SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 Summary

A. The electrical work included in all other divisions is the responsibility of the contractor performing the Division 26 work unless noted otherwise. The Contractor shall refer to other Divisions, and other Consultant's Drawings and Specifications, for additional work to be performed under Division 26. These include, but are not limited to: Architectural, HVAC, Plumbing, etc.

B. The intent of the project is to provide Design-Build Electrical system(s).

1.02 Project Overview

A. Work as described in these specifications, and the attached drawings for the fire station.

1.03 Scope

A. The work under this section includes basic electrical requirements, which are applicable to all Division 26 sections. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections.

B. **Provide:** Any and/or all electrical systems required by state and/or local codes and/or owner requirements. Provide all required drawings, certifications, and submittals required to acquire appropriate approvals and permits. See plans for schematic of required fixtures.

1.04 Related Work

A. Applicable provisions of Division 1 govern work under this Section.

1.05 Reference Standards

A. Abbreviations of standards organizations referenced in this and other sections are as follows:

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
EPA	Environmental Protection Agency
ETL	Electrical Testing Laboratories, Inc.
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
ISA	Instrument Society of America
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code

NFPA National Fire Protection Association
UL Underwriters Laboratories Inc.

1.06 Regulatory Requirements

A. All work and materials are to conform in every detail to applicable rules and requirements of the Wisconsin State Electrical Code Volumes 1 and 2, the National Electrical Code (ANSI/NFPA 70), other applicable National Fire Protection Association codes, the National Electrical Safety Code, and present manufacturing standards (including NEMA).

C. All Division 26 work shall be done under the direction of a currently certified State of Wisconsin Certified Master Electrician.

1.07 Quality Assurance

A. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the performance from the system into which these items are placed.

B. Manufacturer references used herein are intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

C. All materials, except medium voltage equipment and components, shall be listed by and shall bear the label of an approved electrical testing laboratory. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by A/E, shall apply and such items shall bear those labels. Where one of the approved electrical testing laboratories has an applicable system listing and label, the entire system, except for medium voltage equipment and components, shall be so labeled.

1.08 Continuity of Existing Services and Systems

A. No outages shall be permitted on existing systems except at the time and during the interval specified by the Owner's Project Representative. The institution may require written approval. Any outage must be scheduled when the interruption causes the least interference with normal institutional schedules and business routines. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.

B. This Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as possible. Note that institutional operations are on a seven-day week schedule.

1.09 Protection of Finished Surfaces

A. Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

1.10 Approved Electrical Testing Laboratories

A. The following laboratories are approved for providing electrical product safety testing and listing services as required in these specifications:
Underwriters Laboratories Inc.
Electrical Testing Laboratories, Inc.

1.11 Sleeves and Openings

A. Applicable provisions of Division 1 govern work under this Section.

1.12 Sealing and Firestopping

A. Sealing and firestopping of sleeves/openings between conduits, etc., and the structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and firestopping. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.13 Intent

A. The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.

B. If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits the A/E's intent (as determined by the A/E Project Manager). Refer to the General Conditions of the Contract for further clarification.

C. It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.

D. All sizes as given are minimum except as noted.

E. Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to the A/E's inspections, tests and approval from the commencement until the acceptance of the completed work.

F. Whenever a particular manufacturer's product is named, it is intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

1.14 Omissions

A. No later than ten (10) days before bid opening, the Contractor shall call the attention of the A/E to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

1.15 Submittals

A. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.

B. On request from the A/E, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.

C. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.

D. The submittals must be approved before fabrication is authorized.

E. Submit sufficient quantities of submittals to allow the following distribution:

Operating and Maintenance Manuals	2 copies
Owner	1 copy
A/E	2 copies
Field Office	1 copy

F. Electrical Power and Lighting Plans: Provide electrical design plans and calculations designed by a certified Wisconsin Electrical Designer or Engineer.

1.16 Project/Site Conditions

A. All work to be performed is within a fully operational Facility

B. Install Work in locations shown on Drawings, unless prevented by Project conditions.

C. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of A/E before proceeding.

D. Tools, materials and equipment shall be confined to areas designated by the Owner.

1.17 Work Sequence and Scheduling

A. Install work in phases to accommodate Owner's occupancy requirements. During the construction period coordinate electrical schedule and operations with A/E's Construction Representatives.

1.18 Work by Other Trades

A. Every attempt has been made to indicate in this trade's specifications and drawings all work required of this Contractor. However, there may be additional specific paragraphs in other trade specifications

and addenda, and additional notes on drawings for other trades which pertain to this Trade's work, and thus those additional requirements are hereby made a part of these specifications and drawings.

B. Electrical details on drawings for equipment to be provided by others is based on preliminary design data only. This Contractor shall lay out the electrical work and shall be responsible for its correctness to match equipment actually provided by others.

1.19 Offsite Storage

A. If payment will be requested for approved offsite stored material, then the Contractor shall complete an "Off-site Storage Agreement" which is available from the A/E. Prior approval by A/E personnel for offsite storage will be needed. No material will be accepted for offsite storage unless submittals for the material have been approved.

1.20 Request and Certification for Payment

A. Within 10 days after Notice to Proceed, the successful bidder will submit to the A/E in a form prescribed below and by the General Conditions of the Contract, Scheduling and Coordination of Work, Reports, Records and Data, and Payments to Contractor, a cost breakdown of the proposed values for work performed which, if approved by the A/E, will become the basis for construction progress and monthly payments. The cost breakdown items shall reflect actual work progress stages as closely as feasible.

B. In addition, if payment will be requested for approved off-site stored material, then that material shall be listed as a line item and the Contractor shall complete an "Off-site Storage Agreement" which is available from the A/E.

1.21 Certificates and Inspections

A. Obtain and pay for all required State installation inspections except those provided by the A/E in accordance with Wis. Adm. Code Section Comm. 50.12. Deliver originals of these certificates to the Owner's Project Representative.

B. This contractor is responsible for coordination of State electrical inspection. Inspection requirements will be issued at a pre-installation meeting, arranged by this contractor and the State Electrical Inspector (See General Conditions).

1.22 Operation and Maintenance Data

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. Manufacturer’s wiring diagrams for electrically powered equipment.

1.23 Record Drawings

A. The Contractor shall maintain at least one copy each of the specifications and drawings on the job site at all times.

B. The A/E will provide the Contractor with a suitable set of contract drawings on which daily records of changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all buried or concealed piping, conduit, or similar items.

C. The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.

D. At completion of the project, the Contractor shall submit the marked-up record drawings to the A/E prior to final payment.

PART 2 – PRODUCTS

2.01 Identification

A. See Electrical section 26 05 53 – Identification for Electrical Systems.

2.02 Sealing and Firestopping

A. FIRE AND/OR SMOKE RATED PENETRATIONS:

Manufacturers:
3M, STI/SpecSeal, Tremco, Hilti or approved equal.

B. All firestopping systems shall be by the same manufacturer.

C. Submittals:

Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgement can be based upon.

D. Product:

Firestop systems shall be UL listed or tested by an independent testing laboratory approved by the Department of Commerce.

Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.

Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

2.03 Non-Rated Penetrations:

A. Conduit Penetrations:

At conduit penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between conduit and sleeve, or the core drilled opening.

PART 3 – EXECUTION

3.01 Cutting and Patching

A. Refer to Division 1, General Requirements, Cutting and Patching.

3.02 Building Access

A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.03 Equipment Access

B. Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish the access doors to the General Contractor and reimburse the General Contractor for installation of those access doors.

3.04 Coordination

A. The Contractor shall cooperate with other trades and Owner's personnel in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

B. The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to light fixtures, disconnect switches, devices, etc.

C. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

D. Cooperate with the testing consultant in ensuring specification Section 26 05 04 compliance. Verify system completion to the testing consultant. Demonstrate the starting, interlocking and control features of each system so the testing contractor can perform its work.

3.05 Sleeves

A. Pipe sleeves for conduits 6" in diameter and smaller, in new poured concrete construction, shall be schedule 40 steel pipe, plastic removable sleeve, or sheet metal sleeve, all cast in place.

B. In wet area floor penetrations, top of sleeve to be 2 inches above the adjacent floor. In existing wet area floor penetrations, core drill sleeve openings large enough to insert schedule 40 sleeve and grout the area around the sleeve. If a pipe clamp resting on the sleeve supports the pipe penetrating the sleeve, weld a collar or struts to the sleeve that will transfer weight to the existing floor structure. Wet areas for this paragraph are rooms or spaces containing air handling unit coils, converters, pumps, chillers, boilers, and similar waterside equipment.

C. Pipe penetrations in existing concrete floors that are not in wet areas may omit the use of schedule 40 sleeve and use the core drilled opening as the sleeve.

3.06 Sealing and Firestopping

A. Fire and/or Smoke Penetrations:
Install approved product in accordance with the manufacturer's instructions where a pipe (i.e. conduit, wireway, trough, etc.) penetrates a fire rated surface.

B. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.

C. Non-Rated Surfaces:

When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using an approved type of material.

D. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the conduit and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts used to tighten the seal are accessible from the interior of the building or vault.

E. At interior partitions, conduit penetrations are required to be sealed for all spaces where the room pressure or odor transmission must be controlled. Apply sealant to both sides of the penetration in such a manner that the annular space between the conduit sleeve and the conduit is completely filled.

3.07 Housekeeping and Clean up

A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

3.08 Owner Training

A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 4 hours.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE

PART 1 – GENERAL

1.01 Scope

A. The work under this section includes furnishing and installing required wiring and cabling systems including pulling, terminating and splicing.

1.02 Related Work

A. Applicable provisions of Division 1 govern work under this Section.

Section 26 05 33 – Raceway and Boxes for Electrical Systems.
Section 26 05 53 – Identification for Electrical Systems.

1.03 References

A. NFPA 70 - National Electrical Code.

1.04 Submittals

A. Submit product data: Provide for each cable assembly type.

B. Submit factory test reports: Indicate procedures and values obtained.

C. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.05 Project Conditions

A. Verify that field measurements are as shown on Drawings.

B. Conductor sizes are based on copper.

C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.

D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 – PRODUCTS

2.01 General

A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.

B. All conductors shall be copper.

C. Insulation shall have a 600 volt rating.

D. All conductor sizes 10 AWG and smaller shall be solid.

2.02 Building Wire

A. Description: Single conductor insulated wire.

B. Insulation: Type THHN/THWN, XHHW-2 insulation for feeders and branch circuits.

2.03 Wiring Connectors

A. Split Bolt Connectors: Not acceptable.

B. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.

C. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.

D. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

PART 3 - EXECUTION

3.01 General Wiring Methods

A. All wire and cable shall be installed in conduit.

B. Do not use wire smaller than 12 AWG for power and lighting circuits.

C. All conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity. As a minimum use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m).

D. Make conductor lengths for parallel conductors equal.

E. Splice only in junction or outlet boxes.

F. Identify ALL low voltage, 600v and lower, wire per section 26 05 53.

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

3.02 Wiring Installation in Raceways

A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary.

B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

C. Completely and thoroughly swab raceway system before installing conductors.

D. Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral conductors in same raceway or cable.

3.03 Wiring Connections and Terminations

A. Splice only in accessible junction boxes.

B. Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.

C. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.

D. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.

E. Thoroughly clean wires before installing lugs and connectors.

F. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

3.04 Field Quality Control

A. Field inspection and testing will be performed under provisions of Section 26 05 04.

3.05 Wire Color

A. General:

For wire sizes 10 AWG and smaller - Wire shall be colored as indicated below.

For wire sizes 8 AWG and larger – Use colored wire, or identify wire with colored tape at all terminals, splices and boxes. Colors to be as indicated below.

In existing facilities, use existing color scheme.

In new facilities, use black and red for single phase circuits at 120/240 volts, use Phase A black, Phase B red and Phase C blue for circuits at 120/208 volts single or three phase, and use Phase A brown, Phase B orange and Phase C yellow for circuits at 277/480 volts single or three phase. Note: This includes fixture whips except for Listed whips mounted by the fixture manufacturer on the fixture and Listed as a System.

All switch legs shall be the same color as their associated circuit. Traveler conductors run between 3 and 4 way switches shall be colored pink or purple.

Neutral Conductors: White for 120/208V and 120/240V systems, Gray for 277/480V systems. Where there are two or more neutrals in one conduit, each shall be individually identified with a different stripe.

Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.

Feeder Circuit Conductors: Each phase shall be uniquely color coded.

Ground Conductors: Green for 6 AWG and smaller. For 4 AWG and larger, identify with green colored wire, or with green tape at both ends and at all access points, such as panelboards, disconnects and junction boxes.

3.06 Branch Circuits

A. The use of single-phase, multi-wire branch circuits with a common neutral is not permitted. All branch circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase conductors.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 Scope

A. The work under this section includes grounding electrodes and conductors, equipment grounding conductors, and bonding.

1.02 Related Work

A. Applicable provisions of Division 1 govern work under this Section.

1.03 References

A. NFPA 70 - National Electrical Code.
   1. ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
   2. UL 467 Electrical Grounding and Bonding Equipment

1.04 Performance Requirements

A. Grounding System Resistance: 2ohms maximum at building service entrance.

1.05 Regulatory Requirements

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 – PRODUCTS

2.01 Rod Electrode

A. Material: Copper-clad steel, 10’ x ¾” minimum.

B. Rod shall be driven 9’-6” deep, minimum.

2.02 Conductors

A. Material: Stranded copper (aluminum not permitted).

B. Grounding Electrode Conductor: Size as shown on drawings, or as required by NFPA 70, whichever is larger.

C. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used on the same facility.

PART 3 – EXECUTION

3.01 General

A. Install Products in accordance with manufacturer's instructions.

B. Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.

C. Attach grounds permanently before permanent building service is energized.

Terminate each grounding conductor on its own terminal lug. Sharing a single lug by multiple conductors is not allowed.

Grounding electrode conductors shall be installed in PVC conduit, in exposed locations.

3.02 Less Than 600 Volt System Grounding

Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

B. Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.

3.03 Field Quality Control

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 Scope

A. The work under these sections includes conduit and equipment supports, straps, clamps, steel channel, etc, and fastening hardware for supporting electrical work.

1.02 Related Work

A. Applicable provisions of Division 1 govern work under this Section.

1.03 Submittals

A. Product Data: Provide data for support channel.

1.04 Quality Assurance

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 – PRODUCTS

2.01 Material

A. Support Channel: Steel, Galvanized, Enameled or other corrosion resistant. For non-metallic and PVC coated conduits, provide either PVC coated 12 gauge 1-1/2 inch square steel channels or 1-5/8 inch square fiberglass channels, with PVC coated straps and stainless steel bolts for securing conduit.

B. Hardware: Corrosion resistant or stainless steel, as applicable.

C. Conduit hangers: Minimum sized threaded rod for hangers shall be 3/8” for trapezes and single conduits 1-1/4” and larger, and ¼” for single conduits 1” and smaller. For non-metallic and PVC coated conduits, provide stainless steel adjustable conduit hangers with stainless steel hardware.

D. Conduit clamps, straps, supports, etc., shall be steel or malleable iron. One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when rigid steel conduit is installed on the interior or exterior surface of any exterior building wall. For non-metallic and PVC coated conduits, provide PVC coated malleable iron with stainless steel anchors and bolts.

PART 3 – EXECUTION

3.01 Installation

A. All hangers, supports, equipment, anchors, hardware, etc. shall be installed in accordance with the manufacturer's written instructions.

B. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using pre-cast insert system, preset inserts, or expansion anchors.

C. Use toggle bolts or hollow wall fasteners in hollow masonry; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; and wood screws in wood construction.

D. **Power-actuated fasteners and plastic wall anchors are not permitted.**

E. Do not fasten supports to piping, ductwork, mechanical equipment, etc.

F. Do not drill structural steel members unless approved by Owner's Structural Engineer.

G. Fabricate supports from steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

H. Install surface-mounted equipment with minimum of four anchors.

I. Furnish and install all supports as required to fasten all electrical components required for the project, including supports required for those items remotely mounted from the building structure.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 Scope

A. The work under this section includes conduits, and boxes for electrical systems including wall and ceiling outlet boxes, and junction boxes.

1.02 Related Work

A. Applicable provisions of Division 1 govern work under this section.
Section 26 05 29 – Hangers and Supports for Electrical Systems.
Section 26 27 26 – Wiring Devices

1.03 Submittals

A. Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2 – PRODUCTS

2.01 Rigid Metal Conduit and Fittings

A. Conduit: Heavy wall, galvanized steel, schedule 40, threaded.

B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.02 Rigid Non-Metallic Conduit and Fittings

A. Conduit: Schedule 40 PVC, minimum, Listed, sunlight resistant, rated for 90^0 C conductors. Schedule 80 for locations exposed to physical damage or as required.

B. Fittings and Conduit Bodies: NEMA TC2, Listed.

2.03 Electrical Metallic Tubing (EMT) and Fittings

A. Conduit: Steel, galvanized tubing.

B. Fittings: All steel, set screw, concrete tight. No push-on or indenter types permitted.

C. Conduit Bodies: All steel threaded conduit bodies.

2.04 Conduit Supports

A. See section 26 05 29.

2.05 Outlet Boxes

A. Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.

B. Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs.

2.06 Pull and Junction Boxes

A. Pull boxes and junction boxes shall be minimum 4 inch square (100 mm) by 2 1/8th inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4 11/16 inch square (117 mm).

B. Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.

C. Sheet Metal Boxes Larger Than 12 Inches (300 mm) in any dimension shall have a hinged cover.

D. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron or aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

E. Box extensions and adjacent boxes within 48” of each other are not allowed for the purpose of creating more wire capacity.

F. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.

2.07 GENERAL

A. All steel fittings and conduit bodies shall be galvanized.

B. No cast metal, or split-gland type fittings permitted.

C. Mogul-type condulets larger than 2 inch (50 mm) not permitted except as approved or detailed.

D. All condulet covers must be fastened to the condulet body with screws and be of the same manufacture.

E. All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

PART 3 – EXECUTION

3.01 Conduit Sizing, Arrangement, and Support

A. EMT is permitted to be used in sizes 4" (50 mm) and smaller for power and telecommunication systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.

B. Size power conductor raceways for conductor type installed. Conduit size shall be ½ inch (13 mm) minimum except **all homerun conduits shall be ¾",** or as specified elsewhere. **Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.**

C. Arrange conduit to maintain headroom and present a neat appearance.

D. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

E. Maintain minimum 6 inch (150 mm) clearance between conduit and piping. Maintain 12 inch (300 mm) clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

F. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.

G. Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

H. Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.

I. Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.

J. Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, other conduits, etc., unless so approved or detailed.

K. In general, all conduit shall be concealed except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.

L. Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.

M. For indoor conduits, no continuous conduit run shall exceed 100 feet (30 meters) without a junction box.

N. All conduits installed in exposed areas shall be installed with a box offset before entering box.

3.02 CONDUIT INSTALLATION

A. Cut conduit square; de-burr cut ends.

B. Conduit shall not be fastened to the corrugated metal roof deck.

C. Bring conduit to the shoulder of fittings and couplings and fasten securely.

D. Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations.

E. All conduit terminations (except for terminations into conduit bodies) shall use conduit hubs, or connectors with one locknut, or shall use double locknuts (one each side of box wall) and insulated bushing. Provide bushings for the ends of all conduit not terminated in box walls. Refer to Section 26 05 26 – Grounding and Bonding for Electrical Systems for grounding bushing requirements.

F. Install no more than the equivalent of three 90 degree bends between boxes.

G. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm) size unless sweep elbows are required.

H. Conduit shall be bent according to manufacturer's recommendations. Torches or open flame shall not be used to aid in bending of PVC conduit.

I. Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.

J. Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.

K. Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-deflection joints are not required where conduit crosses building control joints if the control joint does not act as an expansion joint.

L. Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.

M. Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide Listed conduit seals to prevent the passage of moisture and water vapor through the conduit.

N. Route conduit through roof openings for piping and ductwork where possible.

O. Ground and bond conduit under provisions of Section 26 05 26.

P. PVC conduit shall transition to galvanized rigid metal conduit before it enters a foundation wall or up through a concrete floor.

Q. Identify conduit under provisions of Section 26 05 53.

R. Clean PVC conduit with solvent, and dry before application of glue. The temperature rating of glue/cement shall match weather conditions. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturer's recommendations.

3.03 CONDUIT INSTALLATION SCHEDULE

A. Conduit other than that specified below for specific applications shall not be used.

B. Exposed Outdoor Locations: Rigid Metal conduit.

C. Wet Interior Locations: Rigid Metal conduit.

D. Exposed Dry Interior Locations: Rigid Metal conduit. Electrical metallic tubing.

E. Motor and equipment connections: Flexible PVC coated metal conduit (all locations). Minimum length shall be one foot (300 mm), maximum length shall be three feet (900 mm). Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.

3.04 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

C. No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.

D. Boxes shall not be fastened to the metal roof deck.

E. It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.

F. In case of any question or argument over the location of an outlet, the Contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.

G. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.

H. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch (450 mm) by 24 inch (600 mm) access doors.

I. Locate and install to maintain headroom and to present a neat appearance.

J. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

3.05 OUTLET BOX INSTALLATION

A. Provide knockout closures for unused openings.

B. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches (300 mm) of box.

C. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide non-metallic barriers to separate wiring of different voltage systems.

D. Coordinate mounting heights and locations of all outlet boxes.

E. Ceiling outlets shall be 4 inch square, minimum 2-1/8 inch (54 mm) deep.

F. Provide recessed outlet boxes in finished areas. Use adjustable steel channel fasteners for flush ceiling outlet boxes.

G. Align wall-mounted outlet boxes for all devices.

H. Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.

I. Surface wall outlets shall be 4 inch (100 mm) square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.

3.06 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install approved access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.

B. Support pull and junction boxes independent of conduit.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 Scope

A. The work under this section includes the products and execution requirements relating to labeling of power and general wiring. Further, this section includes labeling of all terminations and related sub-systems, including but not limited to nameplates and stenciling.

1.02 Related Work

A. Applicable provisions of Division 1 shall govern work under this section.

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

1.03 Submittals

A. Include schedule for nameplates and stenciling.

B. Prior to installation, the Contractor shall provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8 1/2” x 11” sheets annotated, explaining their purposed use.

PART 2 – PRODUCTS

2.01 Materials

A. Labels: All labels shall be permanent. NO HANDWRITTEN OR NON-PERMANENT LABELS ARE ALLOWED. Exception: back side of device plates and junction boxes may use handwritten, legible labeling on box covers, unless specifically prohibited by other specification sections.

B. Cable label size shall be appropriate for the conductor or cable size(s), and outlet faceplate layout. Labels for power conductors (600V and lower) shall be cloth-type. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.

C. Nameplates: Engraved three-layer laminated plastic, black letters on a white background.

D. Tape (phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase.

E. Adhesive type labels not permitted except for phase and wire identification.

PART 3 – EXECUTION

3.01 General

A. All branch circuit and power panels must be identified with the same symbol used in circuit directory in main distribution panel.

B. Clean all surfaces before attaching labels with the label manufacturer's recommended cleaning agent.

C. Install all labels firmly as recommended by the label manufacturer.

D. Labels shall be installed plumb and neatly on all equipment.

E. Install nameplates parallel to equipment lines.

F. Secure nameplates to equipment fronts using manufacturer approved adhesive or cement.

G. Embossed tape will not be permitted for any application.

3.02 Junction and Pullbox Identification

A. Provide circuit numbers, and source panel designations for power wiring. Other system shall be identified as shown on details or approved shop drawings.

B. In exposed areas, identifications should be made inside of device covers, unless directed otherwise. Use machine-generated labels, or neatly hand-written permanent marker

3.03 Power and Control Wire Identification

A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.

B. All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be labeled as soon as it is terminated including wiring used for temporary purposes.

3.04 Nameplate Engraving

A. Provide nameplates of minimum letter height as scheduled below.

B. Circuit Breakers in Distribution Panelboards: 1/2 inch (13 mm); identify circuit and load served, including location.

C. Individual Circuit Breakers, Disconnect Switches, Enclosed Switches, and Motor Starters: ½ inch (13 mm); identify source and load served.

D. Control Panels: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify voltage rating, source and room location of the source.

E. Equipment Enclosures: 1 inch (25 mm); identify equipment designation.

END OF SECTION

SECTION 26 27 02

EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.01 Scope

A. The work under this section includes electrical connections to equipment specified under other Divisions and/or Sections, or furnished by Owner, including, but not limited to:
-HVAC motors and panels
-Wastewater motors and panels
-Plumbing motors and panels

1.02 Submittals

A. Product Data: Provide data for cord and wiring devices.

1.03 Coordination

A. Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

PART 2 - PRODUCTS

2.01 Cords and Caps

A. Straight-blade Attachment Plug: NEMA WD 1.

B. Locking-blade Attachment Plug: NEMA WD 5.

C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.

D. Cord Construction: Oil-resistant thermoset insulated multiconductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.

E. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

2.02 Other Products

A. Refer to related sections for other product requirements.

PART 3 - EXECUTION

3.01 Inspection

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 Preparation

A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.03 Installation

A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

B. Make conduit connections to equipment using flexible PVC-coated metal conduit.

C. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

E. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.

F. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

3.04 HVAC, Wastewater, and Plumbing Connections

A. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters and disconnects to motors or to packaged control panels. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.

B. Unless otherwise specified, all electrical motors and control devices such as aquastats, float and pressure switches, fan powered VAV boxes, switches, electro-pneumatic switches, solenoid valves and damper motors requiring mechanical connections shall be furnished and installed and wired by the Contractor supplying the devices.

C. Each motor terminal box shall be connected with a minimum 12", maximum 36" piece of flexible PVC-coated metal conduit to a fixed junction box. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.

D. Check for proper rotation of each motor.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 Scope

A. This section describes the products and execution requirements relating to furnishing and installing wiring devices and related systems for the project.

1.02 Related Work

A. Applicable provisions of Division 1 govern work under this Section.

1.03 Submittals

A. Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.

1.04 Operation and Maintenance Data

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.01 Wall Switches

A. General: Heavy duty use toggle switch, rated 20 amperes and 120/277 volts AC. Switches shall be UL20 Listed and meet Federal Specification WS-896. All switches shall be heavy duty Specification Grade.

B. Handle: Ivory made of nylon or high impact resistant material.

C. Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with separate green ground screw. Switches shall be as follows:
   1. Hubbell 1221*,
   2. Leviton 1221-S*,
   3. Pass & Seymour CSB20AC1-*,
   4. or approved equal. (* indicates color selection).

2.02 Receptacles

A. General Requirements: NEMA Type 5-20R, ivory nylon or high impact resistant face. Receptacles shall be UL498 Listed and meet Federal Specification WC-596. All duplex receptacles shall be heavy duty Specification Grade, 20 amp rated.

B. Generally, all receptacles shall be duplex convenience type unless otherwise noted.

C. All receptacles installed in outdoor locations, garages, rooftops, and in other damp or wet locations shall be GFCI type with a weather-resistant (WR) rating.

2.02 Convenience and Straight-blade Receptacles: All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be as follows:

1. Hubbell 5362*,
2. Leviton 5362-S*,
3. Pass & Seymour PS5362*,
4. or approved equal. (* indicates color selection).

2.03 GFCI Receptacles with a weather-resistant (WR) rating: Weather-Resistant duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL standard 943 Class-A. WR GFCI receptacles shall be as follows:

1. Hubbell GFR5362*TR, Leviton WR899-*,
2. Pass & Seymour 2095TRWR*,
3. or approved equal. (* indicates color selection).

2.04 Explosion-Proof Receptacles: Pin type, 30 amp rated with matching plug, copper-free aluminum housing with corrosion resistant polyester/epoxy finish, mechanically interlocked plug and switch, “On-Off” lockable indicator handle. Assembly shall be suitable for use in Class I, Division 1, Group C hazardous location as specified in NFPA 70, meeting requirements of UL1686 as follows: Hubbell # HBLVSQ3034 receptacle with Hubbell # HBLVP3485 plug, Emerson #JBR3034-150 with Emerson #ACP3034BC or approved equal.

2.05 Device Plates and Box Covers

A. Weatherproof Cover: All receptacles installed in wet locations shall have an enclosure that is weatherproof whether or not the attachment plug is inserted. Covers shall be gasketed metal with hinged “in-use” device covers, powder coat painted. Non-metallic covers are not allowed. Covers shall be latching type and shall be lockable. Covers shall be identified as “extra-duty” type per NEC 406.9(B)(1).

B. Surface Cover Plate: Raised galvanized steel.

PART 3 - EXECUTION

3.01 Installation

A. See plans for device mounting heights.

B. Install wall switches with OFF position down.

C. Install convenience receptacles with grounding pole on bottom.

D. Install specific-use receptacles at heights shown on Contract Drawings.

E. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

F. Install devices and wall plates flush and level.

G. Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.

3.02 Field Quality Control

A. Inspect each wiring device for defects.

B. Verify that each receptacle device is energized.

C. Test each receptacle device for proper polarity.

D. Test each GFCI receptacle device for proper operation.

3.03 Adjusting

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

B. Mark all conductors with the panel and circuit number serving the device with a machine generated label, at the device, and on the back of the device cover.

END OF SECTION

SECTION 26 27 28

DISCONNECT SWITCHES

PART 1 – GENERAL

1.01 Scope

A. The work under this section includes disconnect switches, fuses, and enclosures.

1.02 Related Work

A. Applicable provisions of Division 1 shall govern work under this section.

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 05 53 - Identification for Electrical Systems

1.03 Submittals

A. Include outline drawings with dimensions, and equipment ratings for voltage, ampacity, horsepower, and short circuit.

PART 2 – PRODUCTS

2.01 Disconnect Switches

A. Fusible Switch Assemblies (use only when overcurrent protection is required): NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: designed to accommodate Class R cartridge type fuses.

B. Non-fusible Switch Assemblies: NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosure: NEMA Type 1 or 3R as indicated on Drawings.

D. Provide manufacturer’s equipment ground kit in all disconnect switches.

2.02 Fuses

A. Fuses 600 Amperes and Less: Dual element, time delay, 250 or 600 volt, UL Class RK 1. Interrupting Rating: 200,000 rms amperes.

B. Provide three (3) spares of each size and type fuse. Provide enclosure for spare fuses.

PART 3 – EXECUTION

3.01 General

A. Install disconnect switches where indicated on Drawings.

B. Provide identification as specified in Section 26 05 53.

END OF SECTION