

SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A.** The General Conditions of the Contract, including Supplementary Conditions, and Division 01, General Requirements, apply to the work of this section.

1.02 DESCRIPTION

- A.** Furnish and install all electrical wiring, systems, equipment and accessories in accordance with the Specifications and Drawings.
- B.** Capacities of equipment and cable are, in general, indicated on the Drawings.
- C.** All ampacities herein specified or indicated on the Drawings are based on copper conductors with conduit and raceways accordingly sized. Aluminum conductors are not permitted.

1.03 WORK INCLUDED

- A.** Work in this section includes lighting system, power distribution and control system, communication and signaling systems, electrical connection of equipment furnished by others and other special systems and related electrical work. The work of this section is not limited to the above but is composed of all work specified in this section and indicated on the electrical plans.
- B.** Provide all necessary labor, tools, equipment, and materials necessary to accomplish the work. Pay all required local, State and federal fees and obtain and bear all costs of permits required.

1.04 WORK NOT INCLUDED

- A.** Related work not included in this section but which is included in other sections of these specifications includes the following:
 - 1.** Furring
 - 2.** Chases

3. Finish Painting
4. Furnishing electric motors
5. Furnishing temperature control devices

1.05 MINIMUM REQUIREMENTS

- A.** The following codes and standards are hereby made a part of these specifications. Work and material furnished under these specifications shall be constructed and designed in accordance with the applicable requirements of these codes and standards, except to the extent that more stringent requirements are indicated or required by governing regulations.
- B.** Whenever a particular standard is referenced, it is the latest edition of that standard to which is referred. In addition to the following list, comply with all state and municipal building and safety laws, ordinances and regulations relating to public health and safety.

Reference

Abbreviation

Name and Address

- | | |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. ADA | The Americans With Disabilities Act
U. S. Department of Justice
Civil Rights Division
Office on the Americans
With Disabilities Act
P. O. Box 6611B
Washington, D.C. 20035-6118 USA |
| 2. ANSI | American National Standards Institute, Inc.
1430 Broadway
New York, New York 10018
USA |
| 3. ASTM | American Society for Testing Materials
1916 Race Street
Philadelphia, Pennsylvania 19103
USA |

4. **BOCA** Building Officials & Code Administration
International, Inc.
17926 South Halsted Street
Homewood, Illinois 60430
USA
5. **EIA** Electronic Industries Association
2001 Eye Street, NW
Washington, D.C. 20006 USA
6. **Fed Spec** Federal Specifications and Standards
Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402 USA
7. **IEEE** Institute of Electrical & Electronics Engineers
345 East 47th Street
New York, New York 10017
USA
8. **IES** Illuminating Engineering Society
345 East 47th Street
New York, New York 10017
USA
9. **IPCEA** Insulated Power Cable Engineers Association
192 Washington Street
Belmont, Maryland 02178 USA
10. **NEC** National Electrical Code (by NFPA)
11. **NECA** National Electrical Contractors Assoc., Inc.
7315 Wisconsin Avenue
Washington, D.C. 20014 USA
12. **NFPA** National Fire Protection Association
Batterymarch Park
Quincy, MA 02269
USA
13. **NEMA** National Electrical Manufacturers Assoc.
2101 L Street, NW
Washington, D.C. 20037 USA
14. **OSHA** Occupational Safety and Health Act

c/o Department of Labor
200 Construction Avenue, NW
Washington, D.C. 20210 USA

15. UL Underwriters Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062
USA

1.06 STRUCTURAL CONDITIONS

- A.** These Specifications and Drawings accompanying same are intended to cover an installation which will not interfere with the structural design of the building, which will fit into the several available spaces, and which will insure a complete and satisfactory system.
- B.** Contractor shall carefully examine the plans for all branches of the work and shall be responsible for the proper fitting of his material and apparatus into the building.
- C.** Should the particular equipment which any bidder proposes to install require other space conditions than those shown on the Drawings, he shall arrange for such space with the Engineer before submitting his bid. Should changes become necessary on account of failure to comply with this clause, the Contractor shall make necessary changes at his (the Contractor's) own expense.
- D.** The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these Specifications and Plans, which shall be reviewed by the Engineer and approved before the work is started. Any interferences with the structural conditions shall be corrected by the Contractor before the work proceeds.

1.07 ACCESS PANELS

- A.** Furnish access panels for installation as specified, where indicated, or wherever required for accessibility of equipment, junction boxes, controls, etc. Cooperate to provide panels that will suit the architectural treatment of the areas where access panels are required. All panels shall be flush type factory prime painted steel, key operated, and of sufficient size to facilitate operation and maintenance of the device enclosed. Furnish shop drawings of access panels for the approval of the Architect, before fabrication.

1.08 EQUIPMENT IDENTIFICATION

- A. Furnish laminated engraved black plastic nameplates attached with stainless steel screws to each piece of equipment identified by name or number on the Drawings. Nameplate shall have condensed gothic letters no less than 1/4" high and be indented white on black background. Equipment requiring name tags includes panelboards, automatic transfer switches, switchboards and each individual switch within each switchboard, disconnect switches, starters, control panels, motor control centers and each individual starter within each motor control center, and special function control switches. Nameplates shall include panel or device name, voltage, and name/location of upstream device feeding equipment. Submit nameplate schedule with wording of all nameplates for approval.
- B. Clearly mark all branch circuit junction box covers above the lay-in ceiling with permanent marker. Markings shall indicate panel name and associated circuit numbers of all contained wiring. Junction box covers for all other systems shall be marked with layperson terminology as to the system type or function.

1.09 EQUIPMENT AND CONNECTIONS

- A. All apparatus, equipment, devices and appliances which are indicated to be electrically roughed-in shall be so equipped. Electrical connections to have junction box with cover or disconnect as shown on Drawings. This item must be coordinated with plans.
- B. Make complete final electrical power and electrical control connections to all equipment supplied under this contract and to all electrically powered equipment furnished or installed by others.

1.10 USE OF ALLOCATED SPACES

- A. Consult the architectural plans, as well as the plans for all other trades, for spaces allocated to piping, conduits, equipment, etc. The electrical plans are essentially diagrammatic indicating approximate location of system components. The architectural plans and details shall take precedence in allocating space requirements for the various pipes, electric conduits, etc. All trades must consult with one another to the end that the available space is best utilized by all. Due consideration shall be given to the pipe, junction boxes, and conduit locations so that the accessibility of all the installed lines from access doors, hand holes, etc., is preserved; and space shall not be unnecessarily used by any contractor to save fittings, offsets, etc., whereby any interference results with other trades or where

furring limits as shown on the architectural plans are exceeded. Each contractor shall consult the Engineer for space requirements for his equipment whenever same is not clearly indicated on the plans, or otherwise provided for. Failure to obtain clearance will leave the Contractor liable to removal and relocation of the affected equipment.

1.11 FOUNDATIONS AND SUPPORTS

- A.** Furnish and install substantial foundations for each piece of apparatus installed under this contract.
- B.** Provide 4" thick concrete bases under all floor mounted equipment. Support all switchgear, transformers, equipment, etc., from the structure in accordance with NEC, using substantial steel hangers, strut, and fasteners.

1.12 EXCAVATION AND BACKFILL

- A.** Provide excavation and backfill for installation of raceway or equipment in accordance with General Excavation and Backfill Sections of these specifications. All trenches inside of building shall be backfilled with approved building pad material, and compacted to secure a stable base. Repair and replace any existing paving or landscaping damaged during the execution of the work to match the existing paving and landscaping to the satisfaction of all parties concerned.

1.13 OPENINGS - CUTTING REPAIRING

- A.** Holes in Concrete: Sleeves shall be furnished, accurately located and installed in forms before pouring of concrete. This Contractor shall pay all additional costs for cutting of holes as the result of the incorrect location of sleeves. All holes through existing concrete shall be either core drilled or saw cut. All holes required shall have the approval of the Structural Engineer prior to cutting or drilling.

Fire seal around all floor and all wall penetrations to ensure a 2-hour fire rating at penetration.

1.14 TESTING AND LOAD BALANCING

- A.** Test all circuits to assure them to be free of grounds. Light and test each lamp. Prove and test energy available at the load side of disconnect switches and the final point of connection to driven equipment. Make all

reasonable tests required by the Engineer to prove the integrity of the work and leave the complete electrical installation in first class condition ready for operation. Branch circuits served from the lighting panelboards vary in loading. Carefully balance the load on each phase when connecting branch circuits in each panelboard. When all load is turned on and the system is operating at 100% demand, the initial unbalanced shall not exceed 10%.

1.15 SUBSTITUTIONS

- A.** After execution of the contract, substitution of equipment of makes other than those specifically named in the contract documents will be approved by the Engineer and the Architect for the following reasons only:
 - 1.** That the equipment specified is discontinued, not allowed by code, or there is savings in time or money to the Owner. In such cases, substitutions shall be proposed prior to bid in accordance to the documentation and time as stated elsewhere in the specifications and/or the bid proposal. Substitutions proposed should be equal to and/or superior to equipment named (in construction, efficiency and utility).
- B.** This does not, in any way, relieve the contractor of the responsibility of ordering equipment for proper sequential delivery.
- C.** Refer to DIVISION 01 for other requirements of substitutions.

1.16 CLEANING EQUIPMENT AND MATERIALS

- A.** Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care shall be taken to provide protection for switchgear, open connections, light fixtures, transformers and electrical apparatus.
- B.** All fixtures, switchgear, finished surfaces and equipment shall have all grease, adhesive labels and foreign materials removed.

1.17 INTERRUPTION OF SERVICES

- A.** While work is in progress, except for designated short intervals during which connections are to be made, continuity of service shall be maintained to all existing systems. Interruptions shall be coordinated with the Owner as to time and duration. The Contractor shall be responsible

for any interruptions to service and shall repair any damages to existing systems caused by his operations.

1.18 GUARANTEE

- A.** Contractor shall guarantee all workmanship, materials and labor for a period of one (1) year, after warranty date set at substantial completion, to be free from defects not due to normal wear or abuse.

1.19 OPERATION MANUALS

- A.** Furnish three bound sets of Operation Manuals along with the various warranties for mechanical and electrical equipment. Deliver Operation Manuals and Warranties to the Engineer prior to Final Inspection. Complete and satisfactory submittal of this material is a condition for final payment.

1.20 CONDITIONS OF FINAL INSPECTION

- A.** The following items must be accomplished and delivered to the Engineer before request for Final Inspection and final payment will be acknowledged:
 - 1.** Operating and Maintenance Instructions: Furnish three (3) complete sets of Operating and Maintenance Instructions for all equipment furnished under this contract.
 - 2.** Deliver all electrical inspection receipts and job record drawings to Engineer.
 - 3.** Deliver one set of reproducible record drawings to the Engineer showing all deviations from the contract drawings.
 - 4.** All work and materials as called for by the contract must be complete.
 - 5.** All lamps shall be new. Personally make a special inspection trip to assure that the work on the project, as a whole, is ready for final acceptance before calling upon the Engineer to make a Final Inspection.

1.21 SHOP DRAWINGS AND SUBMITTED DATA

- A.** Refer to DIVISION 01 for submittal requirements. No work indicated on any shop drawing shall be started until such drawings have been reviewed and approved by the Engineer.
- B.** Submittal data shall be referenced to section and paragraph numbers of the specifications and to fixture and equipment numbers listed or scheduled, and shall be assembled in numerical order of the specification paragraphs. Submittals shall be bound in sets between covers and all sets within a section shall be identical. Identification marks on submittals shall be made in black ink. Do not use red pencil or ink.
- C.** Where equipment manufacturers named as equivalent, or approved equal, are proposed for use by the Contractor, he shall be responsible to coordinate the change with all trades affected and bear cost of changes required by other trades to accommodate the equipment substitution. Submit for approval ¼" scale working drawings of equipment rooms, plan and section.
- D.** Submit the following shop drawings for approval in accordance with these specifications:
 - 1. Raceway, Conduit, Boxes, Fittings, Underfloor Raceway.
 - 2. Wire and Cable.
 - 3. Wiring Devices.
 - 4. Disconnect Switches.
 - 5. Fuses.
 - 6. Panelboards.
 - 7. Light Fixtures and Lamps.
 - 8. Contactors.
 - 9. Transformers.
 - 10. Clocks and Paging Systems.

11. Fire Alarm Systems
12. Communications (Data) Systems.

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 DESCRIPTION

- A.** Run all wire in metal raceways unless noted otherwise.
- B.** Provide cable, wire and connectors in accordance with plans and specifications and in compliance with manufacturers' published application and installation recommendations.

1.02 QUALITY ASSURANCE

- A.** Comply with National Electrical Code (NFPA 70), and National Electrical Manufacturers Association/Insulated Power Cable Engineers Assoc. Standards.
- B.** Provide electric cable wire and connectors which have been listed and labeled by Underwriters Laboratories.
- C.** Remove from project site any damaged materials.

1.03 SUBMITTALS

- A.** Submit manufacturers' data on all cable wire and connectors to be used.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A.** Wire and Cable: General Cable Corp., Southwire, Triangle, or acceptable equal.
- B.** Connectors: Amp, Burndy Corp, General Electric Co., Ideal Industries Inc., Minnesota Mining and Mfg. Co., O.Z./Gedney Co., Thomas & Betts Co., or acceptable equal.

2.02 WIRE

- A. Use soft drawn annealed copper having a conductivity not less than 98% of that of pure copper and with thermoplastic 600 volt insulation. Use no aluminum wire unless called for specifically on plans.
- B. All lighting and power wire indicated on drawings is size 12 unless indicated otherwise or otherwise required by codes. Use no wire smaller than size 12 for power or lighting.
- C. Wire Sizes #12 and #10. Use solid or stranded copper rated THHN/THWN-2 insulation temperature rated for 90 degrees C in wet and dry locations.
- D. Wire Size #8 and Larger. Use stranded copper Type THHN-2/THWN-2 90 degrees C temperature rated insulation for wet and dry locations. Use XHHW-2 where called for on drawings.
- E. Temperature Control Wire. Use stranded THHN copper wire with crimp spade lugs. Minimum size #16.

2.03 CONNECTORS.

- A. Provide factory made metal connectors of size, rating, material, type, and class as indicated by NEC, NEMA, or as indicated on plans.
- B. Use pre-insulated spring-type pressure or crimp-type solderless connectors on wire sizes #12, #10, and #8. For wire sizes larger than #8, use solderless hydraulically die crimped compression type connectors.
- C. Insulate all splices and taps using preformed factory made insulating boots with scotch fill and electrical tape.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Do not pull any wire into raceway until raceway is complete and all burrs and abrading surfaces have been removed.
- B. A U.L. approved lubricant may be used where necessary to facilitate installation of conductors.

- C. Use only continuous conductors without welds or splices or joints between boxes. Mains and feeders are to be run their entire length without splices.
- D. Identify all conductors using color coded insulation or numbered linen or plastic Brady tags. Use the following color coding chart for all lighting and power circuits.

	<u>120/208 Volts</u>	<u>277/480 Volts</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground Wire	Green	Green

Use numbered stick-on Brady wire tags to label all control wire ends according to the numbering scheme printed on the wiring diagram.

- E. Install crimp type ring or spade lugs on ends of all control wires.
- F. Install all wire cable and connectors as indicated and in accordance with manufacturers' written instructions, NEC requirements, and the National Electrical Contractors Association "Standard of Installation".
- G. Insulate all splices and taps to produce an insulated assembly equivalent to, or better than, the electrical and mechanical strength of the conductors being insulated.
- H. Use connectors compatible with the conductor and terminal materials.
- I. Before energizing, check for short circuits and megger all circuits in accordance with NEC.
- J. Do not install more than four phase conductors with dedicated neutrals maximum in a $\frac{3}{4}$ " or larger raceway unless so indicated on plan. Where $\frac{1}{2}$ " conduit is allowed, do not install more than two phase conductors with neutral conductors in a raceway unless so indicated on plan.

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. System Grounding.

1. Secondary service neutrals shall be grounded at the supply side of the secondary disconnecting means and at the related transformers.
2. Separately derived systems (transformers downstream from the service entrance) shall have the secondary neutral grounded.

B. Equipment Grounding.

1. All metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be grounded for personnel safety and to provide a low impedance path for possible ground fault currents.

C. Structure Grounding.

All structural steel columns shall be bonded to a perimeter ring grounding system as indicated on plans.

1.02 RELATED WORK

- A.** Section 260500 COMMON WORK RESULTS FOR ELECTRICAL.

1.03 SUBMITTALS

A. Shop Drawings.

1. Submit catalog cuts and descriptive literature for approval.
2. Include sufficient information, clearly presented, to determine compliance with drawings and specifications.

B. Test Reports.

1. Submit certified test reports of ground resistance to the Engineer for approval.
- C. Certifications: Two weeks prior to final inspection, deliver to the Engineer four copies of the following:
 1. Certification that the material and installation is in accordance with the drawings and specifications and has been properly installed.

1.04 APPLICABLE PUBLICATIONS

A. The following specifications and standards, except as hereinafter modified, are incorporated herein by reference and form a part of this specification to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of invitation for Bids shall be applicable. In text such specifications and standards are referred to by basic designation only.

1. National Fire Protection Association (NFPA) Publications:
No. 70.....National Electrical
Code (NEC)
2. Underwriters Laboratories, Inc. (UL) Publications:
No. 83.....Thermoplastic
Insulated Wires

No. 44.....Rubber-Insulated
Wires and Cables
No. 467.....Electrical
Grounding and Bonding
Equipment
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

No. 142.....Recommended
Practice for Grounding of
Industrial and Commercial Power Systems

PART 2 - PRODUCTS

2.01 GROUNDING WIRES.

- A.** Shall be UL and NEC approved types, copper, with TW or THWN/THHN or THW insulation color identified green, except where otherwise shown on the drawings, or specified.
- B.** Wire size shall not be less than shown on the drawings and not less than required by the NEC.

2.02 GROUND RODS

- A.** Shall be copperclad steel, 5/8-inch diameter by 10 feet long.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERALLY

- A.** Grounding shall be in accordance with the NEC, as shown on the drawings, and as hereinafter specified.

3.02 PRIMARY EQUIPMENT AND CIRCUITS

- A.** Pad Mounted Transformers.
 - 1.** Provide a driven ground rod and connect with a grounding electrode conductor to the grounding facilities at the transformer.
 - 2.** Ground the secondary neutral.
 - 3.** Connect lightning arrestor grounds to the ground pad, and per NEC.
- B.** Lightning Arrestors.
 - 1.** Connect lightning arrestor grounds to the equipment ground bus, or ground rods as applicable.
- C.** Metallic Conduit.
 - 1.** Metallic conduits which terminate without mechanical connection to a housing of electrical equipment by means of locknut and bushings or adaptors shall be provided with grounding bushings. Bushings shall be connected with a bare grounding conductor to the equipment ground bus.

3.03 SECONDARY EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper.

1. Connect the secondary service neutral to the ground bus in the service equipment.

B. Water Pipe and Supplemental Electrode.

1. Grounding electrode conductor: Provide a connection between the service equipment ground bus and the metallic water pipe system. Jumper insulating joints in the water pipe.
2. Provide a supplemental ground electrode and bond to the water pipe ground, or connect to the service equipment ground bus.

C. Service Disconnect (Separate Individual Enclosure).

1. Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.

D. Switchgear, Switchboards, and Unit Substations.

1. Connect the various feeder green grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
2. Connect the grounding electrode conductor to the ground bus.
3. Connect the neutral to the ground bus (main bonding jumper).
4. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and ground wire to the ground bus.

E. Transformers.

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

- F. Conduit Systems.**
 - 1. Ground all metallic conduit systems.
 - 2. Non-metallic conduit systems shall contain a grounding conductor.
 - 3. Conduit provided for mechanical protection and containing only a grounding conductor shall be bonded to that conductor at the entrance and exit from the conduit.

- G. Feeders and Branch Circuits:** Install green grounding conductors with all feeders and branch circuits as follows:
 - 1. Install grounding conductor with all feeders and branch circuits.
 - 2. Connect to all circuits serving fixed equipment and appliances.
 - 3. Connect to all receptacle outlets.
 - 4. Connect to all motors and motor controllers.
 - 5. All items of equipment where the final connection is made with flexible metal conduit shall have a grounding wire.
 - 6. All additional locations and systems as shown on the drawings.

- H. Boxes, Cabinets, Enclosures, and Panelboards.**
 - 1. Bond the grounding wires to each pull box, junction box, outlet box, cabinets, and other enclosures through which the ground wires pass.
 - 2. Provide lugs in each box and enclosure for ground wire termination.
 - 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the ground wires.

- I. Motors and Starters.**
 - 1. Provide lugs in motor terminal box and starter housing for ground wire termination.
 - 2. Make ground wire connections to ground bus in motor control centers.

- J.** Receptacles: Receptacles shall have a ground wire from green ground terminal to the outlet box ground screw.
- K.** Lighting Fixtures: Shall be grounded through green ground wire. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- L.** Electrical Appliances and Equipment: Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green ground conductor.

3.04 CONDUCTIVE PIPING

- A.** Bond all conductive piping systems in the building to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

3.05 GROUND RESISTANCE

- A.** The grounding system shall be tested to ensure that the ground resistance does not exceed 5 ohms.
- B.** Services at power company interface points shall comply with the power company ground resistance requirements.
- C.** Necessary modifications to the ground electrodes for compliance shall be without change in contract amount.

3.06 GROUND ROD INSTALLATION

- A.** Distance: Drive each rod vertically for not less than ten feet.
- B.** Multiple Rods: Where required to obtain the specified ground resistance, install multiple rods.
- C.** Where ground connections will be permanently concealed, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- D.** Where rock prevents the driving of vertical ground rods, install grounding electrodes in horizontal trenches to achieve the specified resistance.

SECTION 26 0533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install complete systems of electrical raceways, including but not limited to, all conduit, fittings, outlet boxes, cover plates, wireways, gutters, expansion fittings, and accessories.
- B. Unless noted otherwise, on drawings, all raceway systems installed underground, in poured concrete floors and walls, and all exposed conduit outside, shall be rigid metal conduit.
- C. All conduit drops not supported by walls or columns in mechanical rooms shall be rigid metal conduit.
- D. Steel EMT may be used in building voids, concealed spaces and where exposed inside.
- E. In intermittent moisture environments use rigid metal conduit.
- F. PVC conduit may be used only where called for on drawings or where allowed by the Engineer in writing.
- G. All underground conduit bends shall be at least 8 times the trade size diameter, or 18" (whichever is larger).

1.02 QUALITY ASSURANCE

- A. All raceway products shall have UL label stamp and shall comply with National Electrical Manufacturers Association standards and current edition of the National Electrical Code.
- B. All outdoor steel boxes, fittings, conduits and accessories shall be galvanized.
- C. Indoor steel boxes may be galvanized or painted.
- D. Submit manufacturer's data on all raceway system components

PART 2 - PRODUCTS

2.01 CONDUIT AND FITTINGS

- A.** Rigid Metal Conduit.
 - 1. Hot dip galvanized inside and outside, standard pipe size, threaded wrought steel. ANSI: C80.1, Federal Spec. WW-C-581.
 - 2. No intermediate metal conduit is allowed.
 - 3. Acceptable Manufacturers: Allied Tube and Conduit, LTV, Wheatland Tube or acceptable equal.

- B.** Weatherproof Outlet Boxes.
 - 1. Provide cast metal weatherproof outlet boxes of type and shape to suit the application with threaded conduit connections, gasketed spring hinged covers, and corrosion-proof hinges and fasteners.
 - 2. Acceptable Manufacturer: Appleton, Crouse-Hinds, or acceptable equal.

- C.** Junction and Pull Boxes (Inside).
 - 1. Provide galvanized steel junction and pull boxes with removable screw-fastened covers of size and gauge to comply with NEC and requirements of the application.
 - 2. Acceptable Manufacturers: Appleton, RACO, Steel City, Hoffman, or acceptable equal.

- D.** Junction and Pull Boxes (Exterior).
 - 1. Provide cast metal junction and pull boxes with gasketed screw on cover and threaded conduit connections, of size to comply with NEC and requirements of the application.
 - 2. Acceptable Manufacturers: Appleton, Crouse-Hinds, or acceptable equal.

- E.** Conduit Bodies.

1. Provide cast metal conduit bodies with threaded conduit connections and gasketed removable galvanized steel or aluminum covers. Conduit bodies specially designed for E.M.T. may be used where applicable.
 2. Acceptable Manufacturers: Appleton, Crouse-Hinds, Killark, or acceptable equal.
- F.** Electric Metallic Tubing (EMT).
1. Cold rolled steel electro-galvanized outside, Silicon painted inside. ANSI: C80.3, Federal Spec. WW-C-563.
 2. Acceptable Manufacturers: Allied Tube and Conduit, LTV Copperweld, Western Tube & Conduit, Wheatland Tube, or acceptable equal.
- G.** PVC Conduit.
1. NEMA Standard Pub. No. TC-6. Schedule 40, UL stamped.
 2. Acceptable Manufacturers: Carlon, or acceptable equal.
- H.** Flexible Metal Conduit.
1. Zinc coated steel, aluminum alloy. Federal Spec. WW-C-566.
 2. Acceptable Manufacturers: Greenfield, General Cable, or acceptable equal.
- I.** Liquid Tight Flexible Metal Conduit.
1. Steel core with moisture and oil proof PVC jacket with copper ground strap.
 2. Acceptable Manufacturers: General Cable, or acceptable equal.
- J.** Conduit Fittings.
1. All conduit fittings shall be steel. No die cast fittings are allowed.
 2. All EMT fittings, smaller than 2", shall be compression gland raintight or set screw type. Indenter style fittings are not allowed.
 3. All EMT fittings 2" and larger shall be compression gland raintight or set screw type with no fewer than 2 screws in each pipe.

4. Acceptable Manufacturers: Appleton, RACO, Thomas & Betts, Carlon (plastic only), or acceptable equal.

2.02 BOXES

A. General.

1. Provide metal boxes of shape, size, and mounting means to suit each respective location and usage, and to comply with NEC.

B. Interior Boxes and Accessories.

1. Hot-dip galvanized steel with extension rings, plaster rings, brackets, fixture studs, and mounting clips to suit the usage. Boxes installed in masonry or concrete walls shall be masonry type. Boxes installed in drywall construction shall be braced on both ends of box such that box end cannot move and does not depend on coverplate or device tabs to brace box.
2. Acceptable Manufacturers: RACO, Steel City, Appleton, or acceptable equal.

C. Wireways and Gutters.

1. Provide steel wireways and gutters of size as indicated on plans with hinged or removable covers. Exterior wireways to be galvanized with conduit entries to use weather tight hubs; interior wireways to be bonderized enameled steel.
2. Acceptable Manufacturer: Square D, Appleton, or acceptable equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General. Conduit.

1. No conduits shall be supported by wire type hangers. Use all thread and strut supports.
2. Horizontal branch circuit conduit in walls is allowed only between boxes that are less than six feet apart. Provide vertical conduit from each box up to ceiling and install horizontal conduit above ceiling where boxes are over six feet apart.

3. In general, conceal all conduit in walls and ceiling spaces and run as indicated on drawings.
4. Run parallel or perpendicular to building walls and floors in straight runs, using bends and offsets as required. Make all bends using proper bending tools with no more than 360 degrees in bends in a run of conduit without using pull boxes. Bends are to be made in such a manner that the internal diameter of the tubing will not be effectively reduced. Replace all flattened or crushed conduit prior to pulling wire. Ream all conduit ends.
5. Swab all underfloor conduit, prior to pulling wire, and cap, or plug all conduit exposed to weather during construction. Wire shall be drawn into a completed conduit system so there is no danger to wire insulation.
6. Size all conduits as indicated on plans or as indicated in National Electrical Code, if not indicated on plans. In no case shall conduit be less than 3/4 inch when installed in poured concrete or underground. All conduit shall be of such size that required conductors may be drawn in without injury or excessive strain.
7. No conduit may be less than 1/2 inch.
8. Do not install conduit larger than 3/4 inch in concrete slabs. Larger conduit may be installed in the underslab fill where indicated on drawings.
9. Maintain a minimum of 3 inches between conduit and steam or hot water lines pipe insulation when running parallel with pipe. Maintain a minimum of 1 inch from the pipe insulation when crossing steam or hot water pipe.
10. Support all conduit using pipe clamps spaced a maximum of 8 feet apart. Rigid non-metallic conduit shall be supported as per table 347-8 of NEC.
11. Support all raceway systems from building structure, not from ceiling system or ceiling hangers or from other pipe or duct systems.
12. Make final conduit connections to motors and other equipment, subject to vibration using liquid tite flexible metallic tubing minimum 12 inches long and maximum 24 inches long. Connection to 1 horsepower or smaller motors within a housing may use flexible metallic tubing.

13. Use liquid tight flexible metallic tubing where flexible conduit is required outdoors or in intermittent moisture environments and for all motor connections and connections to motor driven equipment. Install liquid tight flex conduit so that liquids run off of the surface without draining toward fittings. In areas subject to much vibration or strain, S.T. type connectors shall be used.
14. Provide nylon pull cord in all empty conduits with ends marked to identify terminal points.
15. For conduit stub ups in floors, for future use, set threaded coupling flush with finished floor. Where stub is for future use, install threaded plug in coupler flush with finished floor.

B. Sleeves.

1. Provide a sleeve constructed from electric metallic tubing for each location where a conduit or hanger passes through a concrete slab, masonry wall, roof or other portion of the building structure. Make sleeve flush on both sides of the surface penetrated and pack around the conduit with approved fire stop sealant to maintain the fire rating of rated walls or slabs. Extend sleeves 1" above the finished floor in equipment rooms.
2. When conduit passes through concrete or other structural outside walls below grade, a sleeve must be cast in place. Fill gap between sleeve and pipe with rubber link seal by Thunderline and with silicone sealant and make entire installation water tight

C. Boxes.

1. Install all outlet boxes with front of box within 1/4" of finished non-flammable surface and flush with finished ceiling or wall surface of a flammable surface. Use approved plaster rings to build out to wall surface when box is recessed.
2. Secure all boxes rigidly to building structural members.
3. Support all conduit from structure within 18" of all boxes or cabinets.
4. Locate all boxes for ease of accessibility.
5. Provide knockout closures for knockouts not used.

6. Install all floor boxes in accordance with the manufacturer's written installation instructions and recommendations, and so that box trim is flush with finished floor. Provide carpet flanges where appropriate.
7. Generally locate outlet and switch boxes where indicated on plans. Refer to architectural plans for locations of doors, casework, door swings, and other architectural features which must be considered when selecting box locations. Consult the Architect prior to installing any box which conflicts with architectural features. Failure to do so will obligate the Contractor to relocate said box without cost.

D. Fittings.

1. Use double lock nut bushings on all rigid steel conduit to box fittings, and secure all conduit tight to box.
2. Screw all set screw and compression type couplers and connectors tight to retain ground integrity of raceway system.
3. Use expansion fittings with bonding jumpers where rigid or EMT conduits cross building expansion joints.

SECTION 26 2200

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install transformers as indicated on drawings and the requirements of this section.
- B. Install transformers on the floor, against a wall or partition, or suspended from the structure, and accessible from the front.

1.02 QUALITY ASSURANCE

- A. Comply with National Electrical Code (NFPA 70/ANSI C1) as applicable to construction and installation of transformers. Comply with applicable NEC articles pertaining to installation of wiring and equipment in hazardous locations.
- B. Comply with National Electrical Manufacturers Association construction standards.
- C. Provide transformer units which have been listed and labeled by Underwriters Laboratories.

1.03 SUBMITTALS

- A. Submit manufacturers data on transformers and enclosures, including dimensional drawings of installed transformer units showing accurately scaled layout of unit.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Square D.

2.02 GENERAL

- A. Furnish and install where indicated on the electrical drawings, transformers of the KVA rating and voltage indicated.

- B.** Dry-type transformers to be air-cooled with barrel-type coils, Class H insulation, with high grade insulating varnish of the nonhydroscopic thermo setting type. Windings shall be continuous without splice.
- C.** All transformers 30 KVA and above shall have two-2-1/2% full capacity taps above normal and four-2-1/2% full capacity taps below normal rated primary voltage. All transformers 25 KVA and larger are to have bottom mounted terminal boards.
- D.** For ratings 25 KVA and below, transformers shall not exceed 115 degrees C rise above a 40 degrees C ambient by resistance when tested in accordance with ASA and NEMA standards. Transformers with ratings 30 KVA and larger shall not exceed 150 degrees C rise above a 40 degrees C ambient by resistance when tested in accordance with ASA and NEMA standards. The warmest spot on the enclosure of any Class H transformer shall not exceed 35 degrees C rise above 40 degrees C ambient.
- E.** Transformers shall have non-aging silicon steel miter-cut cores held together with steel channels or angles, with low magnetic flux density, quiet operating. Units 25 KVA and larger shall have enclosures having a minimum steel weight of 12 gauge and the enclosure shall be acoustically lined to provide the lowest possible sound levels. Each transformer shall be guaranteed to be a standard quiet transformer with ratings not to exceed the following:
 - 1. 225 KVA - 3 phase, 55 decibels.
 - 2. 150 KVA - 3 phase, 50 decibels.
 - 3. 75 KVA - 3 phase, 50 decibels.
 - 4. 45 KVA - 3 phase, 45 decibels.
 - 5. 15 KVA - 3 phase, 45 decibels.

Where the decibel readings are taken in accordance with NEMA and ASA standards STI-196.

- F.** Transformer coils in all cases shall have a final wrap of electrical insulating material designed to prevent injury to the magnetic wire. Transformers having coils with magnetic wire visible will not be acceptable. The core and coil is to be subjected to a double dip and bake process. The unit is to be pre-baked and receive its first varnish dip while still warm.

PART 3 - EXECUTION

3.01 INSTALLATION

- A.** Where transformers are indicated to be mounted on the floor, they shall be set on raised concrete pads furnished by the General Contractor. Where transformers are to be wall mounted or suspended, these supports shall be furnished and installed under this section of the specification.
- B.** Transformers shall be isolated from steel supports and concrete bases by setting on combination ribbed neoprene and cork pads. Furnish shop drawings of supports for approval before fabrication.
- C.** Use 18" maximum flexible metal conduit to contain the conductors from the transformer to the raceway system.
- D.** Handle transformers and enclosures carefully to prevent breakage, denting, and scoring the finish. Repair and paint with manufacturers' specified paint all dents and scratches. Store transformers inside where applicable and protect from weather. When necessary to store out-of-doors, elevate well above grade and enclose with durable, weatherproof wrapping.
- E.** Install transformers with adequate clearance for air circulation to remove the heat produced by transformer.

SECTION 26 2416

PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install panelboards as indicated on drawings of voltage, phase, and current rating as indicated on drawings and schedules.

1.02 SUBMITTALS

- A. Submit manufacturers' data on all panelboards and enclosures showing physical dimensions, voltage characteristics, ampacity, breakers, bussing arrangements, enclosure mounting configuration and all accessories.

1.03 QUALITY ASSURANCE

- A. Comply with all UL, NEC, NEMA, and ANSI standards and label with UL and IBEW stamps.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS.

- A. Square D. No substitutions.

2.02 PANELBOARDS

- A. Panelboard Interiors.
 - 1. Panelboard interiors shall be constructed on pre-drilled and pre-tapped channel rails to insure maximum rigidity and interchangeability of units without modification. All ferrous parts shall be galvanized. All main busses shall be copper or aluminum pre-drilled and tapped to accommodate any combination of fusible units or circuit breakers without further modification of the bus or mounting channels. All branch circuit connectors shall be die formed or extruded having a minimum current carrying capacity equal to the switch rating attached to the connector. All bussing shall be sequence type and all units shall be bolted to the bus. All units to be so designed that removal of a unit won't disturb adjacent units, bus structure or insulators. All scheduled spaces shall require only the breaker or switch to make use of the space and

shall include all sub assemblies, brackets, modules, and mounting hardware. Full bus to the space shall be supplied.

B. Fusible Switch Units.

1. All fusible switch units shall be horsepower rated quick make-quick break with deionizing grids and visible silver alloy contacts when the switch door is open. Fuse holders shall be of the high pressure type using a compression coil spring located out of the heat zone. The coil spring shall be installed so that it cannot carry any current. Bails or other external means of reinforcing the fuse clips will not be acceptable. All switches shall have an external operating handle which can be locked in the "OFF" position and cover interlock to prevent opening the switch in the "ON" position. Provision for voiding the interlock by authorized personnel shall be provided. Each switch shall have engraved micarta identification and a nameplate which gives the switch ratings clearly and distinctly.

C. Circuit Breaker Units.

1. All circuit breaker units shall be molded case circuit breakers of the quick make-quick break thermal magnetic type and shall be operated by means of toggle type mechanism with trip indication, to have inverse-time trip characteristics, and shall trip free on overload or short circuit. In addition, a magnetic armature shall be provided to trip the breaker instantaneously for short circuit currents above the overload range. The short circuit rating shall be in accordance with NEMA standards for sizes required.
2. The breakers are to be equipped with Zirconium Oxide refractory arc chutes and exhaust chamber to cool the gases and carry them to the wiring gutter, not the bus compartment. They are to be interchangeable and capable of being operated in any position.
3. Multiple pole breakers are to have common trip so as overload on one pole will trip all poles simultaneously.
4. All circuit breakers to be thermal magnetic bolt in type, unless noted otherwise.

D. Power Distribution Panelboard.

1. Provide dead-front safety type power distribution panelboards where indicated, with switches and protective devices in the number, rating, type and arrangement shown, with anti-burn

solderless pressure type main lug connector approved for copper conductors for connecting feeder to bus or main switch as scheduled; equipped with copper or aluminum bars arranged for the service, voltage and capacity as scheduled, and full size neutral bus mounted on opposite end of panel from main lugs.

Provide suitable lugs on neutral bus for each out-going feeder requiring a neutral connection; provide a bare uninsulated grounding bar with lugs for each outgoing feeder and suitable for bolting to the enclosure; and provide panelboards fabricated by same manufacturer as enclosure. Panelboard to be adjustably mounted in its cabinet to permit an adjustment outward of at least 3/4" and to permit panelboard to be plumbed and centered. Each switch or breaker in power distribution panelboards shall have a white on black engraved laminated plastic nameplate permanently attached.

E. Lighting and Appliance Panelboards.

1. Provide dead-front safety type lighting and appliance panelboards where indicated, with switching and protective devices in the number, rating, type and arrangement shown; with anti-burn solderless pressure type lug connectors approved for copper conductors, for connecting feeder to bus or main switch as scheduled; equipped with copper or aluminum bus bars arranged for the service, voltage and capacity as scheduled and a full sized neutral bar with neutral bar mounted on opposite end of panel from main lugs; provide suitable lugs on neutral bus for each outgoing feeder required; provide a bare uninsulated grounding bar with lugs for each out-going feeder and suitable for bolting to the enclosure; and provide panelboards fabricated by the same manufacturer as enclosures. Panelboard to be adjustably mounted in its cabinet to permit an adjustment outward of at least 3/4" and to permit panelboard to be plumbed and centered.

F. Panelboard Enclosures.

1. Provide sheet steel enclosures with minimum 4-1/2" side gutters and 8" end gutters, or as required by NEC Art. 373, which ever is larger; NEMA Type as required for the application; code gage, minimum 16 gage thickness, with multiple knockouts; provide doors with flush lock and key, with concealed hinges. Provide painted grey enamel finish over a rust inhibitor. Provide enclosures fabricated by the same manufacturer as panelboards to be enclosed.

G. Panelboard Accessories.

1. Provide panelboard accessories including, but not necessarily limited to, cartridge and plug type fuses and circuit breakers, as recommended by the panelboard manufacturer for the ratings indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A.** Examine all areas and conditions where panelboards are to be installed and report to the Engineer any conditions detrimental to the installation of panelboards, or any areas where wall thickness is insufficient to fully recess flush mounted panels, prior to construction. Failure to report such conditions will cause the Contractor to be liable for cost of revising panelboard installation.
- B.** Provide typed panel directories permanently affixed in each panel identifying each circuit connected by function and room numbers served and spares.
- C.** Provide blank space fillers in all breaker spaces not occupied by breakers or switches.
- D.** Install panelboards in accordance with manufacturer's instructions adjusting all interiors flush with panel front and all panel fronts of recessed panels tight against finished walls. Anchor panel boxes firmly to walls or other approved structural support.
- E.** Handle panelboards and enclosures carefully to prevent breakage, denting and scoring the finish. Repair and paint, with manufacturer's specified paint, all dents and scratches. Store panelboards and enclosures inside and protect from weather. When necessary to store out-of-doors, elevate well above grade and enclose with durable, waterproof wrapping. A heat source is to be installed inside the equipment to prevent moisture buildup where such buildup could cause damage to the equipment.

SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install wiring devices including toggle switches, receptacles, and coverplates as indicated on the drawings.

1.02 QUALITY ASSURANCE

- A. Wiring devices shall be industrial specification grade, UL tested, listed and labeled, and comply with appropriate NEC and NEMA provisions for wiring devices.

1.03 SUBMITTALS

- A. Submit manufacturers' data for approval.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Arrow Hart, Hubbell, P & S, Bryant, Square D, Crouse-Hinds.

2.02 Provide wiring devices as scheduled below:

- A. All wiring devices shall be heavy duty type with solid brass backstrap. Backstrap may be coated with nickel over solid brass.
- B. All wiring device contacts shall be nickel plated.
- C. Wall Switches. (Catalog numbers refer to Hubbell devices.) 120/277 volt.

<u>Dry Locations</u>		
	<u>Type</u>	<u>20 AMP</u>
1.	1P	HBL1221
2.	2P	HBL1222
3.	3-way	HBL1223
4.	4-way	HBL1224
5.	Sp 120V	HBL1221PLC

- 6. Sp 277V HBL1221PLC
- 7. SK HBL1221L
- 8. For weatherproof applications, metal, hinged, gasketed, cover.
- 9. Use grey switches and receptacles unless indicated otherwise. Match existing building standard colors when present.

B. Wall Receptacles. (Catalog numbers refer to Hubbell.)

	20 Amp 125 Volt
Single	HBL5361
Duplex	HBL5362
Ground Fault Interrupter	GFR5362SG
USB/Duplex Receptacle	USB20X2

	20 Amp 125 Volt
Single	HBL8310
Duplex	HBL8300
Ground Fault Interrupter	GFR8300SG
USB/Duplex Receptacle	USB8300

C. Cover Plates.

- 1. Provide brushed 302 stainless steel 0.040 inch plates with matching screws for all devices. Use single piece ganged cover plates for multiple switch or receptacle installation. Provide single grommeted hole stainless steel cover plates for all telephone outlets and blank matching cover plates for all empty wall boxes.
- 2. Receptacles in wet locations shall be installed with a hinged outlet cover/enclosure clearly marked "suitable for wet locations while in use" and "UL Listed". There shall be a gasket between the enclosure and mounting surface, and between the hinged cover and mounting base/plate to assure proper seal. Such covers shall be heavy-duty cast aluminum.

PART 3 - EXECUTION

3.01 INSTALLATION

- A.** No thru-wiring of devices will be accepted. All wiring devices shall be “pigtailed”.
- B.** Install all duplex and simplex 20 amp receptacles with ground pin up for new buildings. For remodel projects, match existing orientation.
- C.** All switches and receptacles shall have side terminals insulated with tape wrapped around device or integral plastic hinged covers.
- D.** Install and wire switches as indicated on drawings using appropriately rated devices for the application, minimum rating – 20 amps.
- E.** All receptacles that are 6’ or closer to a sink, shower, tub, toilet, fountain, or drinking fountain shall be ground fault type or on a ground fault circuit breaker whether the contract drawings indicate so or not. The distance shall be as measured by a 6’ cord connected at the receptacle to the nearest edge of the sink or fixture.
- F.** All 20 amp, 120 volt receptacles in kitchens, for vending machines, or outdoors shall be ground fault type or on a ground fault circuit breaker whether the contract drawings indicate so or not.
- G.** Label each device as described in 26 0500, COMMON WORK RESULTS FOR ELECTRICAL.
- H.** Mounting Heights.
 - 1.** Contractor shall field coordinate all receptacle locations and pay particular attention to millwork shop drawings to avoid conflict with shelves and bracing. Failure to coordinate with millwork will require the Contractor to move the device location at his own expense.
 - 2.** Refer to Contract drawings “Typical Device Mounting Heights” detail for information regarding mounting heights. If Contract drawings do not include “Typical Device Mounting Heights” detail, contact the Engineer for mounting height information.

SECTION 26 2813

FUSES

PART 1 - GENERAL

1.01 DESCRIPTION

- A.** Supply and install fuses of the size, number and type indicated on drawings. Where the fuse size is not indicated, provide fuses according to the equipment protected and the applicable provisions of the National Electrical Code. Any conflict between the fuse size and the NEC shall be brought to the attention of the Engineer before installation.
- B.** Maintain selective coordination of the entire system overcurrent protection system, coordinating overcurrent protection devices so that only the overcurrent device nearest the fault interrupts the circuit.

1.02 QUALITY ASSURANCE

- A.** Furnish fuses which comply with all UL, NEC, NEMA and ANSI standards and labeled with UL stamp.

1.03 SUBMITTALS

- A.** Submit manufacturer's data, and curves on all fuses for approval.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A.** Bussman, Ferraz-Shawmutt, Reliance, or acceptable equal for fuses less than 600 amps. Use Bussman or Ferraz-Shawmutt for 600 amps and above.

2.02 FUSES

- A.** Bolt on fuses 601 amperes and larger shall be NEMA Class L current limiting with UL listing for 200,000 ampere RMS symmetrical interrupting capacity and a minimum time delay of 45 seconds at 300% rating. Bussman KRPC or Ferraz-Shawmutt A4BQ.

- B.** Type RFI current limiting fuses shall be installed in main switch gear. For mains requiring fuses 600 amperes and less, Bussman LPN-RK (250V) or LPS-RK (600V) shall be used.
- C.** NEMA Class K (standard NEC dimension) fuses rated 0-600 amperes shall be current limiting time delay with 200,000 amperes RMS symmetrical interrupting capacity. Bussman LPN-RK or LPS-RK.
- D.** All fuses installed ahead of circuit breaker panels shall be U.L. Class RK1. Bussman LPN-RK or LPS-RK.
- E.** Fluorescent fixture ballasts shall be provided with type Buss-GLR fuses sized and installed by the fixture manufacturer in addition to any internal ballast thermal protection, when indicated on the fixture schedule.
- F.** HID fixtures shall be protected by Buss-HEB fuseholds and type Buss-KTK fuses sized in accordance with the recommendations of ballast manufacturer, when indicated on the fixture schedule.
- G.** Fractional horsepower motors shall be protected by Buss SSU, SSX, or SSY fuse holders with Buss Fusetron fuses sized in accordance with the recommendations of the motor manufacturer where indicated on drawing.

PART 3 - EXECUTION

3.01 SPARES

- A.** Supply and install all fuses required in each fused disconnect, using manufacturer's catalog number specified. Provide an additional ten percent (10%) of the number of fuses used for each size and capacity used on the project as spares. Install labels in all fused devices indicating proper size fuse to use.

3.02 COORDINATION

- A.** All fuses shall be of the same manufacturer to ensure selective coordination.

SECTION 26 2816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 DESCRIPTION

- A.** Provide fusible and non-fusible disconnect switches where indicated on drawings, and where required by NEC.

1.02 QUALITY ASSURANCE

- A.** Use switches which comply with applicable provisions of NEC, NEMA, and which have been UL tested, listed, and labeled.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A.** Square D.

2.02 SWITCHES

- A.** Use heavy duty switches only, equal to General Electric Quick- Make Quick-Break, horsepower rated, externally operated with external padlocking provision in either the "ON" or "OFF" position. Ratings, number of poles, and enclosure type shall be as indicated or as required by NEC for the applications.
- B.** Provide fuses for all fusible switches, size as indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A.** Install all disconnect switches in accordance with NEC and manufacturers' recommendations. Maintain adequate clearances and generally mount at 4'-6" finished floor to center line unless field conditions or codes require other locations. Identify equipment served by each disconnect with white on black laminated plastic nameplate.

SECTION 26 2910

CONTACTORS AND RELAYS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install contactors and relays as indicated by drawings and the requirements of this section. These are normally mounted on a wall or partition and are accessible from the front.

1.02 QUALITY ASSURANCE

- A. Provide contactors and relay units which have been listed and labeled by Underwriters Laboratories.
- B. Comply with NEC and NEMA as applicable to construction and installation of contactors and relays. Comply with applicable NEC articles pertaining to installation and wiring.

1.03 SUBMITTALS

- A. Submit manufacturers data and dimensional drawings of contactors and relays showing accurately scaled layout of units.

PART 2 - ACCEPTABLE MANUFACTURERS

- A. Allen-Bradley, ASCO, Square D, or the same manufacturer as the distribution equipment furnished, or pre-approved substitute.

2.02 MATERIALS

- A. All contactors and relays to be general purpose mechanically held type, in either NEMA 1 enclosures, or pull boxes, as shown and noted. Where specifically noted, units shall be electrically held or momentary operational type. Units shall be furnished with line or low voltage control as noted and with the correct number of poles and current characteristics as shown. Where low voltage operation is indicated, furnish proper transformers.

PART 3 - EXECUTION

3.01 LABELS

- A.** Individually mounted contactors shall be labeled as herein before specified. Where contactors or relays are group mounted, they shall be clearly numbered with laminated engraved plastic plates and a directory shall be properly mounted on the enclosure cover, completely filled out, indicating equipment controlled.

SECTION 265000

LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Related Documents:
 - 1. Drawings and general provisions apply to this Section.
 - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

- B. Section includes the following items where applicable and indicated elsewhere in the drawings and specifications:
 - 1. Interior luminaires and accessories.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Ballasts.
 - 5. Lamps.
 - 6. Luminaire accessories.
 - 7. Outdoor area lighting units.

1.02 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
 - 3. Refer to Division 26 Section "Common Results for Electrical" for codes and standards, and other general requirements.

- B. ANSI/NFPA 70 - National Electrical Code.

- C. ANSI – American National Standards Institute:
 - 1. ANSI C78.379 Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
 - 2. ANSI C82.1 Ballasts for Fluorescent Lamps -Specifications.
 - 3. ANSI C82.4 Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).
 - 4. ANSI/NFPA 101 Life Safety Code.

5. ANSI/IES RP-8 Recommended Practice for Roadway Lighting.
 6. ANSI/IES RP-20 Lighting for Parking Facilities.
- D. NEMA – National Electrical Manufacturers Association:
1. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- E. UL – Underwriters Laboratories:
1. UL 924
- F. OSHA Illumination Standards
- G. RoHS

1.03 SUBMITTALS

- A. Submit under provisions as indicated elsewhere in the Specifications. Substitution requests for specified fixtures, where required, shall occur before bidding as stated in General Provisions of the specifications.
- B. Product Data: Submit catalog cuts, drawings, descriptive matter and lighting performance characteristics as required to completely define the materials and construction details employed, finishes applied, dimensions, hinging, latching and relamping provisions, and electrical characteristics.
- C. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE

- A. Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).
- B. Electrical equipment and materials shall be new and within one year of manufacture, complying with the latest codes and standards. No used, re-built, refurbished and/or re-manufactured electrical equipment and materials shall be furnished on this project.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Descriptions, type letters, manufacturers' names and general characteristics are shown on the drawings. If a fixture type designation is missing, furnish

and install fixtures of a type similar to those in other rooms of similar usage. Notify the Engineer prior to purchase or installation.

- B. Special Adapters, Plates, Brackets, and Anchors: Provide where required by construction features of the building to suitably mount lighting fixtures; all such appurtenances and mounting methods approved by the Engineer prior to fabrication and installation.
- C. Lighting fixtures replacement shall not require removal or alteration to a permanent section of the structure i.e. permanent ceiling. Fixtures shall be easily replaceable otherwise a different type of fixture should be provided.
- D. All fixture whips for LED fixtures shall contain a (5)-wire (minimum) flexible whip with power and 0-10VDC dimming control wiring whether or not dimming is being installed with the project. All wiring shall be listed by the manufacturer as suitable for integral installation of power and dimming/occupancy control wiring in the same raceway. This requirement is intended as a minimum installation, as additional wires shall be installed as required by the application.

2.02 LAMPS

- A. Provide Sylvania, General Electric, Westinghouse, or equal lamps of size and types as indicated on the drawings. Lamps shall be operating before final review of the work is requested. Fluorescent lamp color temperature shall be as noted in the Light Fixture Schedule of the Drawings. In building renovations and additions, the color temperature shall match the existing facility. Where specified color temperature is different than existing facility fixtures, confirm temperature color with the Engineer prior to ordering lamps or fixtures.
- B. Fixtures shall have a minimum of 80 CRI unless noted elsewhere in the Drawings or specifications.
- C. LED lamp-life hour is approximately 50,000 hours.

2.03 LED DRIVER

- A. LED driver shall be installed in an electrical enclosure.
- B. Wiring inside enclosure shall comply 600V/105 degrees rating or higher.
- C. LED driver shall comply with UL standard UL1012.
- D. LED driver shall have Class A sound rating.

- E. LED driver shall be UL certified for use in a dry or damp location.
- F. LED driver shall tolerate sustained open circuit and short circuit output conditions without damage.
- G. LED driver shall comply with the requirements of the FCC rules and regulations, Title 47 CFR Part 15 Non-Consumer (Class A).

2.04 LIGHT EMITTING DIODE (LED) FIXTURES

- A. Outdoor luminaires shall have provisions for house side shield to prevent glare from being visible to adjoin properties.
- B. Luminaire shall have door frame and lens with LED arrays and integral airflow ventilation system.
- C. Pole mounted and building mounted lights shall have in-line fusing.
- D. The lighting system shall consist of the type and manufacturer as shown on the drawings or approved equal. If other than fixture shown is submitted complete illumination calculations are required to show equality.

2.05 FLUORESCENT FIXTURES

- A. Fixtures shall be completely assembled, wired and ready for connection to the building lighting distribution system.

2.06 BALLASTS

- A. Solid-state, high frequency, electronic, as manufactured by Sylvania (Motorola), Advance, or Magnatek.
- B. Have power factor above 90 percent and lamp current crest factor of 1.5 or less.
- C. Be sound rated "A" and have FCC certification under part 18-15J and UL listing.
- D. Have metal oxide varistor line transient protection.

2.07 EMERGENCY LIGHT FIXTURE

- A. Mounting Method: For ceiling, back, end mounting or recessed as indicated on drawings. Where indicated, install emergency battery units within standard light

fixtures as designated in the Legend and/or Light Fixture Schedule. Integral emergency units shall have a push-to-test switch and AC-on indicator mounted behind the lens.

- B. Fully automatic constant voltage current limited charger which includes low voltage disconnects to prevent deep discharge of the battery.
- E. Battery re-charge per UL time limits.
- F. Unit provides a full 90 minutes of emergency lighting.
- G. 120/277VAC, 60 Hz.

2.08 EXIT SIGNS

- A. Manufacture: See "Fixture Types" as shown on the drawings.
- B. Mounting Method: For ceiling, back, end mounting or recessed as indicated on drawings. Subcontractor is cautioned to coordinate exit sign locations with Architectural details. Mounting height, in general, shall be no higher than 10'-0" AFF. If ceiling height is higher than 10'-0", wall-mount units centered between ceiling and top of associated door jamb, but no higher than 10'-0".
- C. Conduit Knockouts: Construct all exposed back, top, bottom and side surfaces of any fixture so that no conduit knockout provisions are visible.
- D. Number of Faces: As required for the position of the fixture as shown on the drawings.
- E. Directional Arrows: Provide for all exit signs, except those shown to be recessed or located directly above the exit door.
- F. Lamps: Light-emitting diode (LED), RED color.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL REQUIREMENTS

- A. Fixture Location: Locations shown are approximate only. Install at locations shown on architectural drawings and as required to coordinate with tile patterns, architectural features, and Mechanical Work. In mechanical rooms, locate to clear mechanical installations.

- B. Where location differences occur between electrical lighting plans and architectural reflected ceiling plans, generally install fixtures per the architectural plans. Where quantity differences occur between lighting and reflected ceiling plans, provide and install the greater quantity. Verify final locations in such cases.
- C. Fixture Supports: Where no specific method is shown or specified use steel channel sections, concrete anchors, 3/8-inch diameter steel rods and appropriate miscellaneous fittings. Install 12-gauge galvanized steel wires from flush-mounted fluorescent fixture bodies to 3/8-inch minimum concrete anchors, or as approved, attachment to building structure. Provide two wires for each 2 by 4-foot and each 1 by 4-foot fixture. Where installed in removable tile ceiling systems attach diagonally opposite corners of each fixture to the ceiling support members by bolting with No. 8-32 bolts.

3.02 INDOOR INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Surface Mounted Fixtures: Where mounted on accessible ceilings, hang from metal channels fastened to furring members by means of hanger rods through ceiling to fixture; hanger rods with backup locking device that will allow fixture to be raised on an elevation tight to the ceiling; but not allow raising the ceiling by tightening fixture mounting nuts.
- C. Support of Recessed Fluorescent Fixtures: Integral mounting bars which rotate into position after fixture is lifted into the ceiling cavity or fixtures supported by the ceiling suspension system. Provide two safety wires secured to structural members or slab above suspended ceiling or clip the fixture frame to the ceiling grid.
- D. Support luminaires independent of ceiling framing and ceiling supports.
- E. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- F. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- G. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.
- H. Install recessed luminaires to permit removal from below.
- I. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- J. Install clips to secure recessed grid-supported luminaires in place.

- K. Install wall mounted luminaires, emergency lighting units and exit signs at height as indicated on the drawings.
- L. Install accessories furnished with each luminaire.
- M. Connect luminaires, emergency lighting units and exit signs to branch circuit using flexible conduit or as indicated on the drawings.
- N. Make wire connections within fixtures using solderless connectors as specified; automatic splicing devices or connectors will not be allowed. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- O. Bond products and metal accessories to branch circuit equipment grounding conductor.
- P. Install specified lamps in each luminaire , emergency lighting unit and exit sign.

3.03 OUTDOOR INSTALLATION

- A. Install in accordance with manufacturers' instructions.
- B. Install lighting poles at locations indicated.
- C. Install poles plumb. Provide double nuts to adjust plumb. Grout around each base.
- D. Install lamps in each luminaire.
- E. Bond luminaires, metal accessories and metal poles to branch circuit equipment grounding conductor or provide supplementary grounding electrode at each pole as shown on the drawings.

3.04 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- B. Measure illumination levels to verify conformance with performance requirements.
- C. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.05 ADJUSTING

- A. Aim and adjust luminaires to provide illumination levels and distribution indicated on the drawings.
- B. Relamp luminaires which have failed lamps at Date of Substantial Completion.

3.06 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Wipe lenses inside and outside immediately prior to final acceptance. Adjust trim and flanges to provide proper fit against ceilings or walls without gaps.
- C. Remove dirt and debris from enclosure.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.07 DIFFUSERS AND ENCLOSURES

- A. Install lighting fixture diffusers and enclosures only after construction work, painting and clean up are completed. Handle with clean white canvas gloves.

3.09 CLEAN-UP

- A. Clean lighting control elements, lamps, fixture interiors and exposed exterior surfaces thoroughly before requesting final inspection.