Basis of Design for this project. Substitute products proposed by the bidder must equal the specified products in dimension, configuration, weight, electrical requirements, performance, etc.
- F. Any project design revision necessary to accommodate a substitute product will be the responsibility of the contractor. These revisions may be reflected in a shop drawing prepared by the contractor and approved by the Engineer. In the event that redesign is required by the Engineer, contractor shall be responsible for Engineer's fees to do so.
- G. Any impact to other Divisions created by a Division 26 product substitution shall be clearly described on the substitution request for consideration by the design team. General Contractor shall provide an estimate of associated cost impact to other Divisions where applicable.

1.5 TRAINING

- A. The electrical contractor shall conduct a 4 hour minimum training session with owner's designated staff to review all electrical equipment installed under this contract. At a minimum, the session will include operation and maintenance, programming, and basic operation of the systems.
- B. Contractor shall physically demonstrate the operation of each piece of equipment.
- C. A sign in sheet and agenda indicating a list of all equipment reviewed shall be included in the close out documents.

PART 2 DIVISION 26 SCOPE

2.1 ELECTRICAL WIRING AND CONTROL EQUIPMENT

- A. All line voltage wiring and conduit systems required by any Division shall be the responsibility of the Division 26 contractor. Every attempt will be made to reflect these requirements on the electrical sheets, but it is the Division 26 contractor's responsibility to obtain a complete drawing set, familiarize himself with the complete project scope, and coordinate with other Divisions.
- B. Responsibilities of the Division 26 contractor include but are not limited to:
 - 1. Installation and wiring of variable frequency drives (VFDs furnished by Division 23, startup and programming of VFDs shall be by VFD manufacturer's representative)
 - 2. Wiring to duct smoke detectors, including signal wiring to fire alarm system
 - 3. Wiring to fire/smoke dampers, including signal wiring and provision of disconnecting means at dampers
 - 4. Raceways for control circuits in all Divisions
 - 5. Field wiring of motor overload protection and starters (where required by equipment manufacturer)
 - 6. Field wiring of integral transformers in equipment (where required by equipment manufacturer)
- C. The Division 26 Contractor must coordinate with the Division 23 Contractor regarding the requirements of electrical control components. Any changes or additions required due to the specific nature of equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.
- D. The Division 26 Contractor must coordinate with the Division 23 Contractor to ensure that all required components of control systems are included and fully understood. The Owner shall not incur any additional cost as a result of lack of such coordination.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

- A. The Contractor shall carefully examine the drawings and specifications, visit the site of the work, fully inform himself as to all existing conditions, dimensions and limitations before starting work.
- B. If discrepancies are found between existing conditions and Contract Documents, Contractor shall notify Engineer for direction before proceeding. No claim for additional cost or time extension will be allowed without proper notice plus prior determination of time and cost to the owner.
- C. If existing active or non-active services (which are not shown on plans) are encountered that require relocation or disconnection, the Contractor shall notify the Engineer for a decision on proper handling of these services. The Contractor shall not proceed with the work until so authorized.
- D. Damage to existing improvements caused by the contractor or a party to the contractor during the demolition or construction phase shall be repaired prior to contract date of substantial completion at no additional expense to the owner.

3.2 DEMOLITION AND MODIFICATION OF EXISTING SYSTEMS

- A. The demolition plan shall be used as a schematic guide. Additional demolition may be required to complete the work indicated on the Contract Documents. If additional demolition scope is required, notify Engineer for direction before proceeding.
- B. If concealed conditions are found that are of an unusual nature not ordinarily encountered in work of this kind, and these conditions will impact the cost, schedule, or design of the project, notify Engineer for direction before proceeding. No claim for additional cost or time extension will be allowed without proper notice plus prior determination of time and cost to the owner.
- C. Division 26 contractor is responsible for disconnection of all electrical systems in walls, floors, and ceilings scheduled for removal in the Contract Documents.
- D. Division 26 contractor is responsible for provision of temporary wiring and connections when required to maintain existing systems in service during construction.
- E. Verify that all electrical equipment to be relocated or reused is in working order prior to removal. If the existing material is found to be deficient, contractor shall notify Engineer for direction before proceeding.
- F. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.
- G. Coordinate with general contractor for repair of adjacent construction and finishes damaged or exposed during demolition work. Repairs shall match existing finishes, and include paint on entire wall where required to match color.
- H. Unless otherwise noted in drawings, all existing removed equipment shall be stockpiled at the site at a location approved by Owner until an inspection by the Owner's representative determines what will be salvaged. All equipment not salvaged shall be properly disposed of off-site by Contractor.
- I. Division 26 contractor is responsible for properly disposing of existing hazardous materials removed under Division 26, including but not limited to:
 - 1. Fluorescent Lamps: remove from the site and properly disposing of them with a fluorescent lamp recycling company. Any used bulbs should be removed and placed in a new fluorescent lamp cardboard container. The cardboard container should be properly labeled. Boxes shall be stored and handled so that the used fluorescent lamps will not be crushed.
 - 2. Lighting Ballasts: Inspect ballasts to be removed. Ballasts with a "No PCB" label may be disposed of as normal construction debris. Ballasts without a "No PCB" label shall be assumed to contain PCBs:
 - a. Non-leaking ballasts with PCBs shall be disposed of at a landfill that will accept them. If no such landfill is available, treat as leaking below.

- b. Leaking ballasts shall be transported off-site by a PCB transporter to an EPA-approved chemical processing site.

3.3 PERFORMANCE OF NEW WORK

- A. Provide, install, and coordinate all Division 26 work indicated by Contract Documents. This consists of furnishing all labor, equipment, supplies and materials in addition to performing all operations including cutting, channeling and underground trenching, back fill and tamping necessary for the installation of complete power, lighting, or other systems as shown.
- B. Perform all electrical work in a neat and workmanlike manner in full compliance with all applicable, adopted codes; including, but not limited to: the national electrical code (NEC), UBC, IBC, NFPA, and ADA. all local and state requirements will be observed during the performance of this work.
- C. If any if discrepancies are found between Contract Documents and any associated legal or safety requirements, Contractor shall notify Engineer in writing. The Engineer will modify the Contract Documents as required. If the Contractor proceeds with any work he knows to be in variance of legal or safety requirements, the Contractor will assume all responsibility for this work. He will promptly correct the work when notified, without additional cost to the Owner.
- D. Coordinate all phases of the electrical work with the Architect and General Contractor. Schedule work to minimize disruption and inconvenience to the Owner.
- E. Obtain from system suppliers all wiring diagrams for all equipment and ensure that manufacturer's electrical requirements are met. Any incorrect wiring or devices installed by Contractor without the wiring diagram shall be corrected at Contractor's expense.
- F. Obtain permission from Structural Engineer before drilling or cutting structural members.
- G. Contact utility companies (power, gas, water, sewer, telephone, cable tv, etc.) prior to trenching in order to identify underground utilities. Contractor shall locate secondary service feeders, underground electrical branch circuits, sprinkler lines, etc., prior to trenching. Any cut or damaged underground utilities shall be repaired or replaced at Contractor's expense.
- H. When installing service equipment or metering equipment, coordinate with utility company to ensure that their standards are being met. If any discrepancy is found between utility standards and Contract Documents, notify Engineer for direction.
- I. Coordinate exact locations of electrical components and connections:
 - 1. Where devices are shown in casework, coordinate exact locations with architectural casework details prior to rough-in.
 - 2. Verify final locations of all sinks with the plumbing contractor prior to rough-in of nearby electrical devices. Any above counter electrical devices found within 8" of a sink, and any disposal receptacles found outside the under-sink space, shall be relocated at electrical contractor's expense.
 - 3. The owner reserves the right to relocate any electrical device up to a distance of 12", prior to installation, without additional charge.
 - 4. Coordinate the exact location of equipment requiring electrical connections with other trades prior to rough in. Where there is a question of adequate clearance or coordination between trades, Contractor will submit dimensioned drawings for Engineer's review prior to rough in.

3.4 ELECTRICAL PROJECT CLOSE OUT REQUIREMENTS

- A. Before substantial completion can be granted, the following items must be completed:
 - 1. AHJ inspection shall be completed and work approved
 - 2. All Division 26 equipment shall be installed and connected
 - 3. All Division 26 systems shall be online, tested, adjusted and calibrated

4. Engineer's substantial completion inspection shall be performed
- B. Prior to consideration of Final Payment, the Contractor shall:
1. Provide typed panel directories installed in each panelboard. Directories shall not be printed from drawings unless all circuiting is identical to that shown in drawings.
 2. Have all electrical equipment labeled per requirements in 26 05 53
 3. Provide Record As-Built Drawings to Engineer. As-Built Drawings shall consist of clear, legible markups of the Contract Documents indicating the following:
 - a. Any installed circuiting that deviates from circuiting on plan
 - b. Any equipment size or locations that deviate from plan
 - c. Any other significant deviations from design
 4. Provide copies of permits and/or inspection certificates.
 5. Provide Operating and Maintenance Manual(s).
 6. Return keys to the Owner.
 7. Deliver all spare parts.
 8. Touch up any damaged finishes.
 9. Clean all affected electrical equipment and systems as needed to remove construction debris such as paint, dust, grease, etc.
 10. Remove all existing equipment labels that are no longer accurate.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes building wire and cable, conduit and tubing, surface raceway, boxes, wiring devices, wiring connectors, and connections.

1.2 SYSTEM DESCRIPTION

- A. Wiring Products:
1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
 2. Stranded conductors for control circuits.
 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 4. Conductor not smaller than 16 AWG and stranded conductors for control circuits.
 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 2 percent.
- B. Wiring Methods:
1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation.
 2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation.
 3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation.
 4. Wet or Damp Interior Locations: Use only building wire, Type THWN insulation in raceway, or PVC jacketed armored cable as allowed below under raceway products.
 5. Exterior Locations: Use only building wire, Type THWN XHHW insulation in raceway, or direct burial cable service- entrance cable, armored cable, or metal clad cable.
 6. Underground Locations: Use only building wire, Type THWN insulation, in raceway.
- C. Conductor sizes are based on copper or aluminum as indicated by "CU" or "AL". Conductors shall not be substituted without written approval from the Engineer.
- D. Raceway and boxes shall be located as indicated on Drawings, and at other locations where required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.
- E. Use hinged enclosures for large pull boxes.
- F. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- G. Raceway Products:
1. Concealed Dry Locations - Home Runs over 20 Amps:
Use rigid steel and aluminum conduit, or electrical metallic tubing. Use sheet-metal boxes.
 2. Concealed Dry Locations - Branch Wiring and Home Runs 20 Amps or Less:
Use rigid steel and aluminum conduit, electrical metallic tubing, or metal clad cable. Use sheet-metal boxes.
 3. Exposed Dry Locations (all ampacities):

Use rigid steel and aluminum conduit, electrical metallic tubing. Use sheet-metal boxes. Use flush mounting outlet boxes in finished areas.

4. Wet Interior Locations (ie, crawl spaces) - Home Runs over 20 Amps:
Use rigid steel conduit, or nonmetallic conduit rated for the environmental conditions. Use nonmetallic boxes.
 5. Wet Interior Locations - Branch Wiring and Home Runs 20 Amps or Less:
Use rigid steel conduit, nonmetallic conduit rated for the environmental conditions, or PVC jacketed armored cable. Use nonmetallic boxes.
 6. Underground More than 5 Feet outside Foundation Wall:
Use rigid steel conduit, or nonmetallic conduit rated for the environmental conditions. Use cast metal boxes or nonmetallic handhole.
 7. Underground Within 5 Feet outside Foundation Wall:
Use rigid steel conduit, or nonmetallic conduit rated for the environmental conditions. Use cast metal boxes.
 8. In or Under Slab on Grade:
Use rigid steel conduit, or nonmetallic conduit rated for the environmental conditions. Use cast metal boxes.
 9. Exposed Outdoor Locations:
Use rigid steel conduit. Use cast metal outlet, pull, and junction boxes.
 10. In Slab Above Grade:
Use rigid steel conduit, or nonmetallic conduit rated for the environmental conditions. Use cast or sheet metal boxes.
- H. Minimum Raceway Size: 1/2 inch unless otherwise specified.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog information for each wiring device.

PART 2 PRODUCTS

2.1 SURFACE METAL RACEWAY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Wiremold
 2. Equal
- B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway, with manufacturer's standard Ivory enamel finish. Furnish manufacturer's standard accessories; match finish on raceway.

2.2 SURFACE NONMETALLIC RACEWAY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Wiremold
 2. Equal
- B. Description: Plastic channel with fitted cover, suitable for use as surface raceway, with manufacturer's standard finish. Furnish manufacturer's standard accessories, finish to match raceway.

2.3 WIREWAY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Square D
 2. Equal
- B. Product Description: General purpose or Raintight type wireway with screw cover and manufacturer's standard enamel finish.

2.4 WALL SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- B. Single Pole Switch:
1. Hubbell, Model 1221.
 2. Leviton, Model 1221.2.
 3. Eagle, Model 1221.
- C. Double Pole Switch:
1. Hubbell, Model 1222.
 2. Leviton, Model 1222I.
 3. Eagle, Model 1222.
- D. Three-way Switch:
1. Hubbell, Model 1223.
 2. Leviton, Model 1223.2.
 3. Eagle, Model 1223.
- E. Four-way Switch:
1. Hubbell, Model 1224.
 2. Leviton, Model 1224.2.
 3. Eagle, Model 1224.
- F. Key Switch, Single Pole:
1. Hubbell, Model 1221.2L.
 2. Leviton, Model 1221.2L.
 3. Eagle, Model 1221.2L.
- G. Key Switch, Three-Way:
1. Hubbell, Model 1223.2L.
 2. Leviton, Model 1223.2L.
 3. Eagle, Model 1223.2L.
- H. Indicator Switch:
1. Hubbell, 1221.L.
 2. Leviton, 1221.LH
 3. Eagle, 1221.L.
- I. Description: NEMA WD 1, heavy duty, AC quiet wall switch.
- I. Color: per architect
- J. Current Rating: 20 amperes.
- K. Ratings: Match branch circuit voltage and load characteristics.

2.5 WALL DIMMERS-NA (see Section 26 09 23)

2.6 RECEPTACLES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- B. Duplex Convenience Receptacle:
 - 1. Hubbell, Model 5362.
 - 2. Leviton, Model 5362.
 - 3. Eagle, Model 5362.
- C. GFCI Receptacle:
 - 1. Hubbell, Model GF 5362
 - 2. Leviton, Model 6899
 - 3. Eagle, Model GF 5362
- D. TR (Tamper Resistant) Receptacle:
 - 1. Hubbell : DRS 15GRYTR
 - 2. Hubbell : GF 82 GYTR (GFCI)
 - 3. Equal
- E. Color: per architect.

2.7 WALL PLATES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- B. Decorative Cover Plate:
 - 1. Hubbell.
 - 2. Leviton.
 - 3. Approved equal.
- C. Jumbo Cover Plate:
 - 1. Hubbell.
 - 2. Leviton.
 - 3. Approved equal.
- D. Weatherproof Cover Plate: Gasketed cast metal plate with hinged and gasketed device cover.

2.8 FLOOR MOUNTED SERVICE FITTINGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following
- B. Flush Cover Outlet:
 - 1. Walker, Model 853, 860CP carpet plate.
 - 2. Hubbell, Model B-2537, Box S-3425 cover, S-3082 carpet plate.
 - 3. Steel City, Model 664 or 665 Box, 669 or 665-CST color, cover.
 - 4. Material: Brass.
 - 5. Configuration: Concealed service with carpet flange.
- C. Flush Cover Combination Outlet:
 - 1. Walker RFB4 Box, RAKM III Cover.
Approved equal
 - 2. Material: Brass.

3. Configuration: Concealed service with carpet flange.

2.9 FLOOR MOUNTED RACEWAY

- A. Undercarpet Raceway
 1. Connectrac, 2.7
 2. Approved equal
- B. Surface mounted Outlet
 1. Connectrac, 2.7 DP
 2. Approved equal

2.10 TWIST TIMER SWITCHES- NA

2.11 MULTIOUTLET ASSEMBLY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Walker
- B. Multi-outlet Assembly: Sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as multi-outlet assembly. Furnish manufacturer's standard enamel finish.
- C. Receptacles: NEMA WD 6, type 5-15R, single receptacle. Tamper Resistant
- D. Receptacle Spacing: 12 inches on center.
- E. Fittings: Furnish manufacturer's standard couplings, elbows, outlet and device boxes, and connectors.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Remove exposed abandoned raceway, boxes, wire, and cable, including abandoned raceway and cable above accessible ceiling finishes.
- B. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when associated wire and cable is removed.
- C. Maintain access to existing boxes and wiring connections remaining active and requiring access.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

- A. Route raceway and cable to meet Project conditions.
- B. Use 10AWG conductors for 20 ampere branch circuits longer than 100 feet, unless otherwise specified on drawings.
- C. Pull all conductors into raceway at same time.
- D. Do not rest cable on ceiling grid panels.
- E. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape un-insulated conductors and connector with electrical tape to 150% of insulation rating of Conductor.
- F. Verify continuity of each branch circuit conductor.
- G. Arrange supports to prevent misalignment during wiring installation
- H. Group related conduits and support using conduit rack. Construct using steel channel and provide space on each for 25% additional conduits.
- I. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers and split hangers

- J. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports. Do not attach conduit to ceiling support wires.
- K. Route all conduits parallel and perpendicular to structure.
- L. Route conduit in and under slab from point-to-point. Do not cross conduits in slab.
- M. Maintain 12 inches between conduit and surfaces with temperatures exceeding 104°F.
- N. Install no more than equivalent of three 90-degree bends between boxes.
- O. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- P. Provide #200 nylon 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. Mount raceway channel plumb and level.
- S. Set wall mounted boxes at elevations to accommodate mounting heights indicated
- T. Adjust box location up to 10 feet prior to rough-in when required to accommodate intended purpose.
- U. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.
- V. Verify outlet and switch boxes are installed at proper heights meeting ADA requirements.
- W. Do not install switches behind door swings.
- X. Install switches with OFF position down.
- Y. Do not share neutral conductors between circuits unless specifically allowed in design drawings.
- Z. Install receptacles with grounding pole on bottom.
- AA. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- BB. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, and above accessible ceilings.
- CC. Operate each wall switch with circuit energized and verify proper operation.
- DD. Verify that each receptacle device is energized and Test each receptacle device for proper polarity.
- EE. Test each GFCI receptacle device for proper operation.
- FF. Do not install flush mounting box back-to-back in walls. Provide a minimum of six inches of separation. Provide a minimum of 24 inches of separation in acoustic rated walls.
- GG. Coordinate mounting heights and locations of outlets mounted above counters, benches and back splashes.
- HH. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- II. Use tamper resistant receptacle types in all school spaces where children are present (classrooms, media centers, restrooms, corridors, etc).

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.2 SUBMITTALS

- A. Action submittals: Product Data for each type of product.
- B. Closeout Submittals: As part of As-Built Plans required by Section 26 05 00, show built locations of grounding features, including the following where applicable:
 - a. Test wells.
 - b. Ground rods.
 - c. Ground rings.
 - d. Grounding connections for separately derived systems.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location, environmental conditions, and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

- A. Grounding and bonding conductor sizes: As specified in Contract Drawings, or larger.
- B. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- C. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.

2.3 CONNECTORS

- A. All grounding and bonding connectors: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors:
 - 1. Mechanical type cast silicon bronze, solderless compression or exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 2. Compression type, copper or copper alloy, with two wire terminals.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy.
- I. Straps: Solid copper, cast-bronze clamp or copper lugs. Rated for 600 A.

- J. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- K. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated or stainless-steel bolts. Tin-plated aluminum or Die-cast zinc alloy, listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; size and spacing per Construction Drawings.
- B. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

PART 3 EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Bury at least 24 inches (600 mm) below grade.
- C. Grounding Bus (if specified in Construction Drawings): Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
 - 3. Connect to service grounding electrode.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install wire-type equipment grounding conductors with all feeders and branch circuits.
- B. Conduit or cable sheath is not allowed to be used as an equipment grounding conductor, unless explicitly called for or allowed in a particular location on Construction Drawings.
- C. Where current carrying conductors are increased in size to mitigate voltage drop, the wire type equipment grounding conductor must also be increased by the same percentage in cross sectional area (per NEC 250).
- D. Patient Care Areas (where applicable) meet grounding requirements of NFPA 99 and NFPA 70.
- E. Poles Supporting Outdoor Lighting Fixtures:
 - 1. If the pole structure is supplied by only a single branch circuit, a separate grounding electrode (rod) is not required. Bond the equipment grounding conductor of the supply circuit to pole base rebar and exposed metallic pole components.
 - 2. If the pole structure is supplied by multiple branch circuits, install an 8 ft ground rod at the pole, and bond to pole base rebar, exposed metallic pole components, and equipment grounding conductors of all supply circuits.
 - 3. If the above is not possible due to site conditions, contractor shall submit RFI to Engineer for direction. Owner shall not be responsible for any added cost incurred if alternate grounding strategies are installed without Engineer's direction.

3.3 FENCE GROUNDING

- A. Fences enclosing transformers, generators, or solar/wind generation equipment: bond to the grounding electrode(s) associated with the equipment.
- B. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code (for example, equipment grounding conductors for circuits must follow the same path as the circuit). Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System (where applicable): Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Interconnect ground rods with conductors below grade unless otherwise indicated. Make connections without exposing steel or damaging coating if any.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building (if present). Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. If dielectric fittings are present in interior piping, submit RFI for direction before bonding.
 - 4. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. For all grounding connections: inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. At each location where a maximum ground-resistance level was specified on Construction Drawings: test ground resistance and provide test report to Engineer as part of Closeout Documents.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than

natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

- b. Perform tests by fall-of-potential method according to IEEE 81.
- c. If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce resistance.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Conduit and cable support devices.
 - 3. Support for conductors in vertical conduit.
 - 4. Structural steel for fabricated supports and restraints.
 - 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 6. Supports for roof conduit.
 - 7. Fabricated metal equipment support assemblies.
 - 8. ACTION SUBMITTALS
 - a. Product Data: For each type of product.

PART 2 PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
 - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 2. Channel Width: Selected for applicable load criteria.
 - 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used. Where

applicable, verify suitability for use in lightweight concrete or slabs less than 4 inches thick.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All or Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 SUPPORTS FOR ROOF CONDUIT

- A. Pipe Pier: 4" x 4" x 10½" Polyethylene Foam (Erico PP50H4 or equal) connected to conduit with conduit straps.
- B. Install 24" x 24" of roof membrane underneath pipe pier.
- C. Roof conduit supports to be located within 12" of each side of conduit joints.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Performance: Where custom supports are fabricated for the project, Contractor is responsible for calculation of load and strength required. Submit RFI to Structural Engineer for direction if required.

PART 3 EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. Steel conduit: NECA 101
 3. Aluminum conduit: NECA 102.
 4. Metal cable tray systems: NECA 105.
 5. Nonmetallic cable tray systems: NECA 111.
- B. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps, or single-bolt conduit clamps, or single-bolt conduit clamps using spring friction action for retention in support channel.
- C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, according to NFPA 70.

- B. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, or Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69, or Spring-tension clamps.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks securely attached to substrate. Install sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, or other conduit.
- D. Obtain permission from Structural Engineer before drilling or cutting structural members.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in applicable structural specification sections for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 2. Labels and Signs.
 3. Bands and tubes.
 4. Tapes and stencils.
 5. Tags.
 6. Paint for identification.
 7. Cable Ties and fasteners for labels and signs.

1.2 IDENTIFICATION REQUIRED

- A. EQUIPMENT:
1. Voltage designation for each piece of electrical distribution equipment.
 2. Nameplate for each piece of electrical distribution equipment, using name as shown on Construction Drawings.
 3. Nameplate for each piece of control equipment, indicating system and function.
 4. Emergency instructions or warning labels as specified in Construction Drawings, or required by Authority Having Jurisdiction.
- B. RACEWAYS:
1. Identify all conduit runs longer than 6 feet.
 2. Install bands at changes in direction, at penetrations of walls and floors (each side), at junction boxes and terminations, and straight runs.
 3. Identification spacing: at 50-foot (15-m) maximum intervals in straight runs, and at 20-foot (7.6-m) maximum intervals in congested areas.
- C. UNDERGROUND:
1. Install underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- D. BOXES:
1. Identify the covers of each junction and pull box with voltage, circuit number, and emergency power designation where applicable.
- E. CONDUCTORS:
1. Identify each power conductor at panelboard gutters, pull boxes, and outlet and junction boxes.
 2. Identify each control-circuit conductor in pull and junction boxes, manholes, hand-holes, and terminations, with the conductor or cable designation, origin, and destination.
- F. WORKING SPACE: In unfinished and utility spaces only, apply floor marking tape or tape and stencil to finished surfaces showing working clearances, labeled "KEEP CLEAR". Workspace shall comply with NFPA 70.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 PRODUCTS

2.1 PRODUCT PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70 and NFPA 70E.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Temperature Change: 100 deg F (67 deg C), ambient; 150 deg F (100 deg C), material surfaces.

2.2 PRODUCT COLOR AND LEGEND REQUIREMENTS

- A. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 4. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 5. Color for Neutral: White or gray.
 - 6. Color for Equipment Grounds: Bare copper, Green, Green with a yellow stripe.
 - 7. Colors for Isolated Grounds: Green with white stripe.
- B. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- C. Equipment Identification Labels:
 - 1. Black letters on a white field, or vice versa.

2.3 LABELING PRODUCTS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, flexible label with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

- D. Self-Adhesive Labels: Polyester, Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches (37 by 150 mm)for raceway and conductors.
 - b. 3-1/2 by 5 inches (76 by 127 mm)for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBE PRODUCTS

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameter and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.5 TAPE AND STENCIL PRODUCTS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and is 12 inches (300 mm) wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white or yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 4. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
 - 5. Tape Product:
 - a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility where required, compounded for direct-burial service.
 - b. Width: 4 inches (75 mm).
 - c. Overall Thickness: 5 mils (0.125 mm).
 - d. Foil Core Thickness: 0.35 mil (0.00889 mm).

- e. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
 - f. Tensile according to ASTM D 882: 70 lbf (311.3 N) and 4600 psi (31.7 MPa).
- F. Stenciled Legend: In nonfading, waterproof, high contrast ink or paint. Minimum letter height shall be 1 inch (25 mm).
- 1. TAG PRODUCTS
 - a. Write-on Tags:
 - 1) Polyester Tags: 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
 - 2) Marker for Tags:
 - a) Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - b) Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.6 SIGN PRODUCTS

- A. Baked-Enamel Signs:
 - 1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Minimum Nominal Size: 7 by 10 inches (180 by 250 mm).
- B. Metal-Backed Butyrate Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal Size: 10 by 14 inches (250 by 360 mm).
- C. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Engraved legend.
 - 2. Thickness:
 - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
 - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
 - c. Engraved legend with black letters on white face or white letters on a dark gray background.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting, or self-adhesive where suitable for environment.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIE PRODUCTS

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- H. System Identification for Raceways and Cables: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
- O. Self-Adhesive Labels:
 - 1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- V. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
 - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- W. Write-on Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using cable ties (UV-stabilized if outdoor, or plenum-rated if in plenum).
- X. Baked-Enamel Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.
- Y. Metal-Backed Butyrate Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.
- Z. Laminated Acrylic or Melamine Plastic Signs:
 1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.
- AA. Cable Ties: General purpose, for attaching tags, except as listed below:
 1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION METHODS

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 20 A: Identify with self-adhesive raceway labels or vinyl tape applied in bands.
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags or self-adhesive wraparound labels.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive wraparound labels.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive equipment labels, Baked-enamel warning signs or Metal-backed butyrate warning signs.
 1. Apply to exterior of door, cover, or other access.
 2. For equipment with multiple power or control sources, apply to door or cover of equipment.
 3. Install labels straight and level.
- G. Arc Flash Warning Labeling: Self-adhesive labels.
- H. Emergency Operating Instruction Signs: Self-adhesive labels, Baked-enamel warning signs, Metal-backed butyrate warning signs, Laminated acrylic or melamine plastic signs. White legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer load shedding Insert emergency operations.
- I. Equipment Identification Labels:
 1. Indoor Equipment: Self-adhesive label, Baked-enamel signs, Metal-backed butyrate signs, Laminated acrylic, or melamine plastic sign.
 2. Outdoor Equipment: Laminated acrylic or melamine sign or Stenciled legend 2 inches (50 mm) high or more.
 3. Install labels straight and level.

END OF SECTION

**SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS**

PART1-GENERAL

1.01 DESCRIPTION

- A. The purpose of this section is to specify the Division 26 Contractor's responsibilities and participation in the commissioning process.
- B. Related Sections:
 - 1. Section 01 91 13 – General Commissioning Requirements
 - 2. Division 26 – Electrical
- C. Commissioning is primarily the responsibility of the Commissioning Authority (CxA) per Section 01 91 13, with support and coordination for start-up, testing, and commissioning the responsibility of Division 26. The commissioning process does not relieve Division 26 from participation in the process or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner meeting the design objectives of the Contract Documents, nor does it shift that responsibility partially to the CxA or another party.
- D. The CxA will verify and document the following field tests and observations:
 - 1. Point-to-Point Testing (PTP): Verification of all points of integration between the commissioned equipment and their respective centralized controller(s).
 - 2. Functional Performance Tests (FPT). Functional system tests that verify all systems are functioning and interacting with other systems correctly.
- E. Work of Division 26 includes:
 - 1. Providing Contractor submittals to the CxA.
 - 2. Testing and start-up of the equipment including documentation that PFC's have been completely and properly implemented.
 - 3. Providing qualified personnel for participation in commissioning tests, including FPT's and seasonal testing required after the initial commissioning.
 - 4. Providing equipment, software, materials, and labor necessary to correct deficiencies found during the commissioning process, which fulfill contract and warranty requirements.
 - 5. Providing manufacturer's equipment installation instructions, Operation & Maintenance manuals, as-built drawings and any other reasonable requests for information by the CxA necessary to fully commission the systems.
 - 6. Providing review and comment on the Functional Performance Tests (FPT's) developed by the CxA prior to implementation by the Contractors.
 - 7. If Division 26 includes a central lighting control system, providing operational trend data. Configure and initiate trends of I/O points corresponding to all systems outlined in the Commissioning Plan. Trended data shall be provided to the CxA in graphical format and/or in Microsoft Excel format as defined in the Commissioning Plan. Providing training for the systems specified in Division 26 per the Contract Documents.
 - 8. If Division 26 includes a central lighting control system, the lighting control system Contractor shall assist and cooperate with the CxA to establish a plan for the use of the system as part of commissioning activities. The Contractor shall provide a qualified technician to configure and initiate trends of control points as outlined in the Commissioning Plan. Trended data shall be provided to the CxA in graphical format and/or in Microsoft Excel format as defined in the Commissioning Plan.

- F. In the event of a conflict between this and other Sections of the Contract Documents, the more rigorous requirement shall apply.**

1.02 ABBREVIATIONS

- A. The following abbreviations are utilized throughout this section:

ASI – Architects Supplemental Instructions

BAS – Building Automation System

Cx – Commissioning

CxA – Commissioning Authority **FIV**

– Field Installation Verification **FPT**

– Functional Performance Test **GC**

– General Contractor

HVAC – Heating, Ventilating and Air Conditioning

O&M – Operations & Maintenance

PFC – Pre-Functional Checklist

PTP – Point-To-Point

1.03 SCOPE OF WORK

- A. The following electrical systems will be commissioned on this project in the Base and Alternate scopes of work as follows:

1. Sweep or Scheduled Lighting Controls
2. Daylight Dimming Controls
3. Lighting Occupancy Sensors
4. Emergency Generator + ATS

1.04 COOPERATION

- A. Contractors shall cooperate with the commissioning process in the following manner:

1. Attend all commissioning process meetings as scheduled by the CxA and/or the General Contractor (GC).
2. Complete equipment and system start up in accordance with the commissioning schedule.
3. Allow sufficient time before final completion dates so that Functional Performance Testing (FPT) can be accomplished.
4. Provide labor and material to make corrections when required without undue delay.

PART2-PRODUCTS

2.01 TEST EQUIPMENT

- A. The Division 26 Contractor for the equipment being commissioned provides all standard or proprietary testing equipment required to perform startup and initial checkout (PFC's) and Functional Performance Tests (FPT's). The Division 26 Contractors shall provide two-way radios as necessary.
- B. Proprietary test equipment (hardware, software, or tools available only from equipment manufacturer) and required for system commissioning, whether specified or not, shall be provided by the Division 26 Contractor. The Contractor and/or equipment manufacturer shall demonstrate its use and assist the CxA in the commissioning process. Proprietary test equipment shall be included in the base bid price of the equipment and become the property of the Owner upon completion of commissioning.
- C. All instrumentation shall meet the following standards:
 - 1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required to determine adequate performance.
 - 2. Be calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used.
 - 3. Be maintained in good repair and operating condition throughout the duration of use on this project.
 - 4. Be recalibrated/repaired if dropped and/or damaged in any way during use on this project.

PART3-EXECUTION

3.01 WORK PRIOR TO AND DURING EQUIPMENT STARTUP

- A. The Contractors shall comply with all requirements within the manufacturer's installation, startup, and checkout manuals.
- B. Complete all phases of work so the system can be started, tested, and otherwise commissioned. Division 26 has primary startup responsibilities with obligations to complete systems, including all sub-systems so they are functional. This includes the complete installation of all equipment, materials, wire, controls, software, etc. per the Contract Documents and related directives, clarifications, change orders, etc.
- C. A Commissioning Plan including Functional Performance Tests (FPT's) for each piece of commissioned equipment will be developed by the CxA. Upon request of the CxA, Contractors shall provide assistance and consultation. Prior to normal submittals and before commencement of construction activities, Contractors are obligated to assist the CxA in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation. This requirement does not relieve the Contractors of any of their standard submittals required per Contract Documents. This information will typically include, but is not necessarily limited to:
 - 1. Installation, startup and checkout instructions including those that typically ship with the unit
 - 2. Standard field checkout sheets or forms to be used by the factory of field technicians
 - 3. Operation & Maintenance instructions
 - 4. Warranty information including any requirements or responsibilities of the Owner to keep the warranty in force clearly identified
- D. Contractors shall review the FPT's and provide comments back to the CxA with respect to feasibility, safety, equipment protection, and any potential effect the tests may have on equipment warranty.
- E. Through normal channels of communication, Contractors shall notify the GC, Design Professionals, and CxA of any areas where the Contract Documents appear to have discrepancies or do not contain enough

detail for them to properly perform their work. Contractors shall assist the Design Professionals in the resolution or clarification of these issues.

- F. If Division 26 includes a central lighting control system, the PFC shall include electrical continuity checking, elimination of ground faults, point-to-point test, test of scheduled operation, interlocks, alarms, etc. and complete testing of all software and hardware to render fully operational control systems.
- G. If Division 26 includes a central lighting control system, the lighting control system Contractor shall supply the CxA with the following:
 - 1. Two (2) debugged printouts of all system software, including all user's programming and engineering manuals required to interpret the software. Included in the printouts, though not limited to, shall be the following:
 - a. Point database
 - b. Initial schedules for lighting control
 - c. System graphics
- H. The Contractors shall provide all services required to bring each system into a fully operational state.
- I. If Division 26 includes a central lighting control system, point-to-point tests shall be completed and documented by the lighting control system Contractor and reviewed by the CxA prior to being field verified by the CxA. The lighting control system Contractor shall assume that each point will be field verified by the CxA and a Contractor technician. **While performing point-to-point verifications, if it is determined that work was not completed as documented by the lighting control system Contractor, the CxA shall notify the GC and the point-to-point verification process shall be stopped. The lighting control system Contractor shall then be responsible for repeating their point-to-point tests and documentation and shall be backcharged for any and all subsequent visits by the CxA to complete the point-to-point verification process at their standard hourly rates plus expenses. The cost of the additional work shall be deducted from the contract amount stated in the agreement between the Owner and the General Contractor.**
 - 1. The Contractor shall provide complete, debugged and **blank** I/O summary of all points indicated in the construction documents for review. This document shall include the following at a minimum (also see example format below):
 - a. I/O Point Name
 - b. I/O Point Type
 - c. Cable Tag
 - d. Device Connected
 - e. Statuses to be Verified
 - (i) Centralized Controller Value(s)
 - (ii) Field Measured Value(s)
 - f. Initials of Contractor who Performed Verification(s)
 - g. Date when Verifications were Performed

I/O Point Name	Point Type	Device Connected	Controller Status	Measured Field Status	Date	Chk By
Office 101	BO	Zone 1 Lights	ON/OFF			

2. After review of the blank forms by the CxA, the Contractor shall **complete** the PTP checkout and submit to the Commissioning Authority for review. The PTP checkout should be performed from the completed graphic interface to the physical field location. This completed PTP checkout should include the following elements completed (also see example format below):

- a. Centralized Controller Value(s)
- b. Field Measured Value(s)
- c. Initials of Contractor who Performed Verification(s)
- d. Date when Verifications were Performed

I/O Point Name	Point Type	Device Connected	Controller Status	Measured Field Status	Date	Chk By
Office 101	BO	Zone 1 Lights	ON/OFF	ON/OFF	1/1	JD

3. After review of the completed forms by the CxA, the Contractor shall repeat selections the PTP checkout in the presence of the Commissioning Authority for verification. This completed PTP checkout should include the following elements completed (also see example format below):

- a. Additional Column with the CxA's Initials

I/O Point Name	Point Type	Device Connected	Controller Status	Measured Field Status	Date	Chk By	CxA
Office 101	BO	Zone 1 Lights	ON/OFF	ON/OFF	1/1	JD	QEG

3.02 FUNCTIONAL PERFORMANCE TESTING

- A. Functional Performance Testing is the dynamic testing of systems, rather than just individual components or systems. The CxA develops the Functional Performance Tests (FPT's) in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing Contractor or vendor. In the case of simpler systems to be commissioned such as occupancy sensors for lighting control, the CxA may perform the FPT's without written forms or direct Contractor involvement through the use of dataloggers or manual testing to document system performance.
- B. If Division 26 includes a central lighting control system, the lighting control system Contractor shall be responsible for providing operational trend data as part of the FPT documentation. The Contractor shall configure and initiate trends of I/O points corresponding to all systems outlined in the Commissioning Plan and as defined in the FPT's. Trended data shall be graphed and provided to the CxA in digital ".pdf" format for review and comment as defined in the Functional Performance Test procedures. Though not common, the CxA may also request data to be provided in a ".csv" format for import to a spreadsheet program.
- C. The Contractors have been provided an opportunity to review and comment on the FPT's developed by the CxA. The Contractor shall repeat, at no additional cost to the Owner, the complete FPT procedure until acceptable results are achieved. **The Owner shall not be required to accept the systems and the warranty period shall not begin until acceptable FPT results are achieved. The CxA shall provide a review of one test for each system. If the test fails because the system does not perform as designed, the Contractor shall correct the deficiency and the system will need to be retested. The Contractor shall be backcharged for additional labor and expenses incurred by the CxA in repeating the failed test at their standard hourly rates plus expenses. The cost of the additional work shall be deducted from the contract amount stated in the agreement between the Owner and the**

General
Contractor.

3.03 PARTICIPATION IN COMMISSIONING

- A. Provide skilled technicians to start-up and debug all systems within Division 26. These same technicians shall be made available to assist the CxA in completing the commissioning process as it relates to each system and their technical specialty. Work schedules, time required for testing, etc. will be requested by the CxA and coordinated through the GC. Contractors will ensure the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustment, and/or problem resolutions.
- B. The CxA reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or subsystem. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the CxA to get the job done. A liaison or intermediary between the CxA and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

3.04 WORK TO RESOLVE DEFICIENCIES

- A. In some systems, poor adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work will be completed under the direction of the Architect, with input from the Contractors, Engineers, equipment suppliers, and CxA. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Architect per Division 01 will have final jurisdiction on the necessary work to be done to achieve performance, with acceptance by the Owner.
- B. Corrective work is to be completed in a timely fashion to permit the completion of the commissioning process. Experimentation to render system performance will be permitted. If the CxA deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the CxA will notify the Architect indicating the nature of the problem, expected steps to be taken, and the deadline for completion of activities. If the deadline(s) pass without resolution of the problem, the Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Contractor's responsibility.

3.05 SYSTEMS DOCUMENTATION

- A. In addition to requirements that may be defined elsewhere in the Contract Documents:
 - 1. Prepare a minimum of (3) completed copies of final O&M manuals for the Owner in addition to a digital copy in ".pdf" format. If not already stated in the O&M manual for each piece of commissioned equipment, a recommended schedule of requirements and maintenance frequency shall be provided by the Contractor and/or the manufacturer.
 - 2. Maintain as-built "redlines". "Redlined" drawings developed upon completion of construction, based on memory of key personnel, shall not be satisfactory. Continuous and regular "redlining" of drawings is considered essential and mandatory. Provide a digital copy to the Owner in ".pdf" format.
 - 3. Update the Contract Documents to incorporate field changes and revisions to system designs to account for actual constructed configurations. Division 26 as-built drawings shall include architectural floor plans, elevations and details, and the individual mechanical or electrical systems in relation to actual building layout.
 - 4. If the project includes a central lighting control system, the lighting control system Contractor shall also include a completed set of as-built shop diagrams for the system. Provide a digital copy to the Owner in ".pdf" format. The as-built diagrams shall include, but are not necessarily limited to:
 - a. Updated and clarified modes of operation documenting actual programmed configuration and initial setpoints
 - b. Updated control diagrams and schematics
 - c. Final I/O summary including both physical and virtual points

- d. Locations of all field sensors such as ceiling mounted occupancy sensors or sensors measuring lighting levels for dimming control clearly identified on the as-built building floor plans
- e. Network and communications trunk wiring schematics overlaid upon building floor plans and indicating locations of each controller in the system

END OF SECTION

SECTION 26 20 00
LOW-VOLTAGE ELECTRICAL TRANSMISSION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes enclosed switches and enclosed circuit breakers, panelboards, and fuses.

1.2 SUBMITTALS

- A. Shop Drawings: Submit panelboard and dry transformer shop drawings.
- B. Product Data: Submit product data for all switches, circuit breakers, panelboards, fuses, dry type transformers.

1.3 EXTRA MATERIALS

- A. Furnish two of each panelboard key.
- B. Furnish three spare fuses of each Class, size, and rating installed.

PART 2 PRODUCTS

2.1 ENCLOSED FUSIBLE SWITCH

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D
 - 2. Siemens
 - 3. Eaton
- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.
- D. Enclosure: NEMA KS 1, Type to meet conditions.

2.2 ENCLOSED NONFUSIBLE SWITCH

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D
 - 2. Siemens
 - 3. Eaton
- B. Product Description: NEMA KS 1, Type GD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Enclosure: NEMA KS 1, Type to meet conditions.

2.3 MOLDED CASE CIRCUIT BREAKER

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D
 - 2. Siemens
 - 3. Eaton
- B. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1.
- C. Enclosure: NEMA AB 1, Type to meet conditions.

2.4 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D
 - 2. Siemens
 - 3. Eaton
- B. Product Description: NEMA PB 1, circuit breaker type panelboard.
- C. Minimum integrated short circuit rating: 42000 amperes rms symmetrical.
- D. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- E. Controllers: NEMA ICS 2, AC general-purpose Class A controller for induction motors rated in horsepower.
 - 1. Control Voltage: 120 volts, 60 Hertz.
 - 2. Cover Mounted Pilot Devices: NEMA ICS 5, standard duty type.
 - 3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
- F. Enclosure: NEMA PB 1, Type to meet conditions.
Cabinet Front: Flush or Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

2.5 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D
 - 2. Siemens
 - 3. Eaton
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical.
- D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
- E. Enclosure: NEMA PB 1, Type to meet conditions.
- F. Cabinet Front: Flush or Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

2.6 LOAD CENTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D
 - 2. Siemens
 - 3. Eaton
- B. Product Description: Circuit breaker load center, with bus ratings as indicated on Drawings.
- C. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical.

- D. Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for poles, listed as Type SWD for lighting circuits, Class A ground fault interrupter circuit breakers where indicated. Do not use tandem circuit breakers.
- E. Enclosure: General Purpose.
- F. Box: Flush or Surface type with door, and lock on door. Finish in manufacturer's standard gray enamel.

2.7 FUSES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bussman
 - 2. Littelfuse
 - 3. Shawmut-Gould
- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.
- D. Main Service Switches Larger than 600 amperes: Class L (time delay).
- E. Main Service Switches: Class RK1 (time delay).
- F. Power Load Feeder Switches Larger than 600 amperes: Class L (time delay).
- G. Power Load Feeder Switches: Class RK1 (time delay).
- H. Motor Load Feeder Switches: Class RK1 (time delay). RK5. J (time delay).
- I. Lighting Load Feeder Switches Larger than 600 amperes: Class L time delay.
- J. Lighting Load Feeder Switches: Class RK1 T.
- K. Other Feeder Switches Larger than 600 amperes: Class L time delay.
- L. Other Feeder Switches: Class RK1 (time delay).
- M. General Purpose Branch Circuits: Class RK1 (time delay).
- N. Motor Branch Circuits: Class RK5.
- O. Lighting Branch Circuits: Class G.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fuses in fusible disconnect switches.
- B. Install distribution equipment plumb.
- C. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- D. Install panelboards and load centers in accordance with NEMA PB 1.1.
- E. Install recessed panelboards and load centers flush with wall finishes.
- F. Provide typed circuit directory for each branch circuit panelboard and load center.
- G. Provide filler plates for unused spaces in panelboards.
- H. Install fuse with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICE FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes field-mounted SPD for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating
- B. SPD: Surge Protective Device(s), both singular and plural.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- C. Comply with NEMA LS 1.
- D. Comply with UL 1283 and UL 1449.
- E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Service Conditions: Rate SPD devices for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: -40 to 150 deg F.
 - 3. Humidity: 0 to 95 percent, non-condensing.
 - 4. Altitude: Less than 20,000 feet above sea level.

1.7 COORDINATION

- A. Coordinate location of field-mounted SPD devices to allow adequate clearances for maintenance.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 TRANSIENT VOLTAGE SURGE SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies Inc. (APT).
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 4. Leviton Mfg. Company Inc.
 5. Liebert Corporation; a division of Emerson Network Power.
 6. Northern Technologies, Inc.; a division of Emerson Network Power.
 7. Siemens Energy & Automation, Inc.
 8. Square D; a brand of Schneider Electric.
 9. MVC.
- B. Surge Protection Devices:
1. Comply with UL 1449.
 2. Modular design (with field-replaceable modules).
 3. Fuses, rated at 200-kA interrupting capacity.
 4. Fabrication using bolted compression lugs for internal wiring.
 5. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
 6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 7. LED indicator lights for power and protection status.
- C. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2
1. Line to Neutral: 100,000 A.
 2. Line to Ground: 100,000 A.
 3. Neutral to Ground: 100,000 A.
- D. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 700 V for 208Y/120 V.
 2. Line to Ground: 700 V for 208Y/120 V.
 3. Neutral to Ground: 600 V for 208Y/120 V.
 4. Line to Line: 1000 V for 208Y/120 V.
- E. Protection modes and UL 1449 SVR for 240/120 V, single-phase, 3-wire circuits shall be as follows:
- Not used.
- F. Protection modes and UL 1449 SVR for 480Y/277 V, 3-phase, 4-wire, shall be as follows:
- Not used.

2.2 ENCLOSURES

- A. Indoor Enclosures: NEMA 250 Type 1.
- B. Outdoor Enclosures: Not used.

PART 3 EXECUTION

3.1 INSTALLATION

- A. SPD devices at service entrance: install on load side, with ground lead bonded to service entrance ground.
- B. SPD devices for panelboards: Not used.

3.2 STARTUP SERVICE

- A. Do not energize or connect service entrance equipment and panelboards to their sources until SPD devices are installed and connected.

- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel to maintain SPD devices.

**END OF
SECTION**

SECTION 26 51 19
LED LIGHTING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes the following for LED luminaires:
 - 1. Products.
 - 2. Substitutions.
 - 3. Materials.
 - 4. Luminaire support.
 - 5. Emergency lighting units.
 - 6. Batteries for single luminaires.
 - 7. Exit signs.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Unit of light output (total in all directions).
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.
- H. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- I. BUG Rating: Backlight-Uplight-Glare rating, as defined by the Illuminating Engineering Society and referenced in codes and standards.
- J. IES File: Photometric performance data for a luminaire, in .ies format for use in photometric calculation software.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, arranged by drawing designation.
- B. Shop Drawings: For nonstandard and custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 FIELD CONDITIONS

- A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.
- B. Product Schedule: Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

- a. Warranty Period: Three year(s) from date of Substantial Completion.
- b. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 PRODUCTS

2.1 LUMINAIRE LISTING REQUIREMENTS

- A. Standards:
 1. Electrical Components, Devices, and Accessories shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. NRTL Compliance: Luminaires for hazardous locations (where indicated on drawings) shall be listed and labeled for indicated class and division of hazard by an NRTL.
 3. Recessed luminaires shall comply with NEMA LE 4.
 4. Emergency lighting units, exit signs, and batteries shall comply with UL 924.

2.2 SUBSTITUTIONS

- A. Provide product specified on drawings or propose an equivalent product according to the procedure below.
- B. Alternative products specified in luminaire schedule do not require prior approval. Luminaire types listed as "no substitutions" on drawings may not be substituted.
- C. ALL substitutions must be approved by engineer prior to bidding. Substitutions proposed during the submittal phase will be rejected. Substitution requests must include the following:
 1. Cutsheets for each proposed substitute product.
 2. IES files must be readily available for all general illumination, cove, or display lighting fixtures.
 3. Any other documentation necessary to demonstrate compliance with the requirements listed below.
- D. Proposed substitute products must meet the requirements listed on drawings in order to be approved, including but not limited to:
 1. Lumen output shall generally be within 20% of specified luminaire, or closer as determined by engineer during review of proposed substitute.
 2. Optical distribution shall be similar to that of specified luminaire, as determined by engineer during review of proposed substitute.
 3. Substitute luminaire must have diffusing lenses in all positions where specified fixture has a diffusing lens. Examples include upright diffusers on indirect fixtures, or diffusing bottom lenses on high bay fixtures.
 4. CRI shall be equal to or greater than CRI shown on drawing.
 5. CCT shall be within 500K of CCT shown on drawing.
 6. BUG rating shall be equal or less than specified. Note that BUG consists of three numbers, each one must individually be equal to or less than that of specified luminaire.
 7. Rated lamp life shall be equal to or greater than that of specified luminaire. If not specified, lamp life shall be 50,000 or more hours to L70.
 8. Dimming range and dimming protocol shall match or exceed that of specified fixture. If alterations to controls design or submittal will be required due to

substitution, the substituting contractor shall be responsible for redesign and any additional controls costs in materials or labor.

9. LED drivers shall be internal to luminaires, unless otherwise specified on drawings. Where remote drivers are specified, ensure that substitute driver will fit in space available.
10. Lens thickness shall be equal to or greater than that of specified luminaire.
11. Where specified fixture has an integral battery pack, substitute shall also have one. Remote battery packs are not considered equal substitutes.

2.3 BATTERIES

- A. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with driver.
 1. Emergency Connection: Operate lamp(s) continuously upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Indoor Ambient Temperature: 32 deg F (0 deg C) or exceeding 104 deg F (40 deg C).
 - b. Outdoor Ambient Temperature: Minus 10 deg F (minus 23 deg C) to 105 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
 - c. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
 - d. Humidity: More than 95 percent (condensing).
 - e. Altitude: Exceeding 6000 feet (1829 m).
 4. Test Push-Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 5. Battery: Sealed, maintenance-free.
 6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 7. Integral Self-Test (where specified): Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one luminaire, remote mounted from luminaire. (For battery/inverter units supplying multiple luminaires, see Section titled Central Inverters for Emergency Lighting)
 1. Emergency Connection: Operate lamp(s) continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.

2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Battery: Sealed, maintenance-free.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Type 1 (type 3R if located outdoors) enclosure listed for installation inside, on top of, or remote from luminaire. Comply with manufacturer's instructions regarding installation distance.
6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
8. Integral Self-Test (where specified): Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.4 MATERIALS

- A. Metal Parts:
 1. Free of burrs and sharp corners and edges.
 2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.
- F. Supports shall be able to maintain luminaire position after cleaning and maintenance.
- G. Support luminaires without causing deflection of finished surface.
- H. Exterior luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.

- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire if not integral.
- D. Adjust luminaires that require field adjustment or aiming. Include adjustment of exterior photoelectric devices to prevent false operation of relay by artificial light sources, favoring a north orientation.
- E. Supports: Sized and rated for luminaire weight.
- F. Flush-Mounted Luminaire Support: Secured to outlet box.
- G. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- H. Suspended Luminaire Support:
 - 1. Where suspension is longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Cable mounted luminaires: Use 5/32-inch- (4-mm-) diameter aircraft cable supports.
 - 4. Do not use ceiling grid as support for suspended luminaires. Connect support wires or rods to building structure.
- I. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Support from structure per code.
 - 3. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
- J. Install ground-mounted luminaires on concrete base with top 4 inches (100 mm) above finished grade (unless noted otherwise on drawings) or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth.

3.2 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

- D. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION

SECTION 27 05 00
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common communications installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. All data for Division 27 must be submitted as a single package as the Engineer will commence review only when all data has been received. Engineer will commence review only when all data has been received in the format required. Incomplete submittals will be returned to sender.
- B. Electronic submittals will be reviewed provided the following conditions are met.
 - 1. Complete submittals in pdf format will be reviewed by CSI Specification Division
 - 2. All data for Division 27 must be submitted as a single package as the Engineer will commence review only when all data has been received.
 - 3. Group submittals by Section (ie: 27 57 17)
 - 4. Submittals linked to a manufacturer's web site will not be reviewed
 - 5. Re-submittals must highlight changes from previous submittals.
- C. The Contractor shall determine and verify field measurements and field construction criteria for conformance with Drawings and Specifications and for conflicts with other items of Construction past or present. He shall coordinate each submittal with the requirements of the Work and of the Contract Documents and notify the Engineer in writing, at the time of the submission, of any and all deviations in the submittals from requirements of the Work and Contract Documents.

No fabrication or work which requires submittals shall begin until submittals are returned with the Engineer's approval.
- D. Engineer's review does not constitute acceptance or responsibility for accuracy or dimensions, nor shall it relieve the Contractor from meeting any requirements of the Work and Contract Documents, nor shall it constitute approval for any deviation from the Contract Documents unless such deviations are specifically stated as such on the submittal and specifically allowed by the Engineer by specific written notification for each such variation. The Engineer's review will not relieve the Contractor from responsibility for errors or omissions in the Shop Drawings.
- E. Submit copies of materials for submittal review as required by Division 1.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

1.6 FINAL INSPECTIONS

- A. Engineer will make periodic inspections as appropriate and deemed necessary by Engineer. One final inspection for completion of project will be performed by the Engineer. Any and all additional inspections requested by the Contractor or required because of contractor's failure to complete Scope of Work shall be paid for by the Contractor. The cost of additional inspection(s) shall be deducted from the contract amount stated in the agreement between the Owner and the Contractor. Costs for additional inspections shall be assessed at the Engineer's hourly rates.

1.7 PERMITS

- A. Permits necessary for the performance of the work under this contract shall be secured and paid for by the Contractor. Final inspection by the Engineer will not be made or certificate of final payment issued until certificates of satisfactory inspection from the inspection authorities are delivered.

1.8 SUBSTITUTIONS

- A. Prior approval required. When required by Division 1 of the Specifications, materials and equipment in Division 27 will be reviewed for prior approval. Bidder is required to document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

1.9 TRAINING

- A. The electrical contractor shall conduct a 4 hour minimum training session with owner designated staff to review all electrical equipment and lighting installed under this contract. At a minimum, the session will include operation and maintenance, lighting lamp changes, and basic operation of the systems. Contractor shall physically demonstrate the operation of each piece of equipment. A sign in sheet and agenda indicating a list of all equipment reviewed shall be included in the close out documents.

PART 2 PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

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

PART 3 EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors **2 inches** above finished floor level.
- G. Size pipe sleeves to provide **1/4-inch** annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for **1-inch** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for **1-inch** annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 31 23 16

EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation for slabs-on-grade
 - 2. Excavating for foundations.
 - 3. Excavating for site structures.
- B. Related Sections:
 - 1. Section 31 23 17 – Trenching.
 - 2. Section 31 23 23 - Fill.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Excavating Soil Materials:
 - 1. Basis of Measurement: By cubic yard.
 - 2. Basis of Payment: Includes general excavating to required elevations, loading and removing from site.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil.
- B. Local utility standards when working within 24 inches of utility lines.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of New Mexico, and local regulations.
- B. Field inspection shall be performed by the Soils Engineer in accordance with the applicable specifications.
- C. The Soils Engineer shall be called with a minimum of 48 hour notice to inspect all exposed bearing, surface, and native materials to be stockpiled and re-used as fill materials.
- D. Special inspections shall be performed as required by the 2015 International Building Code and as outlined on sheet S2 of the contract documents.

PART 2 - EXECUTION

2.1 PREPARATION

- A. Call Local Utility Locate Information service at not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company to remove or relocate utilities if necessary.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, rock outcroppings and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

2.2 SOIL DENSIFICATION

- A. Densify existing subsoils to densities specified in the project drawings.
 - 1. Densify subsoils to a minimum depth of 1 foot to the specified density.
- B. Densification Equipment:
 - 1. Provide machinery appropriate to provide the specified densities to the applicable soils at the required soil moisture contents.

2.3 EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation work.
- B. Excavate subsoil to accommodate foundations, utilities, construction operations, and over-excavation as required by conditions or as noted in the plans.
- C. Compact disturbed load bearing soil in direct contact with foundations to specified densities. Slope banks with machine to angle of repose.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Trim excavation. Remove loose matter.
- G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- H. Notify Architect/Engineer of unexpected subsurface conditions.
- I. Correct areas over excavated with structural fill specified in Section 31 23 23.
- J. Remove excess and unsuitable material from site and legally dispose.

- K. Repair or replace items indicated to remain damaged by excavation.

2.4 FIELD QUALITY CONTROL

- A. Request visual inspection of bearing surfaces by the Soils Engineer before installing subsequent work.

2.5 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.
- D. Protect excavations from surface run-off water.

END OF SECTION

SECTION 31 23 17

TRENCHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Excavate trenches for utilities.
- B. Compacted bedding under fill over utilities to sub-grade elevations.
- C. Backfilling and compaction for utilities.

1.2 RELATED SECTIONS

- A. Testing Laboratory Services: Testing fill compaction.
- B. Construction Facilities and Temporary Controls: Water control in excavations.
- C. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
- D. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
- E. Section 31 23 16 – Excavation.
- F. Section 31 23 18 - Rock Removal: Removal of rock during excavating.
- G. Section 31 23 23 – Backfill: General Backfilling.
- H. Section 33 11 13 - Public Water Distribution Systems.
- I. Section 33 31 00 - Sanitary Sewer Systems.
- J. Section 33 42 14 - HDPE Corrugated Drain Pipe.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.
- B. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ANSI/ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- E. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures.

1.4 SUBMITTALS

- A. Materials Source: Submit name of imported fill materials suppliers.
- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with applicable New Mexico state standards and specifications of the utility provider.
- B. Perform Work in accordance with applicable OSHA trench safety standards.
- C. Special inspections shall be performed as required by the 2015 International Building Code and as outlined on sheet S2 of the contract documents.

1.6 FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the Work are as shown on Drawings.
- B. Verify field measurements prior to fabrication.

1.7 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Types A, C, E, F materials as specified in Section 31 23 23

2.2 BED MATERIALS

- A. Type C Material: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, or organic matter; graded per ANSI/ASTM C136, within the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4	100
No. 14	10 to 100
No. 50	5 to 90
No. 100	4 to 30
No. 200	0

- B. Type E: As specified in Section 31 23 23.
- C. Concrete: Lean concrete with a compressive strength of 1500 psi.

2.3 ACCESSORIES

- A. Geotextile Fabric. To be approved by the Engineer for each specific application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The Soils Engineer shall verify fill materials to be used acceptable.
- B. Lay pipes to lines and grades indicated on Drawings.

1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

3.2 PREPARATION

- A. Call "One Call" and local utilities not less than three working days before performing Work.
 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Maintain and protect existing utilities remaining, which pass through work area.
- D. Protect plant life, lawns, rock out-cropping and other features remaining as a portion of final landscaping.
- E. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- F. Protect above and below grade utilities which are to remain.
- G. Cut out soft areas of sub-grade not capable of in-situ compaction. Backfill with Type F fill and compact to density equal to or greater than requirements for subsequent backfill material.
- H. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 EXCAVATION

- A. Cut trenches to width indicated on Drawings, providing at least 6 inches of clear space between the trench face and the outside diameter of the pipe. The maximum permissible width of the trench shall be the outside diameter of the pipe (or distance between pipes plus pipe diameters in the event that two pipes are buried in the same trench) plus 24 inches, unless permission in writing to use a greater width is obtained from the Engineer.
- B. Intercept and divert surface drainage and precipitation away from excavation through use of dikes, curb walls, ditches, pipes, or other means.
- C. Dewater and maintain substantially dry subgrade during pipe installation.
 1. Remove groundwater by pumping to keep excavations dry.
 2. Comply with New Mexico state standards and requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.
 3. If a separate bid item is not included on the Bid Form for dewatering, the cost thereof will be considered incidental to the cost of trenching and utility installation.
- D. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
- E. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by the Soils Engineer until suitable material is encountered.

- F. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type B material and compact to density equal to or greater than requirements for subsequent backfill material.
- G. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by the Soils Engineer.
- H. Remove excess subsoil not intended for reuse, from site.
- I. Do not leave more than 50 feet of trench open at end of working day.
- J. Protect open trench to prevent danger to the public and to wildlife.
- K. Excavation shall not interfere with normal 45 degree bearing splay of foundations.
- L. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- M. Remove lumped subsoil, boulders, and rock up to the size that would require special equipment beyond conventional machinery used for trenching, in which case the Engineer should be notified immediately.
- N. Do not advance open trench more than 100 feet ahead of installed pipe.
- P. Correct unauthorized excavation at no cost to Owner.
- Q. Correct areas over-excavated by error.
- R. Stockpile excavated material to be reused in area designated on site and legally remove and dispose excess material not being used from site.
- S. Excavate subsoil required for utilities.

3.4 BEDDING

- A. Support utilities during placement and compaction of bedding fill.

3.4 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work. If the Engineer orders the sheeting to be left in place for the protection of the work, a payment will be allowed only for the actual cost of the timber left in place.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen materials.
- B. See Section 31 23 23 - Backfill, Articles 3.3 and 3.4 for general backfill requirements, as well as trench backfill and bedding requirements around pipelines.
- C. Systematically backfill to allow proper compaction. Do not backfill over porous, wet, frozen or spongy sub-grade surfaces.
- D. Use geotextile fabric when required to stabilize material not able to be compacted prior to placing the first lift of fill.
- E. Structural Fill: Place and compact materials in continuous layers not exceeding 8 inches loose depth. Compact to 90% of ASTM D-1557.
- F. Select Fill: Place and compact material in continuous layers not exceeding 12 inches loose depth. Compact to 90% of ASTM D-1557.
- G. Employ a placement method that does not disturb or damage foundation perimeter drainage and sealed utilities in the trench.
- H. Maintain optimum moisture content of backfill materials to attain required compaction density.
- I. Remove surplus backfill materials from site.
- J. Refer to the 'Typical Piping and Trenches at Foundations' detail in the plans for additional requirements where utility trenches are adjacent to foundations.

3.6 TOLERANCES

- A. Top Surface of Backfilling: Plus or minus one inch from required elevations.
- B. Top Surface of General Backfilling: Plus or minus one inch from required elevations.

3.7 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of the specifications.
- B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D1556 and with the specifications.
- C. Compaction testing will be performed in accordance with ANSI/ASTM D1556 ANSI/ASTM D-1557 and with the specifications.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.
- E. Frequency of Tests: one test per 50 linear feet of trench per each lift of backfill.
- F. Compaction testing shall be done to the extent such that the Owner and Engineer can be reasonably assured that the backfill has been placed in accordance with the requirements of the Contract Documents, or as required by the utility for which the trenching is being provided, whichever is the more stringent. When a testing allowance is established on the Bid Form, the Owner and Engineer will determine the testing

frequency to be used throughout the project. If no allowance is included, the frequency of testing shall be at least once every 400 linear feet of trenching.

3.8 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of the specifications.
- B. Scarify and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 31 23 23
STRUCTURAL BACKFILL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backfilling building perimeter to subgrade elevations.
 - 2. Backfilling site structures to subgrade elevations.
 - 3. Fill under slabs-on-grade and grade beams.
 - 4. Fill under paving.
 - 5. Fill for over-excavation.
 - 6. Pipe bedding material.

- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 31 23 16 - Excavation.
 - 3. Section 31 23 17 - Trenching.
 - 4. Section 32 91 19 - Landscape Grading: Filling of topsoil to finish grade elevation.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Fill Type: Subsoil
 - 1. Include supplying fill materials, stockpiling, scarifying substrate surface, placing where required, and compacting.

- B. Structural Fill: Type A through G
 - 1. Basis of Measurement: By cubic foot.
 - 2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing where required, and compacting.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 4. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
 - 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 6. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
 - 7. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 8. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 - 9. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - 10. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.

1.4 SUBMITTALS

- A. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- B. Materials Source: Submit name of imported fill materials suppliers.
- C. Submit samples and certified test documentation of all materials to be used.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- E. Submit field soil test on material in place as backfill.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Suitable materials may be processed on-site, or may be imported. If imported materials are required to meet the quantity requirements of the project, it will be provided at no additional expense to the Owner, unless a unit price item is included for imported materials in the bidding schedule. The following types of materials are defined as suitable:

- 1. Type A - Coarse Stone Gravel: Angular, natural stone; free of shale, clay, friable material, sand, debris; graded in accordance with ANSI/ASTM C136 within the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
2 inches	100
One inch	95
3/4 inch	95 to 100
5/8 inch	75 to 100
3/8 inch	55 to 85
No. 4	35 to 60

- 2. Type B - Pea Gravel: Natural stone; free of clay, shale, organic matter; graded in accordance with ANSI/ASTM C136, to the following:

- a. Minimum Size: 1/4 inch. Maximum Size: 1/2 inch.
- b. Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements. The material shall have a minimum sand equivalent value of 75.

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4-inch	100
No. 4	30 – 50
No. 200	0 – 5

- 3. Type C - Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, or organic matter; graded in accordance with ANSI/ASTM C136. Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a No. 4 sieve, and a sand equivalent value not less than 30.
- 4. Type D – Blended Material: Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 2 to 4 percent passing a No. 8 sieve and 1 to 2 percent passing a No. 200 sieve.
- 5. Type E - Select Fill: Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a No. 4 sieve.
- 6. Type F – Structural Fill: Granular, non-expansive imported or site materials approved by the Soils Engineer. Crushed rock or gravel meeting the following gradation requirements:

- | | | <u>Sieve Size</u> | <u>Percentage Passing</u> |
|-----|---|-------------------|--|
| | | 2-inch | 100 |
| | | 1-1/2-inch | 90 - 100 |
| | | 1-inch | 20 - 55 |
| | | 3/4-inch | 0 - 15 |
| | | No. 200 | 0 - 3 |
| 7. | Type G - Soil Cement | | |
| | | <u>Sieve Size</u> | <u>Percentage Passing</u> |
| | | 1-inch | 100 |
| | | 3/4 inch | 80 - 100 |
| | | No.4 | 30 - 60 |
| | | No.10 | 20 - 45 |
| | | No. 200 | 3 - 10 |
| 8. | Type H - Subsoil: Drain rock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements: | | |
| | | <u>Sieve Size</u> | <u>Percentage Passing</u> |
| | | 1-inch | 100 |
| | | 3/4-inch | 90 - 100 |
| | | 3/8-inch | 40 - 100 |
| | | No. 4 | 25 - 40 |
| | | No. 8 | 18 - 33 |
| | | No. 30 | 5 - 15 |
| | | No. 50 | 0 - 7 |
| | | No. 200 | 0 - 3 |
| 9. | Type I - Not Used. | | |
| 10. | Type J - Cement-treated Backfill: Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901 - Test Method for Cement Content of Freshly Mixed Soil Cement. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders. | | |
| 11. | Type K - Topsoil: Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris. | | |
| 12. | Type L - Controlled strength material: Controlled low strength material shall meet the following requirements: | | |
| | | a. | Slurry shall have a 7-day compressive strength of not less than 100 psi and not more than 200 psi. The compressive strength shall be determined in accordance with ASTM D4832. |
| | | b. | The water-cement ratio of the mix shall not exceed 3.5:1. The water content shall not exceed that required to provide a mix that will flow and can be pumped. |
| | | c. | The consistency of the slurry shall be such that the slurry flows easily into all openings between the pipe and the lower portion of the trench. |
| 13. | Type M - Aggregate sub-base, structural fill. Well-graded crushed rock or natural gravel meeting the following gradation requirements: | | |
| | | <u>Sieve Size</u> | <u>Percentage Passing</u> |
| | | 4-inch | 100 |
| | | 3-inch | 95 - 100 |
| | | No. 200 | 3 - 15 |

- B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, the Engineer shall

be immediately notified. In case of conflict between types of pipe embedment backfills, the Contractor is to use the agency-specified backfill material if that material provides a greater degree of structural support to the pipe, as determined by the Engineer. In case of conflict between types of trench or final backfill types, the Contractor shall use the agency-specified backfill material if that material provides the greater in-place density after compaction.

- C. Fill and backfill types, including use of native soil, shall be used in accordance with the following provisions. Native soil used for fill and backfill must meet the requirements of the type of material specified below and as shown for the corresponding type of material shown in 2.1.A above.
1. Embankment fills shall be constructed of Type M material, as defined herein, or other material approved by the Project Engineer. Drainage structures embankments shall be backfilled with materials used in original construction.
 2. Pipe zone backfill shall consist of the following materials for each pipe material listed below.
 - a. Concrete pipe, shall be provided Type A or B pipe bedding and embedment backfill material, or native material that meets the criteria described in Article 3.4 below, and is acceptable to the Engineer.
 - b. Plastic pipe shall be provided Type D bedding and embedment zone material, or native material that meets the criteria described in Article 3.4 below, and is acceptable to the Engineer.
 3. Trench zone backfill for pipelines shall be any of Types A through H backfill materials or any mixture thereof.
 4. Final backfill material for pipelines under paved areas shall be Type G backfill material.
 5. Final backfill under areas not paved shall be the same material as that used for trench backfill, unless otherwise indicated.
 6. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.
 7. Aggregate base materials under pavements, curb and gutter, and sidewalk shall be Type G material constructed to the thickness indicated.
 8. Aggregate sub-base shall be Type M material.
 9. Backfill around structures shall be Types A through Type H materials, or any mixture thereof.
 10. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used. Before the Type F material is placed, filter fabric shall be placed over the exposed foundation. Filter fabric shall be Mirafi 140 N, Mirafi 700X, or equal.
 11. Under all other structures, Type G or H material shall be used.
 12. Backfill used to replace pipeline trench over-excavation shall be a layer of Type F material with a 6-inch top filter layer of Type E material or filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.

2.2 ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable. Product to be selected for specific conditions and approved by the Soils Engineer.

3 PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify exposed native materials at bottom of over-excavation are checked and approved by the Soils Engineer for their intended use.
- B. Verify fill materials to be reused are acceptable to the Soils Engineer for the intended use.
- C. Check existing foundations for damage to concrete and water/damp-proofing and repair as required or as directed by the Engineer when damage is significant.
- D. Verify sub-drainage, damp-proofing, or waterproofing installation has been inspected.
- E. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

3.2 PREPARATION

- A. Verify with the Soils Engineer native material at bottom of excavations has been adequately scarified and re-compacted and is suitable for supporting structural backfill, foundations and slabs and that it is of uniform density.
- B. Compact sub-grade to density requirements for subsequent backfill materials.
- C. Cut out soft areas of sub-grade not capable of compaction in place. Backfill with Type F fill and compact to density equal to or greater than requirements for subsequent fill material.
- D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.
- E. Provide and install geotextile fabric in areas of native soils that can not achieve adequate density by other means.

3.3 BACKFILLING

- A. Backfill areas to contours and elevations with approved and unfrozen materials. Slope backfill as required to follow sloping slab requirements so concrete will not be less than the required thickness at any point.
- B. Systematically backfill in depths compatible with compaction machinery. Do not backfill over porous, wet, frozen or spongy sub-grade surfaces.
- C. Place geotextile fabric, if required, over materials incapable of satisfactory compaction prior to placing next lift of fill.
- D. Structural Fill: Place and compact materials in continuous layers not exceeding 6 inches of compacted depth.
- E. Select Fill: Place and compact material in continuous layers not exceeding 8 inches of compacted depth.
- F. Employ a placement method that does not disturb or damage foundation perimeter drainage, (if applicable) foundation damp proofing, foundation waterproofing and protective cover and utilities in trenches.

- G. Maintain optimum moisture content of backfill materials to attain required compaction density.
- H. Backfill and compact against grade beams evenly on both sides. Do not backfill against laterally unsupported foundations.
- I. Slope finished grade away from building at a minimum 10% for a minimum of 10 ft. where paving or sidewalks do not adjoin the building unless noted otherwise. Slope away at 5% for the next 10 ft. Provide grading that will remove water to natural water courses.
- J. Make grade changes gradual. Blend slope into level areas.
- K. Legally remove surplus backfill materials from site.
- L. Leave fill material stockpile areas completely free of excess fill materials.
- M. In no case shall man-made or deleterious materials be used in any backfill. There shall be no native, or imported granular materials larger than 4" in any dimension used in any backfill location.

3.4 BACKFILLING OF TRENCHES

- A. Pipe bedding material around plastic pipe shall be fine gravel with no particles larger than 1/2-inch (Backfill Type D material). Excavated native material will be allowed, provided that it is free draining material which contains no organic materials, and no rocks, clods or frozen lumps. If the trench is wet, the pipe bedding material shall be 3/8-inch to 3/4-inch stone. All pipe bedding material shall receive prior approval by the Engineer before use.
- B. Pipe zone backfill materials shall be manually spread around the pipe so that, when compacted, the pipe zone backfill will provide uniform bearing and side support.
- C. A 4-inch thickness of granular bedding material shall be placed in the ditch before the pipe is laid and the joint made. Pipe bedding material shall be placed on both sides of the pipe and on top to a depth of 12 inches over the top of the pipe, 15 inches over the top of the pipe in paved or traffic areas, and compacted by hand held compacting tools before other backfilling is done.
- D. In especially rocky areas where there is concern that settling rocks in the surrounding material may rupture the pipeline, the amount of bedding material below and above the pipe shall be increased. In these cases there will be 8 inches of bedding material below the pipe and 15 inches above. The Resident Project Representative shall indicate where this special bedding specification shall apply.
- E. When the bottom of the trench is unstable, an additional 4 inches shall be over-excavated and filled with bedding material before laying of pipe.
- F. Employ a placement method that does not disturb or damage utilities in the trench. Maintain optimum moisture content of fill materials to attain required compaction density.
- G. Where the backfill material moisture content is too high to permit the specified degree of compaction, the material shall be dried until the moisture content is satisfactory.
- H. Trench backfill material to be placed and compacted in equal continuous layers not exceeding 12 inches compacted depth.

- I. Compaction testing will be performed in accordance with applicable ASTM testing standards as identified in Section 31 23 17 - Trenching. If tests indicate Work does not meet specified requirements, remove material, replace, compact, and retest.

3.5 TOLERANCES

- A. Top Surface of compacted backfill: Plus or minus inches from required elevations.

3.6 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D1557.
- B. Perform in place compaction tests in accordance with the following:
 1. Density Tests: ASTM D1556.
 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to the Owner.
- D. Frequency of Tests: One test of moisture content and density per 600 square feet of each lift of backfill. Test utility trench backfill once for each 100 feet of trench for each lift of backfill. Additional tests shall be provided where the Soils Engineers technician may suspect inadequate compaction.
- E. Field inspection and testing will be performed under provisions the specifications. Tests and analysis of fill material will be performed in accordance with the specifications.

3.7 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic.

3.8 SCHEDULE (Compaction is relative to ASTM D1557)

- A. Exterior side of stemwalls (without adjacent paving)
 1. Native material as approved by the Soils Engineer compacted to 85%
- B. Fill under grass areas:
 1. Subsoil fill, to 6 inches below finish grade, compacted to 80 percent, except where noted otherwise.
- C. Fill under landscaped areas:
 1. Subsoil fill, to 6 inches below finish grade, compacted to 80 percent, except where noted otherwise.
- D. Fill Over Drainage Piping Gravel Cover:
 1. Fill Type H, to 6 inches below finish grade, compact uniformly to 90 percent of maximum density.
- E. Fill under asphalt or concrete paving:
 1. Type A or F fill, to 4 inches below finish paving elevation, compacted to 90 percent.
- F. Fill for over-excavation:
 1. Type A or F fill, flush to required elevation, compacted to 90 percent.

- G. Fill under foundations:
 - 1. Type A or F fill, compacted to 90 percent, unless noted otherwise.

- H. Fill under interior slabs-on-grade:
 - 1. Type A or F fill, compacted to 90 percent

END OF SECTION

SECTION 33 11 16
WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings for site water line including domestic water line, and fire water line.
 - 2. Valves.
 - 3. Hydrants.
 - 4. Positive displacement meters.
 - 5. Backflow preventers.
 - 6. Underground pipe markers.
 - 7. Precast concrete vault.
 - 8. Bedding and cover materials.

- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete for thrust restraints.
 - 2. Section 31 23 16 - Excavation: Product and execution requirements for excavation and backfill required by this section.
 - 3. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.
 - 4. Section 31 23 23 - Fill: Requirements for backfill to be placed by this section.

- C. References:
 - 1. NFPA 24 2019

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories.

1.3 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Perform Work in accordance with the City of Aztec Specifications and NM APWA Standards for Construction

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 WATER PIPING

- A. Ductile Iron Pipe: AWWA C151 Class 250
 - 1. Fittings: AWWA C110, cast iron 350psi.
 - 2. Joints: AWWA C111, rubber gasket with rods.
- B. PVC Pipe: AWWA C900 DR 18:
 - 1. Fittings: AWWA C110, cast iron 350psi.
 - 2. Joints: ASTM D3139 compression gasket ring.

2.2 GATE VALVES

- A. Gate Valve:
 - 1. 4" and 6" Buried Gate Valves: Gate valves shall be designed for 250psi operating pressure and shall be Mueller Resilient Seat Type A-2361 or approval equal. Gate valves shall be supplied complete with valve box and cover. Valve boxes shall be two-piece screw type. Approved manufactures: 1) Clow 2) Mueller 3) Kennedy 4) Dresser
 - 2. 4" and 6" Above Ground Gate Valves: Gate valves shall be designed for 250psi operating pressure and shall be Mueller Resilient Seat Type A-2360 or approval equal. Gate valves shall be supplied complete with manual hand crank. Approved manufactures: 1) Clow 2) Mueller 3) Kennedy 4) Dresser
 - 3. 4" and 6" Check Valves: Mueller A-2600-6-01B1 or approved equal.
 - 4. 6" Flow Meter: Octave Ultrasonic Epoxy Coated DI with 4-20mA connection or approved equal.

2.3 UNDERGROUND PIPE MARKERS

- A. Trace Wire: Tracer wire shall be a minimum of 10 gage wire size for all installations and shall be coated wire. All service laterals from the main line to the water meter/valve can shall be installed with a 10 gage coated tracer wire. The tracer wire for the lateral shall be connected to the tracer wire on the main line by taping at least every joint. A minimum of a three foot pigtail shall be left in the meter/valve can for tracing purposes.

2.4 BEDDING AND COVER MATERIALS

- A. Bedding: Existing soil free of rocks over 1".
- B. Soil Backfill from Above Pipe to Finish Grade: Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter

2.5 ACCESSORIES

- A. Thrust Restraints: Joint Restraints shall be per NFPA 24 2019

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

- B. Verify building service connection and municipal utility water main size, location, and invert are as indicated on Drawings.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 17 for Work of this Section.

3.4 INSTALLATION - PIPE

- A. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- B. Pipe shall be restrained against movement at changes in direction.
- C. Thrust blocks shall be permitted only where soil is stable and capable of resisting the anticipated thrust forces. Thrust blocks shall be concrete of a mix not leaner than one part cement, two and one-half parts sand, and five parts stone. Thrust blocks shall be placed between undisturbed earth and the fitting to be restrained and shall be capable of resisting the calculated thrust forces. Wherever possible, thrust blocks shall be located so that the joints are accessible for repair.
- D. Restrained Joint Systems. Private fire service mains using restrained joint systems shall include one or more of the following:
 - 1. Locking mechanical or locking push-on joints
 - 2. Mechanical joints utilizing setscrew retainer glands
 - 3. Bolted flange joints
 - 4. Pipe clamps and tie rods
 - 5. Other approved methods or devices
- E. Install trace wire continuous over top of pipe. Coordinate with Section 31 23 23; 31 23 17.
- F. Backfill trench in accordance with Section 31 23 23

3.5 INSTALLATION - VALVES AND HYDRANTS

- A. Set valves on compacted soil.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
- C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
- D. Set hydrants to grade, with nozzles at least 20 inches above ground.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Flush and disinfect system in accordance with Section 33 13 00.

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform pressure test on domestic site water distribution system in accordance with NM APWA.

END OF SECTION

SECTION 33 13 00

DISINFECTION OF WATER DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Disinfection of potable water distribution and transmission system.
- B. Testing and reporting results.

1.2 RELATED SECTIONS

- A. Section 02660 - Installation of Water Transmission and Distribution Lines.

1.3 REFERENCES

- A. ANSI/AWWA B300 - Standard for Hypochlorites.
- B. ANSI/AWWA B301 - Standard for Liquid Chlorine.
- C. ANSI/AWWA B302 - Standard for Ammonium Sulfate.
- D. ANSI/AWWA B303 - Standard for Sodium Chlorite.
- E. ANSI/AWWA C651 - Standards for Disinfecting Water Mains.
- F. ANSI/AWWA C652 - Disinfection of Water Storage Facilities.

1.4 SUBMITTALS

- A. Test Reports: Indicate results comparative to specified requirements.
- B. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Disinfection report; record:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological report; record:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certification that water conforms, or fails to conform, to bacterial standards of NMED
8. Bacteriologist's signature and authority.

1.6 QUALITY ASSURANCE

Perform Work in accordance with ANSI/AWWA C651.

1.7 QUALIFICATIONS

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years experience.
- B. Testing Firm: Company specializing in testing/examining potable water systems, approved by the State of New Mexico.

1.8 REGULATORY REQUIREMENTS

Conform to applicable code or regulation for performing the work of this Section.

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

- A. Chemicals: ANSI/AWWA B300, Hypochlorite, ANSI/AWWA B301, Liquid Chlorine.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that piping system has been cleaned, inspected, and pressure tested.
- B. Perform scheduling and disinfection activity with start up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 CLEANING AND DISINFECTION

- A. Water Piping: Disinfection of interior water piping shall be done in strict accordance with AWWA Standard C 651 except as herein specified. Flushing shall be done prior to chlorination in such a manner so that the water being flushed travels through the piping at such a velocity to remove all foreign particles. The procedure for applying chlorine will be in accordance with Section 7 of AWWA C 651 Standard. A tap shall be made by the CONTRACTOR at no extra pay for insertion of the chlorine. The tap shall be located as directed by the ENGINEER. The chlorine shall be inserted at a rate of 100 ppm of free chlorine by weight for a period of 24 hours. A different equivalent time/amount ratio may be used at the ENGINEER's option for a time less than 24 hours. The sampling procedure to follow shall be as given below. After the water piping has been disinfected, flushed, and filled with normal residual potable water prior to being placed into service the following procedure shall be followed:
1. CONTRACTOR shall collect two (2) samples of water for bacteriological analyses at different locations. CONTRACTOR will be responsible for hiring an independent laboratory to analyze for bacterial content of samples. Results of analysis will be provided to OWNER and ENGINEER the same day results are reported to CONTRACTOR.
 2. Should the samples contain bacteria, the water piping disinfection procedure shall be repeated at no cost to the OWNER.
 3. Upon satisfactory results of bacteriological analyses, the lines shall be placed into service.

3.3 EXECUTION

- A. Provide and attach required equipment to perform the work of this Section.
- B. Introduce treatment into piping system.
- C. Maintain disinfectant in system for 24 hours.
- D. Flush, circulate and clean until required cleanliness is achieved.
- E. Replace permanent system devices removed for disinfection.
- F. Pressure test system to 150 psi. Repair leaks and retest.

3.4 QUALITY CONTROL

- A. Provide testing of treated water under provisions of Section 01400.

B. Test samples in accordance with ANSI/AWWA C651.

END OF SECTION