PART 1 - GENERAL

1.1 SCOPE

A. Minimum composition requirements and/or installation methods for the following materials and work are included in this section:

1. Fire Stopping
2. Miscellaneous Supports
3. Access Doors and Panels
4. Boxes and Cabinets
5. Equipment Pads, Bases and Supporting Devices
6. Equipment Labeling
7. Arc Flash and Hazard Labeling

1.2 SUBMITTALS

A. Product data for:

1. Fire Stopping Materials

1.3 QUALITY ASSURANCE

A. The contractor shall engage the services of a qualified installer for the installation and application of joint sealers, flashing, access panels, and cutting and patching.

B. All work shall be done in a neat and workmanlike manner. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Director’s Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

C. Materials specified herein shall comply with the applicable requirements of:

1. The following Articles of the National Electric Code (NFPA 70)
   a) 314 - Outlet, Device, Pull and Junction Boxes, Conduit bodies and fittings
   b) 312 - Cabinets, Cutout Boxes and Meter socket Enclosures
PART 2 - PRODUCTS

2.1 FIRE STOPPING

A. Fire-stopping for Openings Through Fire and Smoke Rated Walls and Floor Assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire-Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire-Stops" designated ASTM E814.

B. Acceptable Manufacturers:
   1. Dow Corning Fire-Stop System Foams and Sealants.
   2. Nelson Electric Fire-Stop System Putty, CLK and WRP.
   3. Thomas & Betts - S-100 FS500/600,
   5. Hilti Firestop Systems

2.2 MISCELLANEOUS SUPPORTS

A. Metal bars, plates, tubing, etc. shall conform ASTM standards:
   1. Steel plates, shapes, bars, and grating - ASTM A 36
   2. Cold-Formed Steel Tubing - ASTM A 500
   3. Hot - Rolled Steel Tubing - ASTM A 501
   4. Steel Pipe - ASTM A 53, Schedule 40, welded

B. Metal Fasteners shall be Zinc-coated (type, grade and class as required)

2.3 ACCESS DOORS AND PANELS

A. Steel access doors and frames shall be factory fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush.

B. Construction:
   1. Frames:
      a) 16 gage steel with 1 inch wide exposed perimeter flange and adjustable masonry anchors for units installed in masonry, pre-cast, cast in place concrete, ceramic tile.
      b) 16-gage steel, perforated flanges with bead for gypsum or plaster wall board.
      c) 16-gage steel with galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame for full bed plaster applications.
2. Access Doors:

   a) Provide 14 gage sheet steel flush panel doors with concealed continuous piano hinge factory installed, primed and painted, set to open 175 degrees.

   b) Provide fire rated, insulated flush panel doors, with continuous piano hinge and self closing mechanism rated for 1 ½ hour “B” labeled, in fire rated partitions.

C. Provide flush, screwdriver operated cam locks on all access doors.

2.4 BOXES AND CABINETS

A. Outlet Boxes and Covers

1. Shall be galvanized steel, not less than 1-1/2" deep, 4" square or octagonal, with knockouts. Outlet boxes exposed to moisture, exterior, wet or damp locations shall be cadmium cast alloy complete with threaded hubs and gasketed screw fastened covers. Minimum box size shall be as indicated in Article 314 of the National Electrical Code for the conductors and devices installed. Boxes shall be approved for the environmental condition of the location where they will be installed.

2. Acceptable manufacturers:

   a) Steel City
   b) Raco
   c) Appleton
   d) Crouse Hinds

B. Flush Floor Outlet Boxes

1. Refer to drawings for details.

2. Adjust to be flush with final grade and carpet or tile trim. Coordinate trim type with G.C. prior to final setting.

C. Pull and Junction Boxes

1. Shall be constructed of not less than 14 gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type covers. Boxes installed in damp or wet locations shall be of raintight construction with gasketed cover and threaded conduit hubs. In no case shall boxes be sized smaller than as indicated in Article 314 of the National Electrical Code for conduit and conductor sizes installed. Boxes shall be approved for the environmental condition of the location where they will be installed.
2. Acceptable manufacturers:
   
   a) Hoffman
   b) Keystone
   c) Or equivalent

3. Flush floor junction boxes shall be recessed cover boxes designed for flush mounting in masonry. Provide checkered plate gasketed cover suitable for foot traffic. Make: O.Z. Gedney Type YR or approved equal.

D. Terminal and Equipment Cabinets:

1. Terminal and Equipment Cabinets shall be code gauge galvanized steel with removable endwalls. Fronts shall be of code gauge steel, flush or surface type (as indicated) with concealed trim clamps, concealed hinges, flush lock, and grey baked enamel finish. Boxes and front shall be U.L. listed and shall be minimum 35"H x 24"W x 6"D. Provide removable insulated plywood terminal board mounted on inside back wall of cabinet.

2. Acceptable manufacturer:

   a) Square D "Mono-Flat"
   b) Approved equal

2.5 EQUIPMENT BASES, PADS AND SUPPORTING DEVICES

A. Supports, support hardware and fasteners shall be protected with zinc coating or treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic. Products used for outdoor applications shall be hot dipped galvanized.

B. Provide clevis hangers, riser clamps, conduit straps, threaded c clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps as applicable.

C. 14 gauge U-Channel systems with 9/16 inch diameter holes at a minimum of 1 7/8 inches on center in the top surface. Provide fittings and accessories that match and mate channel.

D. Provide carbon steel or wedge or sleeve type expansion anchors, steel spring head toggle bolts and heat treated steel power driven threaded stud fastening equipment as required by construction types.

E. Provided field fabricated supporting devices such as angles, channels, pipe supports, etc. All fabricated supports shall be of metal construction as called for in 2.1.

F. Acceptable Manufacturers:

   1. Allied Tube
   2. American Electric
3. B-Line
4. Unistrut Diversified Products
5. Cooper Industries
7. O/Z Gedney
8. Spring City Electrical Mfg. Co.
9. Thomas & Betts Corporation

2.6 EQUIPMENT LABELING

A. Provide adhesive marking labels for raceway and metal-clad cable. The labels shall indicate voltage and service, and be located above ceilings every 75 feet and on wall mounted conduit in mechanical and equipment rooms.

B. Provide colored self adhesive vinyl tape, minimum 3 mils thick by 1 inch wide for all phase marking on cable.

C. Provide 6-inch wide bright colored continuously printed, plastic tape compounded for direct-burial services. Printing shall indicate service below.

D. Provide engraved, plastic laminated labels, signs and instruction plates. Engraving stock melamine plastic laminate. Use 1/16-inch minimum thick for signs up to 20 square inches or 8 inches in length. Use 1/8 inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners. Emergency equipment shall have red face.

E. Acceptable Manufacturers:
   1. W.H. Brady Co.
   2. Markal Corp.
   3. National Band & Tag Company
   4. Cole-Flex Corporation

2.7 ELECTRICAL HAZARD LABELING

A. Provide multi-colored self adhesive vinyl label, minimum dimension 5” wide x 3” high.

B. Shall designate the potential and arc flash hazard for equipment according to NFPA-70E.

C. Label shall include the following information:
   1. “ARC FLASH & SHOCK HAZARD APPROPRIATE PPE REQUIRED”
   2. Flash Hazard Category
3. Flash protection Boundary
4. List of required personal protective equipment (PPE)
5. Voltage of max. present shock hazard
6. Limited, Prohibited, and Restricted approach boundaries

D. Acceptable Manufacturers:
   1. W.H. Brady Co.
   2. Markal Corp.
   3. National Band & Tag Company
   4. Cole-Flex Corporation

PART 3 - EXECUTION

3.1 FIRE STOPPING

A. Installation of Fire-stopping for Openings Through Fire and Smoke Rated Walls and Floor Assemblies shall be as follows:

1. Provide fire-stop system seals at all locations where piping, tubing, conduit, electrical busways/cables/wires, ductwork and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for dry wall construction.

2. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.

3. The methods used shall incorporate qualities that permit the easy removal or addition of electrical conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating.

4. Provide rigid steel sleeves where non-armored cables pass through fire rated walls and barriers.

B. Provide additional installations as called for in specification section 078413.

3.2 ACCESS DOORS AND PANELS

A. Install access doors, sized to permit complete access for any concealed and/or inaccessible junction boxes, control and monitoring devices, duct mounted fire alarm detectors and other electrical equipment requiring access for maintenance or operation.
B. Set frames accurately in position and securely attach to supports with face panels plumb and level in relation to adjacent finish surfaces.

C. Adjust hardware and panels after installation for proper operation.

3.3 BOXES AND CABINETS

A. Consider location of outlets shown on drawings as approximate only. Study architectural, process piping, mechanical, plumbing, structural, roughing-in, etc., drawings and note surrounding areas in which each outlet is to be located. Locate outlet so that when fixtures, motors, cabinets, equipment, etc., are placed in position, outlet will serve its desired purpose. Where conflicts are noted between drawings, contact Director’s Representative for decision prior to installation. Comply with Article 314 of National Electrical Code relative to position of outlet boxes in finished ceilings and walls.

B. Outlet boxes in separate rooms shall not be installed "back-to-back" without the approval of the Director’s Representative.

C. Outlet boxes shall be sized to accommodate the wiring device(s) to be installed.

D. Outlet boxes installed in plaster, gypsum board or wood paneled walls shall be installed with raised plaster covers or raised tile covers.

E. Outlet boxes installed in tile, brick or concrete block walls shall be installed with extra-deep type raised tile covers or shall be 3-1/2" deep boxes with square corners and dimensions to accommodate conductors installed.

F. Surface ceiling mounted outlet boxes shall be minimum 4" square, 1-1/2" deep, galvanized sheet metal.

G. Surface wall mounted outlet boxes shall be cast type boxes having threaded or compression type threadless hubs. Exterior boxes shall be cast type with threaded hubs and gasketed cover plates secured by non-ferrous screws.

H. Floor outlet boxes shall be installed flush with finished floor, adjust level and tilt as required. Where finished floor is terrazzo, provide boxes specifically designed for installation in terrazzo. Where floors are to receive carpet, provide floor outlet with carpet flange.

I. Install junction and pull boxes in readily accessible locations. Access to boxes shall not be blocked by equipment, piping, ducts and the like. Provide all necessary junction or pull boxes required due to field conditions and size as required by the National Electrical Code.

3.4 OUTLET BOX ROUGH-IN HEIGHTS:

A. Unless otherwise noted, mount devices and equipment at heights measured from finished floor to device/equipment centerline as follows:

1. Toggle switches 46"
2. Receptacle outlets 18"
3. Receptacle outlets, above hot water or steam baseboard heaters. Do not install receptacle outlets above electric baseboard heaters. 30"
4. Receptacle outlets, hazardous areas 48"
5. Receptacle outlets, weatherproof, above-grade 24"
6. Clock outlets 90"
7. Telephone outlets 18"
8. Telephone outlets, wall mounted 46"
9. T.V. outlet 18"
10. Fire alarm manual station 46"
11. Fire alarm audio/visual 80"
12. Branch circuit panelboards, to top of backbox 72"
13. Distribution panelboards, to top of backbox 72"
14. Terminal cabinets, control cabinets 72"
15. Disconnect switches, motor starters, enclosed circuit breakers 48"
16. Where structural or other interference’s prevent compliance with mounting heights listed above, consult Director’s Representative for approval to change location before installation.

3.5 **EQUIPMENT PADS, BASES AND SUPPORTING DEVICES**

A. Hangers and Supports:

1. Provide steel angles, channels and other materials necessary for the proper support and erection of motor starters, distribution panelboards, large disconnect switches, pendant-mounted lighting fixtures, etc.

2. Panelboards, cabinets, large pull boxes, cable support boxes and starters shall be secured to ceiling and floor slab and not supported from conduits. Small panelboards, etc., as approved by Director’s Representative, may be supported on walls. Racks for support of conduit and heavy electrical equipment shall be secured to building construction by substantial structural supports.
3. Provide concrete bases for all floor mounted equipment. Provide 3,000 lb. concrete, chamfer edges, trowel finish, securely bond to floor by roughening slab and coating with cement grout. Bases 4" high; shape and size to accommodate equipment. Set anchor bolts in sleeves before pouring and after anchoring and leveling, fill equipment bases with grout.

3.6 EQUIPMENT AND HAZARD LABELING

A. Provide engraved laminoid identification nameplates on main switchboard and on all panelboards using designation shown in panelboard schedule.

B. Provide engraved laminoid identification nameplates for each circuit breaker in the main distribution panel listing the panelboard or equipment connected to each device.

C. Provide engraved laminoid identification nameplate on individual circuit breaker enclosures, motor starters and disconnect switches, listing the equipment connected to the particular device, feeder panelboard and feeder circuit number.

D. Provide complete type written directory for each panelboard listing room number, function, etc, for each circuit breaker. Provide type written updated panelboard directories for existing panelboards affected by this work.

E. Nameplates shall be engraved black, with white core, with Helvetica medium 3/16" lettering.

F. Identify junction and pullboxes for particular service such as power, lighting, fire alarm, telephone, intercom, public address, nurse call, etc. using stencil lettering on cover.

G. Provide a tape label on all receptacle and switch coverplates, power poles, etc. listing panel designation and circuit number. Tape shall be attached to outside of receptacle or switch coverplates.

H. Provide potential and arc hazard labeling on all new switchboards, panelboards, industrial control panels, motor control centers.

3.7 FLASHING AND SEALING

A. Opening through roofs shall be flashed in manner not to affect roof guarantee or bond. Engage qualified Roofing Contractor licensed by the Roofing Manufacturer, as part of contract. Provide non-ferrous flashing pieces, skirts, hoods and collars as required to make ducts, pipes, conduits, and other penetrations watertight. Where curbs are called for with respect to rectangular openings in new roofs, flashing will be done by others unless specifically indicated otherwise. Caulk and waterproof with additional material so as to seal airtight and watertight.

3.8 CUTTING AND PATCHING

A. Perform cutting, fitting and patching of electrical equipment in all following cases:

1. To uncover work for installation of poorly coordinated or ill-timed electrical work.
2. To remove and replace defective work.

3. To remove and replace work not conforming to requirements of the Contract Documents.

4. Remove samples of installed work as specified for testing.

5. Install equipment and materials in existing structures.

6. Cut, remove and legally dispose of all electrical equipment, components, and materials as called for and all other items not indicated on plans but made obsolete by the installation of new work.

7. Protect the structure, furnishings, finishes and adjacent materials not being removed and maintain temporary

END OF SECTION
PART 1 - GENERAL

1.1 WORK INCLUDED
A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents

1.2 SCOPE
A. This section includes minimum requirements for the following:
   1. Low Voltage Conductors
   2. Cat. 6 Cable
   3. Fiber Patch Cable
   4. Fiber to Copper Ethernet Transceiver
   5. Connectors and Terminations

1.3 SUBMITTALS
A. Provide product data for the following:
   1. Low Voltage Conductors
   2. Cat. 6 Cable
   3. Fiber Patch Cable
   4. Fiber to Copper Ethernet Transceiver

1.4 QUALITY ASSURANCE
A. All conductors shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Materials specified herein shall comply with the applicable requirements of:
   1. The following Articles of the National Electric Code (NFPA 70)
      a) 300 - Wiring Methods
      b) 310 - Conductors for General Wiring
c) 332 - Type MI Mineral Insulated, Metal Sheathed  
d) 320 - Type AC Armored Cable  
e) 330 - Type MC Metal Clad Cable  
f) 334 - Type NM, NMC, and NMS Nonmetallic-Sheathed Cable  
g) 338 - Type SE and USE Service Entrance Cable  
h) 340 - Type UF Underground Feeder and Branch-Circuit Cable  
i) 400 - Flexible Cords and Cables  
j) 402 - Fixture Wires

2. The following U.L. Standards:
   a) UL 83 Thermoplastic-Insulated Wires and Cables
   b) UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
   c) UL 854 Service Entrance Cable
   d) UL 6, 1981 Rigid Metal Electrical Conduit
   e) All Other Applicable Standards

PART 2 - PRODUCTS

2.1 LOW VOLTAGE CONDUCTORS

A. Feeder branch circuit and control wiring:
   1. Annealed Copper, 98% conductivity.
   2. Minimum wire size:
      a) #12 AWG for branch circuits
      b) #14 AWG for control and signal circuits
   3. Wire shall be stranded.
   4. 600 volt insulation for all wiring above 50 volts.
   5. 300 volt insulation permitted for all wiring below 50 volts.
   6. Thermal plastic with PVC insulation with nylon jacket, suitable for wet or dry locations, THHN/THWN 90 degree Celsius.
   7. 90 degree C maximum operating temperature rating.
8. UL 83 Listed

B. Acceptable manufacturers:
   1. BICC
   2. Southwire
   3. Okonite
   4. Prysmian

2.2 COLOR CODING

A. All circuits shall be color coded according to the following schedule:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>A PHASE</th>
<th>B PHASE</th>
<th>C PHASE</th>
<th>NEUTRAL</th>
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</thead>
<tbody>
<tr>
<td>208Y/120V, 3 Phase</td>
<td>Black</td>
<td>Red</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>480Y/277V, 3 Phase</td>
<td>Brown</td>
<td>Orange</td>
<td>Yellow</td>
<td>Gray</td>
</tr>
<tr>
<td>240/120V, 1 Phase</td>
<td>Black</td>
<td>Red</td>
<td></td>
<td>White</td>
</tr>
</tbody>
</table>

*ALL GROUNDING CONDUCTORS SHALL BE GREEN
*ALL ISOLATED GROUNDING CONDUCTORS SHALL BE GREEN WITH YELLOW STRIPE

B. #6 AWG and smaller shall have insulation continuously colored as called for above.

C. #4 AWG and larger may be identified using a minimum 3” tape band.

D. Color code all conductors at all pullboxes, enclosures, and terminations.

E. Switched legs shall be identified with the same color insulation as the phase leg.

2.3 TYPE SO/SOOW FLEXIBLE CORD

A. Construction:
   1. Annealed Copper wire
   2. Black outer jacket.
   3. Water and Oil resistant
   4. Flexible cord schedule for hard use.
   5. Wire shall be stranded per. ASTM B-174
   6. 600 Volt insulation
   7. EPDM rubber insulation
   8. -40ºC minimum through 90ºC maximum operating temperature rating.
   9. UL Listed Flexible Cord – Subject 62
B. Design Make: General Cable Carol Series

2.4 CAT. 6 CABLE

A. Construction:
   1. UL type CMP plenum rated
   2. Blue outer jacket
   3. IEEE Category 6 Certified
   4. Tested to 350Mhz
   5. Factory terminated no-snap RJ-45 male connectors on each end

B. Length 2-meter

C. Design Make: Leviton

D. Acceptable Manufacturers:
   1. ADC
   2. Belden
   3. Commscope

2.5 FIBER PATCH CABLE

A. Construction:
   1. Duplex 1-pair single-mode optical fiber patch cable
   2. Yellow outer jacket
   3. Meets TIA-568-C.3 standards
   4. Factory terminated strain relief ST connectors on one end (media transceiver) and SC connectors on other end (patch panel)

B. Length 2-meter

C. Design Make: Leviton

D. Acceptable Manufacturers:
   1. ADC
   2. Belden
   3. Corning
2.6 FIBER TO COPPER ETHERNET TRANSCEIVER

A. Gigabit Ethernet connectivity conversion from single-mode fiber (1000Base-LX) to 100-Ohm UTP copper (10/100/1000 Base-T)

B. Interfaces:

1. ST fiber connector
2. RJ-45 UTP connector

C. Transmission guaranteed up to 5km over single-mode fiber

D. Provide w/ wall mount bracket accessory

E. Provide w/ 120V plug-in power supply

F. Design Make: Blackbox Part# LMC107A-SMST or Approved Equal

2.7 LOW VOLTAGE CONNECTORS AND TERMINATIONS

A. Straight Splices, #26 AWG To #10 AWG

1. Nylon Insulated compression butt-splices.
2. 600 volt, 90 degree C rated.
3. Make: Burndy “Insulink”, T&B “Sta-Kon”, or approved equal

B. Straight Splices, #8 AWG and Larger

1. Two way, long barrel, compression type, copper
2. Provide heat shrink tubing over splice.
3. 600 volt rated.

C. Pigtail Splices, #26 AWG to #10 AWG

1. Twist type pressure connector.
2. 600 volt rated, 105 degree C.
3. Size as required for number and size of conductors used.
4. Make: T&B Scotchlock, or approved equal.

D. Lug Terminations for Control and Signal Wiring.

1. Nylon insulated fork with compression termination of #26 AWG to #10 AWG.
2. Nylon insulated ring with compression termination for #8 AWG and larger.
3. 300 volt rated.

E. Lug Terminations for Power Wiring

1. Long barrel, compression type, copper body, on hole for #8 AWG to #2/0 AWG.
2. Long barrel, compression type, copper body, two hole, for #3/0 AWG and larger.
3. 600 volt rated.
4. Make:
   a) One-hole lug: Burndy “Hylug”, T&B 54900 Series, or approved equal.
   b) Two-hole lug: Burndy “Hylug”, T&B 54800 Series, or approved equal.

PART 3 - EXECUTION

3.1 LOW VOLTAGE WIRE AND CABLE

A. General

1. Install cables in raceway as called for after the entire raceway system has been completed.

2. Install splices and connections in accessible outlet, pull, and junction boxes.

3. Insulate all splices and connections with UL Labeled plastic tape, heat shrink tubing, or plastic molded caps.

4. All wiring systems shall be properly grounded and continuously polarized throughout, following the color coding specified.

5. Provide insulated green grounding conductor in each raceway, and white insulated neutral conductor for each multi-wire branch circuit.

6. Provide isolated grounding conductor for multi-wire computer panel “CP” branch circuits and dedicated neutral for each computer panel “CP” branch circuit.

7. Install a maximum of three phase conductors, one neutral conductor, and one grounding conductor in each ¾” home run. (Obtain approval for additional conductor fill where field conditions require. Adhere to NEC de-rating requirements.).

8. Provide stranded wire to motors, transformers, equipment, and vibrating machinery.

9. Feeder conductors shall be continuous from point of origin to load termination without splice. If this is not practical, contact the Owner's Representative and receive written approval for splicing prior to installation of feeder(s). Where feeder conductors pass through junction and pull boxes, bind and lace conductors of each feeder together. For parallel sets of conductors, match lengths of conductors.
10. Where multiple conductors are installed in a common raceway they shall be pulled simultaneously. Use of pulling compound or lubricant shall be avoided unless absolutely necessary. Where pulling lubricant is required, use UL approved compounds approved for cable type. Lubricant shall meet all OSHA and Toxic Control Act standards.

11. All SO/SOOW flexible cord shall make horizontal take-offs out of all junction boxes and hard-wired connections. Vertical drops out of junction boxes down from ceiling are not acceptable.

12. Provide 6’ service loop of SO/SOOW flexible cord anchored with a “Ty-Rap” above all drops.

13. Provide strain relief grip at each hard-wired termination point on flexible SO/SOOW cords.

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>CABLE TYPES</th>
<th>DESIGN</th>
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<tr>
<td>MAKE</td>
<td></td>
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</tr>
<tr>
<td>General purpose</td>
<td>Rubber, Neoprene, Nylon,</td>
<td>Ideal - Yellow</td>
</tr>
<tr>
<td>77</td>
<td>&amp; PVC, High Density</td>
<td></td>
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<tr>
<td>Construction</td>
<td>XLP, Hypalon</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| High Temperature           | Rubber, Neoprene, Nylon,         | Ideal - Yellow 190 |
| Construction               | & PVC, High Density XLP,          |              |
| Maintenance                | Hypalon, Low Density Polyethylene, |              |
|                            | Semiconducting Jacket            |              |

| Utility construction &     | Rubber, Neoprene, Nylon,         | Aqua-Gell II  |
| Maintenance                | PVC, High Density XLP,            |              |
|                            | Hypalon, Low Density Polyethylene, |              |
|                            | Semiconducting Jacket            |              |

| Cold Weather               | Rubber, Neoprene, Nylon,         | Aqua-Gel CW   |
| Construction               | & PVC, High Density XLP,          |              |
| Maintenance                | Hypalon, Low Density Polyethylene, |              |
|                            | Semiconducting Jacket            |              |

14. Use pulling means including fish tape, cable, rope and basket type grips which will not damage cables or raceways. Use approved mechanical pullers for feeders and branch circuits as required for #6 AWG cable and larger. Do not use mechanical means to pull conductors No. 8 or smaller.

15. Branch circuit conductors installed in panelboards, and control conductors installed in control cabinets and panels shall be neatly bound together using "Ty-Raps" or equivalent.
16. Reconnect branch circuit wiring at panelboards as required to obtain a balanced three phase load on the feeders.

17. Provide conduit seals in explosion proof areas as called for on the plans and as required by the National Electrical Code.

### 3.2 FIBER TO COPPER MEDIA TRANSCEIVER

A. Field measure all fiber and cat. 6 patch cable lengths prior to ordering equipment

B. Coordinate connections into existing fiber patch panels and Ethernet switches with owners IT representative prior to installation

C. Neatly coil and secure all patch cables.

D. Mount fiber to copper media transceiver to wall at each end.

### 3.3 CONNECTORS AND TERMINATIONS

A. Cover un-insulated splices, joints, and free ends of conductor with rubber friction tape or PVC electrical tape. Plastic insulating caps may serve as insulation.

### 3.4 TESTS

A. Low Voltage Feeders

1. After low voltage feeders are pulled in, and before being connected, test feeders with a 1000 volt, 60 Hz insulation tester for one minute to determine that the conductor insulation to ground is greater than that recommended by the manufacturer.

END OF SECTION
SECTION 260526

GROUNDING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide a complete grounding system meeting or exceeding the requirements of Article 250 of the latest National Electrical Code. Install all raceway systems, including metal conduit, wireways, pullboxes, junction boxes, bus ducts, enclosures, and motors, to provide a continuous ground path with the lowest possible impedance.

1.2 DESCRIPTION OF WORK

A. This section includes minimum requirements for the following:

1. Conductors
2. Ground Rods
3. Hardware

1.3 QUALITY ASSURANCE

A. All grounding systems shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Materials specified herein shall comply with the applicable requirements of:

1. The National Electrical Code, Article 250.

1.4 SUBMITTALS

A. Not Required.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Exposed grounding conductors such as bars, straps, cables, flexible jumpers, braids, shunts, etc., shall be bare copper unless otherwise called for.

B. Conductors shall be copper, as called for in Specification Section 260519 – Low Voltage Cables.
C. Provide conductors with THHN/THWN insulation. Sizes #10 AWG and smaller shall be
green in color. Conductor sizes #8 AWG and larger may have green taped bands at each
end, and in all pullboxes.

D. Acceptable Manufacturers:
   1. Same as for 600 volt conductors.

2.2 GROUND RODS

A. Solid copper or copper clad steel cylindrical rods, 5/8 in. minimum diameter, minimum 8
   ft. long.

B. Acceptable Manufacturers:
   1. Copperweld or approved equal

2.3 CONNECTORS

A. Provide bronze mechanical connectors. Solderless compression terminals shall be
copper, long-barrel, NEMA two bolt.

   1. Acceptable Manufacturers:
      a) Burndy
      b) Anderson
      c) T & B
      d) Penn-Union

PART 3 - EXECUTION

3.1 INSTALLATION

A. Service Entrance

   1. Solidly ground the electrical service at the service entrance. Provide a grounding
electrode conductor from the service entrance ground bus to a minimum of two
(2) grounding electrodes, as follows:

      a) Metal water pipe, ahead of the meter.
      b) Building steel
      c) Made grounding electrode grid.
2. For a grounded electric service, solidly connect the grounded (neutral) conductor to the service entrance ground bus. Do NOT make any grounding connections to any grounded conductors on the load side of the service disconnecting means.

3. Provide a bare, copper, #4/0 bonding jumper across the water meter.

B. Raceway Systems:

1. All metal supports, cable trays, frames, sleeves, brackets, braces, etc. for the raceway system, panelboards, switchboards, switches, enclosures, starters, controls, etc., which are not rigidly secured to and in contact with the raceway system, or which are subject to vibration and loosening, shall be bonded to the raceway system. Size the bonding conductor in accordance with NEC Article 250, Table 250-122.

2. Terminate rigid conduit at all boxes, cabinets, and enclosures tightly with two locknuts and a bushing.

3. Conduit which runs to or from all boxes, cabinets, or enclosures having concentric or eccentric knockouts which partially perforate the metal around the conduit and hence impair the continuity of system ground circuits shall be provided with bonding jumpers sized in accordance with NEC Article 250, Table 250-122. Connect the bonding jumper between a grounding type bushing on the conduit and a ground bus or stud inside the box, cabinet, or enclosure.

4. Provide bonding jumpers sized in accordance with NEC Article 250, Table 250-122 for all conduit expansion joints.

5. Provide a grounding conductor in all flexible metallic conduit and liquid-tight conduit, sized in accordance with NEC Article 250, Table 250-122.

6. Provide a grounding conductor in all nonmetallic runs of conduit and raceway, sized in accordance with NEC Article 250, Table 250-122.

7. Provide isolated ground conductors of systems as called for on the plans.

C. Secondary Electrical Systems:

1. Solidly ground all transformer neutral conductors and enclosures to building steel, or a cold water pipe 1” or larger in size as called for in Table 250-122 of the National Electrical Code.

2. Provide an equipment grounding conductor from the point of termination back to the ground bus of the serving panelboard, switchboard, or transformer. Do not splice equipment grounding conductors.

3. Provide an equipment grounding conductors from the point of termination back to the ground bus of the serving panelboard, switchboard, transformer, or switchgear.
4. The grounding conductors contained in the interstices of interlocked armor cable shall be connected to the ground bus at every equipment termination point and to each other and to system ground; ground at every splice location.

3.2 TESTS

A. Grounding:

1. Grounds and grounding systems shall have a resistance to solid earth ground not exceeding following values:

   a) For grounding non-current carrying metal parts associated with secondary distribution system: 25 Ohms

2. Providing grounding tests to verify the above values. Where these values are not met, add additional ground rods or connections in order to meet these values.

END OF SECTION
SECTION 260532

RACEWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents

1.2 DESCRIPTION OF WORK

A. This section includes minimum requirements for the following:

1. Rigid Galvanized Steel Conduit (RGS)
2. Electrical Metallic Tubing (EMT)
3. Flexible Metal Conduit
4. Liquidtight Flexible Conduit
5. Innerduct/Electrical Non-Metallic Tubing (ENT)
6. Rigid Non-Metallic Conduit
7. Fittings and Conduit Bodies
8. Expansion Fittings
9. Surface Metal Raceway

1.3 QUALITY ASSURANCE

A. All raceways shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Materials specified herein shall comply with the applicable requirements of:

1. The following Articles of the National Electric Code (NFPA 70)
   a) Wiring Methods
   b) Cable Trays
   c) Electrical Nonmetallic Tubing
   d) Nonmetallic underground conduit with conductors
   e) Rigid metal conduit
   f) Rigid nonmetallic conduit
   g) Electrical metallic tubing
h) Flexible metallic tubing
i) Flexible metal conduit
j) Liquidtight Flexible metal conduit and Liquidtight flexible nonmetallic conduit.
k) Surface Metal Raceways and Surface Nonmetallic raceways
l) Underfloor raceways
m) Metal wireways and nonmetallic Wireways
n) Outlet, Device, Pull and Junction Boxes, Conduit Bodies and Fittings
o) Auxiliary gutters

2. The following National Electrical Manufacturers Association (NEMA) Standards:
   a) NEMA, RN1, 1986 PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   b) NEMA, TC 3, 1982 PVC fittings for use with Rigid PVC Conduit and tubing.
   c) NEMA, TC 6, 1983 PVC and ABS Plastic Utilities Duct for Underground Installation.

3. The following American National Standards Institute (ANSI) standards:
   a) ANSI-C80.2, 1983 Specification for Rigid Steel Conduit, Enameled
   b) ANSI-C80.3, 1983 Specification for Electrical Metallic Tubing, Zinc-coated
4. The following U.L. Standards:
   a) UL 1, 1985 Flexible Metal Electrical Conduit
   b) UL 3, 1984 Flexible Nonmetallic Tubing for Electric Wiring
   c) UL 5, 1985 Surface Metal Electrical Raceways and Fittings
   d) UL 6, 1981 Rigid Metal Electrical Conduit
   e) UL 360, 1986 Liquidtight Flexible Steel Conduit, Electrical
   f) UL 514B, 1982 Fittings for Conduit and Outlet Boxes.
   g) UL 651, 1981 Schedule 40 and 80 PVC Conduit
   h) UL 797, 1983 Electrical Metallic Tubing
   i) UL 870, 1985 Electrical Wireways, Auxilliary Gutters and Associated Fittings

1.4 SUBMITTALS

A. Provide product data for the following:
   1. Rigid Galvanized Steel Conduit
   2. Liquid Tight Flexible Metal Conduit

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Galvanized Steel Conduit

   1. Shall be hot-dipped galvanized steel, including threads.
   2. Acceptable manufacturers:

         a) LTV Steel
         b) Triangle
         c) Allied Tube
         d) Steel Duct
         e) Wheatland
B. Electrical Metallic Tubing

1. Electrical Metallic Tubing shall be electro-galvanized steel.

2. Acceptable manufacturers:
   a) Triangle
   b) Wheatland
   c) Allied Tube
   d) Steel Duct
   e) LTV Steel

C. Flexible Metal Conduit

1. Flexible Metal Conduit shall be constructed of one continuous length of spirally wound, interlocked, zinc coated strip steel. Interior surface shall be free from burrs or sharp edges.

2. Acceptable manufacturers:
   a) Anaconda
   b) American Flexible Conduit Co.
   c) O-Z/Gedney
   d) Thomas and Betts

D. Liquidtight Flexible Metal Conduit

1. Flexible Metal Conduit shall be constructed of one continuous length of spirally wound, interlocking zinc coated strip steel. Interior surfaces shall be free from burrs and sharp edges. Provide with a liquid-tight jacket of flexible polyvinyl chloride (PVC).

2. Acceptable Manufacturers:
   a) Allied
   b) American Flexible Conduit
   c) Carlon
   d) Thomas and Betts
E. Innerduct/Electrical Non-Metallic Tubing (ENT)

1. This may also be referenced as Innerduct in the contract documents.

2. Size: 1 ¼” diameter corrugated wall flexible tubing unless otherwise indicated on drawings.

3. Shall be UL Listed type CMP (plenum rated), CMR (riser rated), or CMG (general purpose) as required for the installation.

4. Acceptable Manufacturers:
   a) Carlon
   b) Dura - Line
   c) Arnco
   d) VikiMatic

F. Rigid Non-Metallic PVC Conduit

1. Extra-Heavy wall conduit: Schedule 80, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial and normal above ground use.

2. Acceptable manufacturers:
   a) Carlon
   b) Thomas & Betts
   c) Certainteed
   d) Condux

G. Fittings

1. Rigid galvanized steel fittings shall be fully threaded and shall be of the same material as the respective raceway system.

2. Fittings for electrical metallic tubing shall be single screw indenter fittings for conduits up to 2” and double screw indenter fittings for conduits 2” and larger.

3. Fittings for flexible metal conduit shall be center stopped, insulated throat, U.L. E-11852 listed.

4. Fittings for liquidtight flexible metal conduit shall have zinc plated steel ferrule, compression type with sealing ring.
5. Fittings for rigid non-metallic conduit shall be solvent cemented in accordance with the manufacturer's instructions.

6. Fittings for PVC coated rigid galvanized steel conduit shall be threaded, hot dipped galvanized, and coated inside and outside with a urethane coating.

7. Connectors shall have insulated throat up to and including 1" size. For sizes 1-1/4" and larger, provide plastic insulating bushing.

8. Die-cast or pressure cast fittings are not permitted.

9. Provide conduit bodies types, shapes and sizes as required to suit application and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

10. Acceptable manufacturers:
    a) O.Z. Gedney
    b) Steel City
    c) Thomas & Betts
    d) Crouse-Hinds
    e) Carlon

H. Expansion Fittings

1. Galvanized steel expansion joints for RGS or EMT conduit, PVC for PVC conduit.

2. Minimum 4” movement in either direction.

3. Weatherproof for outdoor applications.

4. At expansion joints in concrete pours, provide Deflection/Expansion fittings capable of movement of ¾” in all directions from the normal.

5. Design Make: O.Z./Gedney, Type "AX" (exposed), “DX” (Concrete Pour)

6. Acceptable manufacturers:
    a) O.Z./Gedney
    b) Crouse-Hinds
    c) Appleton
2.2 SURFACE METALLIC RACEWAY

A. Single channel suitable for up to (9) #12 AWG conductors or (11) 0.2” O.D. Cables
   1. Color shall be ivory.
   2. Two piece raceway with single compartment, length as indicated on the drawings. Nominal 1-29/32” x 7/8” with snap on cover.
   3. Design Make: Wiremold V2400 series

B. Two channel with devices suitable for up to (48) #12 AWG conductors or (50) 0.2” O.D. Cables.
   1. Color shall be ivory.
   2. Two piece raceway with divider for power and communications, length as indicated on the drawings. Nominal 4-3/4” x 1-3/4” with flush, snap on cover.
   3. Provide devices in the raceway as shown on plans
   4. Provide Tee and corner fittings suitable for fiber optic bend radius.
   5. Design Make: Wiremold V4000 with “FO” series tees and corners

C. One-piece raceway
   1. Shall have Ivory finish
   2. Size raceway as required based on the following:
      a) .040” steel suitable for (8) #12 AWG conductors or (2) 0.2” O.D. cables
   3. Design Make: Wiremold V700 Series

D. Two piece multi-outlet assembly with pre-wired single outlets
   1. Length as indicated on the drawings.
   2. Provide 4-wire, two circuit assembly with 20A outlets on 12” centers.
   3. Color as selected by the Architect.
   4. Design Make: Wiremold 2000 Plugmold

E. Provide miscellaneous boxes, fittings and supports designed and manufactured by the raceway manufacturer as required making a complete job.

F. Acceptable Manufacturers:
   1. Wiremold
2. B-Line Systems, Inc
3. Mono-Systems

### 2.3 WIREWAYS AND WIRE TROUGH

A. Wireway shall be steel, enclosed type. Provide hinged, JIC sectional NEMA dust resistant, oil tight type where subjected to moisture, in Pump Rooms, Mechanical, Electric and Fan Rooms, exterior walls, Maintenance Shops, and similar locations. Size to meet NEC fill requirements or larger as noted on Contract Documents. Provide knockouts along runs. Provide all elbows, tees, pullboxes, fittings, hangers, reducers, supports, etc., to meet installation requirements.

B. Cover: Screw cover.

C. Connector: Flanged.

D. Fittings: Lay-in type with removable front.


F. Acceptable manufacturers:
   1. Square D "Square Duct"
   2. General Electric
   3. Hoffman

### 2.4 CABLE HANGERS

A. Provide prefabricated, zinc coated, carbon steel hangers designed specifically for Category 6 and Optical Fiber cable installations.

B. Hangers shall have open top, rolled edges and a 2” diameter loop.

C. Provide beam clamps, rod fasteners, flange clips and brackets as job conditions require.

D. Design Make: Caddy “CableCat Clip” series.

### PART 3 - EXECUTION

#### 3.1 GENERAL

A. Size raceways as indicated on the drawings. Where sizes are not indicated, raceways shall be sized as required by the National Electrical Code in accordance with the quantity, size, type and insulation of conductors to be installed.
B. Minimum 1/2" trade size for branch circuit and fire alarm wiring.

C. Minimum 3/4" trade size for voice/data outlets, television outlets, and branch circuit "Home Runs" to panelboards.

D. Support raceways from building construction. Do not support raceways from ductwork, piping, or equipment hangers. Do not support raceways from pre-existing conduit runs, banks, racks, hangers, etc.

E. Support outlet, pull, and junction boxes independently from building construction. Do not support from raceways.

F. Install raceways parallel or perpendicular to building walls, floors and ceilings.

G. Install raceways concealed except in the following areas:
   1. Mechanical Rooms
   2. Electric Rooms
   3. Manufacturing areas
   4. Garage or maintenance areas
   5. Unfinished basements or crawl spaces

H. Provide a code compliant ground path between all outlets and the established electrical system ground.

I. Cut raceways square, ream ends to remove burrs, and bush where necessary.

J. Coordinate all raceway runs with other trades.

K. Do not install raceways adjacent to hot surfaces or in wet areas.

L. Provide expansion fittings with external grounding straps at building expansion joints.

M. Do not install conduit horizontally in concrete block or dry wall partitions.

N. Arrange neatly to permit access to the raceway, outlet, pull, and junction boxes, and work installed by other trades.

O. If it is necessary to burn holes through webs of beams or girders, call such points to the attention of the Owner's Representative and receive written approval both as to location and size of hole before proceeding with work. All holes shall be burned no larger than absolutely necessary.

P. Core drill, sleeve, and fire stop all penetrations through existing floors.
Q. Support all raceways with malleable iron pipe clamps or other approved method. In exterior or wet locations, provide minimum ¼” air space between raceway and wall. Secure raceway within 3 ft. of each outlet box, junction box, cabinet or fitting.

R. Provide conduit seals and explosion proof devices as indicated on the plans and as dictated by the National Electrical Code for all hazardous locations indicated on the drawings.

S. Provide green ground wire in all EMT, flexible conduit, and non-metallic conduit.

T. Size all raceways as indicated on the plans and not to exceed 40% cable fill based on National Electrical Code for power wiring and TIA/EIA 569-A for telecommunication and low-voltage cabling.

U. Do not install voice and data cabling in any surface metal raceway smaller than Wiremold V2400, except single voice outlets where cable runs straight down and no bends occur in raceway.

3.2 CONDUIT

A. Install with a minimum of bends and offsets. Bends shall not kink or destroying the interior cross section of the raceway. Factory made bends shall be used for raceways 1” trade size and larger.

B. Provide at least one junction or pullbox for each 360 degrees of bends.

C. Plug the ends of each roughed-in raceway with an approved cap or disc to prevent the entrance of foreign materials during construction.

D. Provide U.L. approved rain-tight and concrete-tight couplings and connectors.

E. Secure within three feet of each outlet box, junction box, cabinet or fitting.

F. Provide a #14 AWG fish wire in all "Spare" or "Empty" conduit runs to facilitate future installation of conductors.

G. Install raceways in concrete floor slabs as follows:

1. All conduit in concrete floor slabs shall be rigid galvanized steel with concrete tight threaded fittings.

2. Provide expansion fittings where conduits cross building expansion joints.

3. Install conduit below the reinforcing mesh.

4. Locate conduits to provide a minimum of 1” of concrete around conduit.

5. Obtain approval from the Owner's Representative prior to installing conduit larger than 1” trade size in concrete slabs.

H. Wherever a cluster of four (4) or more conduits rise out of floor exposed, provide neatly formed 4 in. high concrete envelope, with chamfered edges, around raceways.
I. Provide conduit supports based on the following table:

<table>
<thead>
<tr>
<th>Conduit Trade Size</th>
<th>Horizontal Type of Run</th>
<th>Horizontal Spacing in Feet</th>
<th>Vertical Spacing in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>½&quot; , 3/4&quot;</td>
<td>Concealed</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>1&quot; , 1-1/4&quot;</td>
<td>Concealed</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>1-1/2&quot; &amp; larger</td>
<td>Concealed</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>½&quot; , 3/4&quot;</td>
<td>Exposed</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>1&quot; , 1-1/4&quot;</td>
<td>Exposed</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>1-1/2&quot; &amp; larger</td>
<td>Exposed</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

J. Where conduits puncture roof, install pitch pockets as required in order that the roof warranty is maintained.

K. Provide 4 spare 3/4-in. raceways from each flush mounted panelboard or cabinet to an area above the nearest accessible ceiling space. Make 90° turn above the ceiling, arranged for further continuation of raceway, and cap.

L. Conduit System Installation:

1. Wiring below 600 volts in exterior above grade locations:
   a) Rigid Galvanized Steel

2. Wiring below 600 volts in exterior below road or driveway locations:
   a) Rigid Galvanized Steel

3. Wiring below 600 volts in Class 1, Div. 1 locations:
   a) Rigid Galvanized Steel
   b) Liquidtight Flexible Metal Conduit

4. Wiring below 600 volts, non hazardous interior locations:
   a) Electrical Metallic Tubing

5. Wiring below 600 volts, exterior, non hazardous below grade locations:
   a) Schedule 80 PVC

3.3 SURFACE RACEWAYS

A. Support with expansion anchors, concrete inserts, masonry inserts or toggle bolts as field conditions require. Provide supports at five foot centers.

B. Install a separate green ground conductor in raceway from the junction box where surface raceway begins to the ground terminal of the device, fixture or equipment being supplied.

C. Provide all fittings, connectors, elbows, tees, boxes etc. as required for the installation.
D. Submit factory drawings detailing the installation. Include a complete part list.

E. Paint all surface mounted raceways in finished areas as directed by Owners representative.

END OF SECTION
PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.2 DESCRIPTION OF WORK

A. This section includes minimum requirements for the following:

1. Receptacles
2. Cord Reels
3. Switches
4. Coverplates

1.3 QUALITY ASSURANCE

A. All wiring devices shall be installed neatly, and parallel with building lines. Recessed devices shall be flush with the face of the wall. Provide extension rings on outlet boxes as required. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

1.4 SUBMITTALS

A. Provide product data for all wiring devices and cover plates.

PART 2 - PRODUCTS

2.1 GENERAL

A. Wiring devices shall be specification grade as a minimum.
B. Wiring device color shall be ivory.
C. Suitable for installation in a 2-1/2” deep outlet box.
D. All receptacles and switches shall be from the same manufacturer.
E. Acceptable Manufacturers:

1. Hubbell
2. Pass & Seymour/Legrand
3. Arrow Hart
4. Bryant
5. General Electric
6. Leviton

2.2 CONVENIENCE DUPLEX RECEPTACLES

A. 125 volt, 20 ampere, two pole, three wire, grounding, straight blade, NEMA 5-20R.
B. Side and back wiring.
C. 0.32” thick brass three prong power contacts and #8 brass screws
D. Brass center rivet
E. All brass grounding system
F. Nylon face with glass reinforced nylon back
G. Terminals Identified in accordance with U.L 498
H. UL94V-2 Flame rating
I. 2000V withstand rating
J. Design Make: Hubbell 5352 series

2.3 GFI RECEPTACLES

A. 125 volt, 20 ampere, two pole, three wire, grounding, straight blade, NEMA 5-20R.
B. Side and back wiring.
C. Nylon face and back.
D. Designed to trip at maximum 6mA leakage current to ground.
E. Suitable for feed through protection.
2.4 SPECIAL RECEPTACLES

A. TYPE [ ]: 250 volt, 20 ampere, 2 pole, 3 wire, grounding. NEMA 6-20R.
B. TYPE [ ]: 250 volt, 30 ampere, 2 pole, 3 wire, grounding. NEMA 6-30R.
C. TYPE [ ]: 125/250 volt, 30 ampere, 4 pole, 4 wire, grounding. NEMA L14-30R (Dryer receptacle). Plug configuration to match equipment furnished by equipment supplier.
D. TYPE [ ]: 125/250 volt, 50 ampere, 4 pole, 4 wire, grounding. NEMA L14-50R (Range receptacle). Plug configuration to match equipment furnished by equipment supplier.
E. TYPE [ ]: 125 volt, 15 ampere, 2 pole, 3 wire, grounding, twistlock. NEMA L5-15R.
F. TYPE [ ]: 125 volt, 20 ampere, 2 pole, 3 wire, grounding, twistlock. NEMA L5-20R.
G. TYPE [ ]: 125 volt, 30 ampere, 2 pole, 3 wire, grounding, twistlock. NEMA L5-30R.
H. TYPE [ ]: 250 volt, 15 ampere, 2 pole, 3 wire, grounding, twistlock. NEMA L6-15R.
I. TYPE [ ]: 250 volt, 20 ampere, 2 pole, 3 wire, grounding, twistlock. NEMA L6-20R.
J. TYPE [ ]: 250 volt, 50 ampere, 2 pole, 3 wire, grounding, twistlock. NEMA L6-30R.
K. Design Make: Hubbell

2.5 CORD REELS

A. Cord reels shall be located for static discharge grounding.
B. Provide with grounding cable. Include 3/32" insulated stainless steel wire, 100-feet wound on spool with military truck clamp, argent industries part #m83413/7-1.
C. Stainless steel housing and reel assembly.
D. Constant tension, designed for wall mounting.
E. Weatherproof spring motor gasket.
F. Nylon guide rollers.
G. Design Make: United Equipment Waverly, IA Model 50 Series

2.6 SWITCHES

A. 120-277 VAC, 20 ampere rated.
B. Side or back wired.
C. Quiet operation.

D. Single pole, three way, and four way as called for on the plans.

E. Design Make:
   1. Single pole: Hubbell catalog no. 1221
   2. Three way: Hubbell catalog no. 1223
   3. Four way: Hubbell catalog no. 1224

2.7 KEY SWITCHES

A. 120-277 VAC, 20 ampere rated.

B. Locking type. Provide (1) key per switch, all keyed alike.

C. Side or back wired.

D. Quiet operation.

E. Single pole, three way, and four way as called for on the plans.

F. Design Make:
   1. Single pole: Hubbell catalog no. 1221L
   2. Three way: Hubbell catalog no. 1223L
   3. Four way: Hubbell catalog no. 1224L

2.8 COVERPLATES

A. Provide type 302 stainless steel cover plates with satin finish for general purpose flush devices.

B. Provide utility cover plates for surface mounted devices in mechanical rooms.

C. Provide gasketed cover plates with a hinged cover on a cast aluminum outlet box for all devices in wet areas designated “WP”.

D. Provide high impact red cover plates for emergency circuits.

2.9 WEATHERPROOF COVERS

A. Impact resistant polycarbonate, NEMA 3R construction.

B. Clear cover to view the connection of the device.

C. UL listed as a weatherproof enclosure with the receptacle in use.
D. Hinged, latching cover with an opening at the bottom for a cord to exit the device.
E. Padlockable
F. Suitable for installation of a GFI protected duplex receptacle.
G. Design Make: Hubbell Catalog No. WP26MGP
H. Acceptable Manufacturers:
   1. Hubbell
   2. Leviton
   3. Arrow Hart
   4. Pass & Seymour
   5. Bryant

PART 3 - EXECUTION

3.1 GENERAL

A. Install devices generally where called for.
B. Coordinate exact locations of all devices with equipment, millwork, counters, fin radiation, windows, etc and adjust locations as required as part of this contract.
C. Provide steel box for all devices.
D. Install receptacles and switches vertical, with the grounding pin down, and the toggle up in the on position.
E. Install all switches on the strike side of the door, with the edge of the outlet box approximately 3” from the door frame.
F. Do not install devices “back to back” in the same stud cavity without prior approval of the Owner.
G. Provide plaster rings on all outlet boxes to permit flush installation of devices.
H. In all wet or damp areas, provide a surface mounted cast aluminum outlet box with threaded connections, gasketed cover, and non-ferrous screws.
I. Prior to installation and as part of the contract, relocate any device a distance of 5 feet in any direction at the request of the Owner.
J. Size outlet boxes in accordance with the NEC, based on the number and size of wires in the box.

K. Provide a coverplate on all devices.

3.2 CORD REEL MOUNTING

A. Provide uni-strut support channeling and threaded rod to support cord reels.

3.3 EQUIPMENT MOUNTING HEIGHTS

A. Refer to Specification Section 260000 – Basic Materials and Methods for mounting heights.

3.4 LABELING

A. Provide tape labels indicating panelboard and circuit on the outside of all device coverplates.

3.5 TESTING

A. Test all receptacles for proper voltage, polarity, and grounding.

B. Test all GFI receptacles for proper voltage, polarity, grounding, and verify the receptacle trips at 6 milliamperes or less.

C. Rewire receptacles as required until receptacles test properly.

END OF SECTION
SECTION 260543

UNDERGROUND CONDUIT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

B. Cut, excavate, and patch existing asphalt parking lot and grass areas for new underground conduit installations as called for on the drawings.

1.2 SCOPE

A. Minimum composition requirements and/or installation methods for the following materials and work are included in this section:

1. Excavation – Section 312333 Trenching and Backfill
2. Ordinary Fill and Crushed Stone – Section 310000 Earthwork
3. Underground Conduit – Section 260532 Raceways
4. Soil Repair – Section 310101 Site Restoration
5. Asphalt Paving
6. Handholes

1.3 SUBMITTALS

A. Product data for:

1. Handholes

1.4 QUALITY ASSURANCE

A. The installation shall comply with the applicable sections of the BICSI “Customer Outside Plant Design Manual.”

B. The contractor shall engage the services of a qualified installer for all excavation and restoration work.

C. All work shall be done in a neat and workmanlike manner. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Director’s Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
1.5 PROJECT CONDITIONS AND REQUIREMENTS

A. The following conditions apply to excavation:

1. Identify and maintain and protect existing building services which cross the excavation area.

2. Protect utilities, sidewalks, structures, pavements and other facilities from damage caused by settling, lateral movements, undermining, washouts and other hazards created by excavation work.

3. Locate and verify existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.

4. Verify subsurface conditions prior to excavation work.

B. Obtain as built drawings from the Director’s Representative for all previous underground work done on the campus. Field verify location of the existing underground utilities and cabling that is shown on these plans. Use tracing equipment as required.

C. The contractor shall be responsible for the repair all existing utilities that are identified on existing as built drawings or construction documents that are damaged during the installation of contract work.

D. The contractor shall sub contract a qualified mechanical or plumbing contractor to repair any underground piping that is damaged as a result of the installation of contract work.

PART 2 – PRODUCTS

2.1 ASPHALT PAVING

A. Use locally available materials exhibiting satisfactory record of previous installations.


C. Asphalt Requirements:

1. Foundation Course: Provide 6” layer compacted in 3” increments. Material shall comply with NYS DOT Standard Type 1 Fill.

2. Base Course: Provide 2” compacted layer or additional material until movement in front of roller ceases. Material shall comply with NYS DOT Standard Type 2 Fill.

3. Tack Coat: Emulsified asphalt, slow setting type, NYS DOT Designation 702-3601 (SS-1h) or 702-4501 (CSS-1h).

5. Asphalt Concrete Binder Course: Provide minimum 3” binder course. Material shall be hot plant mixed asphalt concrete complying with NYS DOT Type 3 Binder.

6. Asphalt Concrete Top Course (over existing paving): Provide minimum 1 ½” top course up to 3” to achieve level surface. Material shall be hot plant mixed asphalt concrete complying with NYS DOT Type 7 Top.

D. Painting:

1. Pavement marking paint shall comply with NYS DOT standard 727-01.

E. Compaction Equipment:

1. Provide Compaction equipment in suitable size and number, and in satisfactory working condition to complete construction on schedule.
2. Use Self propelled tandem roller with minimum 10-ton weight. Hand held compactor may be used in areas inaccessible to rollers when approved in advanced by engineer.

2.2 HANDHOLES

A. Provide pre-cast or cast-in-place reinforced concrete designed for H-20 loading.

B. Shall have angled corners, cut on 45 degrees for optimum cable racking.

C. Covers and frames shall be cast iron, with a minimum opening of 27” suitable for H-20 loading. Covers shall have pick holes and have “Communications”, “cast in 2” high lettering on the cover.

D. Floors shall be 6 inches thick with a 12” diameter sump hole. In wet soil, provide reinforced floor with 5/8” bars, 8 inches on center.

E. Provide two courses of bricks with all joints fully filled with mortar both inside and outside the collar. Provide layer of mortar on top course for bricks.

F. Provide cable racks with “T” slots for attaching support hooks. Provide two per wall.

G. Provide pulling irons on each wall 12” below duct.

H. Refer to details on drawings for additional information.

I. Acceptable Manufacturers: Lakelands Precast or approved equal.

2.3 EXTERIOR DUCT

A. Exterior exposed conduits shall be 4” trade size and provided in 10 ft. straight lengths with factory installed reverse spin coupling for easy assembly without turning outer shell.
Reverse spin coupling shall have 3 set screws to prevent coupling from backing off, before or after installation. Conduit shall be Galvanized Steel Raceway.

B. Underground straight length conduit sections shall be 4” trade size Sch. 80 PVC or Galvanized Rigid Steel as called for.

C. Provide 45-degree and 90-degree GRS large radius (36”) sweeps at bend locations. Provide PVC to GRS adapters as required.

D. Couplings shall be mechanically or chemically sealed water tight.

E. Provide deflection joint to allow ¾” movement in all axis, and a total bend of up to 30 degrees. Provide fixed galvanized steel bends or flexible metal conduit bends to allow changes in direction. Fixed or flexible bends shall be provided with factory installed reverse spin coupling. Fixed or flexible bends shall have Nylon 6 innerduct to prevent "burn through" due to friction when tapes, ropes, or cables are installed.

PART 3 - EXECUTION

3.1 EXCAVATION AND TRENCHING

A. Preparatory Work:

1. Build lines to grade and elevations shown. Provide stakes, grade boards, cleats, nails, instruments. Locate and stake each new run for its entire length. Verify elevations given. Start excavation at low point. Notify Engineer of elevation discrepancies. Protect marks and stations. Before excavating work, coordinate with Director’s Representative and other trades. Furnish schedule of operations to Director’s Representative and each trade. Provide and maintain temporary bridges, walks and bridges over excavations where underground utility lines, sewers, water lines, etc., cross access roads, walks, and streets. Make necessary arrangement with authorities having jurisdiction.

2. Examine substrates, areas and conditions, with the installer present, for compliance with requirements for installation tolerances and other conditions affecting installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
B. Protection:

1. Provide bracing, shoring, sheathing and other work for: protection of personnel, the contract work, excavations, trees, shrubs, existing structures, and surrounding properties. Slope sides of excavations to comply with local codes and ordinances. Provide, erect, and maintain barricades, warning signs, flags, and lights to provide protection for work, workmen, public, and property. Plank walks, pavements, and curbs to be crossed by equipment. Protect adjacent property, existing fences, trees, shrubs, roads, curbs, sidewalks, manholes, hydrants, and other items:

2. Restore, repair, rebuild or replace any such items damaged or destroyed to condition equal to that existing before such damage occurred.

3. Establish conditions, before starting work, by taking photographs to determine state to which existing conditions must be restored. Submit such photographs notarized, identified and dated for record.

C. Existing Utilities:

1. If existing telephone or electric cables are broken during the new installation the contractor shall repair to new condition.

2. Report immediately any utility lines encountered.

3. Notify Underground Facilities Protection Organization (UFPO), where same exists, before starting work. Phone (800)-962-7962 for information and location of nearest organization address and telephone number. Verify exact location of existing utility lines where work crosses existing utilities and where connections are to be made by test hole before starting work. Notify utility companies, municipalities, and other involved jurisdictions when excavation occurs within vicinity of existing underground service such as sewers, water, electric, gas, telephone, including such services owned by Owner.

4. If existing service lines, utilities and utility structures which are to remain in service are uncovered or encountered during this excavation, they shall be protected from damage, and securely supported as directed and approved by the involved jurisdiction. Comply with Section 1918 of Penal Law of State of New York with regard to work in vicinity of combustible gas piping. Immediately report damage or injury to utility lines to Director’s Representative and involved jurisdiction. Repair or replace utility lines damaged or injured as directed and approved by the involved jurisdiction. Excavate by hand in proximity to existing underground utility lines; take extreme care when excavating around ductbanks carrying energized cable. Remove plug or cap inactive or abandoned utilities encountered during construction operations. The location of such utilities shall be noted on the record drawings. Verify "inactivity" of services with involved jurisdiction before start of work.
D. Cutting and Patching

1. Before starting work, obtain necessary permits and pay fees and charges for same. Cut paved areas as called for, perpendicular to surface and in straight saw-cut lines. Replace pavements, roadways, streets, blacktop areas, walks, disturbed by excavating operations with materials equal to adjacent pavements.

E. Methods

1. Provide for buried work in contract both inside and outside of building. Excavate to proper depth and width for installation work as called for and comply with rules set forth by New York State Department of Labor. Remove materials including masonry work, rubble, earth, brickwork, concrete, sand, debris, abandoned pipe lines, drains and sewers, rocks, boulders, and concrete, all of which is considered "earth excavation." Provide for legal disposition of excess excavated materials. Make allowance for gravel fill, sand bases, form work, floor slabs, manholes, anchor and thrust blocks, sheet piping, drainage pumps, and work space. Start excavation at rough grade and provide form work and sheet piling where required.

2. Trench excavation:
   a) By open cut, to proper depth and grade no wider than required for placement of work and not more than 100 ft. in advance of utility being installed.
   b) Should trench bottom be wet, unstable, and/or otherwise incapable of supporting the contract work, immediately report same to Director’s Representative. Should it be deemed unsuitable, excavate to depth as directed and back fill with gravel to trench depth, or provide concrete cradling.
   c) Should rock be encountered, excavate 6 in. deeper and fill space between trench bottom and pipe with coarse sand, well tamped to form firm bed.

F. Shoring, bracing, sheathing:

1. In addition to governing codes, protect sides of excavations with sheeting and bracing where necessary to prevent sliding or caving of banks and to protect adjacent structures. Remove as back fill is placed.

2. Provide at locations adjacent to existing manholes, hydrants, and similar items.

G. Backfill

1. Provide bedding around piping with coarse sand from 6 in. below to 8 in. above. Apply by hand and compact under and at sides by mechanical means

2. Piping, jackets and sand bed must be inspected and tested prior to backfill of any nature. Provide necessary anchors, thrust blocks, for testing.
3. Fill remainder of trench in 12 in. layers, use ordinary fill material, except as otherwise specified. Do not use frozen material. Remove boulders, stones, broken rock, wood, bricks, blocks, and debris from fill material before backfill operation.

4. Under roadways, manholes, drives, parking areas, walks, slabs, on grade and at utility entrance to building provide backfill in 6 in. layers with gravel or crushed stone, free from organic or other unsuitable material, to grade. Thoroughly compact each layer.

5. Compaction to not less than 95% density compared to maximum laboratory tests by weight, per modified ASTM D1557-64T, latest editions, method "A" under slab on grade, roadways, drives, and other paved areas and 85% for general grading. Submit certified results of tests by an approved soil testing laboratory.

H. Paving

1. Compact each individual material layer as specified.

2. Adjust grading of finish coat to match surrounding surfaces.

3. Finished surface shall be free from depressions, footprints, or imperfections that may collect water or are clearly visible.

4. Repair and repaint of traffic control and parking lot lines to match existing.

I. Removal of water

1. Provide pumps, hoses, pipe, labor and fuel, necessary to keep excavations free of water accumulation. Maintain and operate equipment. Discharge water in manner not interfering with any trade's work and not to undermine or disturb existing or adjacent structures or land. Grade to prevent surface water from flowing into all excavations and trenches. Do not discharge dirt, backfill, debris, into sanitary or storm drainage systems.

J. Rock Excavation

1. Rock Excavation defined as:
   
a) Ledge rock requiring blasting or air hammer for removal.

b) Boulders in excess of 1-1/2 cu. yds. in size. Demonstrate that material in question cannot be removed with a 1-1/2 yd. backhoe or shovel.

c) Procedure: Should rock be encountered, remove only upon written order of the Director’s Representative.
2. Measurement of rock excavation, for purpose of payment to Contractor, will be
taken 1 ft. wider than ductbank, manhole, pipe or conduit being installed. No
allowance made for additional rock taken out accidentally or for convenience of
Contractor beyond amount required for installation of work. Rock excavation
claimed must be measured each day and verified by the Director’s Representative
except through procedures outlined above.

K. Job completion:

1. On completion of the work, clean the entire site, remove surplus earth, large
stones and debris, to off-site legal disposal. Remove tools and equipment and
leave the entire area in a neat condition.

2. Rough grade to 6 in. below finished grade. Scarify subsoil to depth of 2 In. to
achieve bond between topsoil and subsoil.

3. Repave, reseed and completely restore the area to the condition prior to the start
of excavation and trenching work

3.2 MANHOLES, VAULTS AND HANDHOLES

A. Locate to avoid unnecessary hazards and cause minimum interference with normal traffic
flow. Locate outside traveled parts of road wherever possible.

B. Where possible conduits entering manholes shall be splayed. Use center conduit
entrances only where splaying is not possible. Refer to table 3-27 of the BICSI
“Customer Outside Plant Design Manual.” for options. Use the first choice wherever
possible.

C. Seal all conduits watertight after conduits or ductbanks are complete.

3.3 UNDERGROUND DUCTBANKS

A. Where ductbanks penetrate foundation, footings or outside walls, rigid metallic conduits
with expandable rubber shields shall be used.

B. Where ducts enter manholes they shall be centered as nearly as possible to the center
between roof and floor and end walls.

C. Securely tie raceways in place to prevent floating.

D. Pull iron-shod mandrel not more than ¼” smaller than bore of raceway to remove
concrete and other obstructions. Clean raceway by drawing cylindrical brushes through
duct.

E. Provide metallic elbows where conduits rise out of ground.

F. Provide nylon pull strings in all innerducts and individual pathways inside raceways.

G. Seal all conduits watertight prior to backfill.
H. Provide bushings at each conduit termination.

I. In locations where non-metallic raceways are used, change to heavy wall metallic conduit of same internal diameter before rising out of ground; provide metallic conduit elbows at conduit rise.

J. Place conduit in straight lines. Place direct-bury conduit tier-by-tier method, backfilling each layer to achieve proper spacing. Elbows shall have a minimum radius of 36 in. Follow proper low temperature installation procedures as recommended by PVC conduit vendor. Repair or replace all existing utilities and facilities damaged, due to ductbank installation, as part of contract.

K. Provide a bushing at each conduit termination unless fitting at box where conduit terminates has hubs designed in such a manner to afford equivalent protection to conductors. Provide grounding type insulated bushings on all conduit sizes 1-1/4" trade size and larger, and on all feeder raceways regardless of size.

END OF SECTION
SECTION 262416
SWITCHBOARDS AND PANELBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED
A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.2 DESCRIPTION OF WORK
A. This section includes minimum requirements for the following:
   1. Circuit Breakers
   2. Disconnect Switches
   3. Enclosed Circuit Breakers
   4. Low Voltage Fuses

1.3 QUALITY ASSURANCE
A. All low voltage power distribution equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Materials and installation practices specified herein shall comply with the applicable requirements of:
   1. The following Articles of the National Electric Code (NFPA 70)
      a) 240 - Overcurrent Protection
      b) 368 - Busways
      c) 404 - Switches
      d) 408 - Switchboards and Panelboards
   2. The following National Electrical Manufacturers Association (NEMA) Standards:
      a) NEMA AB 1 1993 - Molded Case Circuit Breakers and Molded Case Switches
      b) NEMA BU 1 - Busways
c) NEMA PB 1 - Panelboards

d) NEMA PB 1.1 - Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or less.

e) NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

f) NEMA 250 - Enclosures for Electrical Equipment

g) NEMA ST20 – Dry Type Transformers

3. The following American National Standards Institute (ANSI) standards:

a) ANSI/IEEE C12.1 Code for Electric Metering

4. The following U.L. Standards:

a) UL 50 - Enclosures for Electrical Equipment

b) UL 67 - Panelboards

c) UL 98 - Enclosed and Dead-Front Switches

 d) UL 489 - Molded Case Circuit Breakers and Circuit Breaker Enclosures

e) UL 857 - Underwriters Busway Standard

f) UL 943 - Standard for Ground Fault Circuit Interrupters

1.4 SUBMITTALS

A. Provide product data including voltage, current, interrupting rating, and enclosure type for the following:

1. Thermal Magnetic Molded Case Circuit Breakers

2. Electronic Trip Molded Case Circuit Breakers

3. Disconnect switches.

4. Low voltage fuses.

1.5 MINOR MODIFICATIONS

A. Provide modifications to circuit breaker trip rating within the frame size at no additional cost, until shop drawings are reviewed and submitted.
1.6 FIELD SUPERVISION

A. Provide field supervision and start-up by a qualified representative of the equipment manufacturer. Provide certification that the equipment has been installed in accordance with the manufacturer’s requirements.

1. Service Entrance power Monitoring

PART 2 - PRODUCTS

2.1 CIRCUIT BREAKERS

A. General

1. Molded case circuit breakers shall be constructed of a glass reinforced insulating material. All current carrying components shall be completely insulated and isolated from the outside of the circuit breaker.

2. Provide an over-center, trip-free handle to provide quick-make, quick-break contact action.

3. Provide multi-pole breakers with common trip.

4. When the circuit breaker has tripped, the handle shall move to a position between the “on” and “off” positions. Provide a visual indication that the circuit breaker has tripped.

5. The ampere rating shall be clearly marked on the face of the circuit breaker.

6. Any series rated fuse/circuit breaker installations shall be UL listed as recognized component combinations. Provide a label at the Series rated device reading “Caution - Series Rated System. ___________A available”. Provide identical replacement of equipment”.

7. Make provisions to add circuit breaker handle locks.

8. Circuit breakers shall have voltage, ampere, and interrupting ratings as called for on the Panelboard Schedule.

B. Thermal Magnetic Molded Case Branch Circuit Breakers

1. Permanent trip unit containing individual thermal and magnetic trip elements.

2. Thermal trip unit shall be long time, non-adjustable, thermal overload trip.

3. Magnetic trip unit shall be instantaneous, electro-magnetic trip. Magnetic trip unit shall be adjustable for all frame sizes 225 amperes and larger.

4. Interchangeable rating plugs shall be provided for all frame sizes 400 amperes and larger.
5. 60°C terminal temperature rating for circuit breakers rated 125 amperes or below.

6. 75°C terminal temperature rating for circuit breakers rated above 125 amperes.

7. All 20 and 30 ampere, single pole circuit breakers shall be UL listed for switching duty.

8. Circuit breakers shall be plug-on. I-Line type distribution circuit breakers are acceptable.

9. Circuit breakers rated 250 amperes and below shall be UL listed HACR type.

10. Where ground fault circuit breakers are required, provide a shunt trip circuit breaker with a zero sequence sensing ground fault module.

11. Design Make: Square D QO, QOB (250 volt), EH, EHB (480 volt), I-Line style (600 volt)

12. Acceptable Manufacturers:

   a) Square D
   b) General Electric
   c) Westinghouse/Cutler Hammer
   d) Siemens ITE

C. Standard Function Electronic Trip Molded Case Circuit Breakers

1. Microprocessor based true RMS sensing current sensing device with accuracy to the thirteenth harmonic.

2. Sensor frame and rating plug size shall be as indicated on the Panelboard Schedule.

3. UL listed to carry 80% of the ampere rating continuously.

4. Provide the following time/current response adjustments:

   a) Long Time Pickup
   b) Long Time Delay
   c) Short Time Pickup
   d) Short Time Delay (I^2t IN only)
   e) Instantaneous Pickup
   f) Ground Fault Pickup
g) Ground Fault Delay (I^2t OUT only)

5. Provide a means to cover the trip unit adjustments in accordance with NEC Article 240-6(b).

6. Provide trip indication for overload, short circuit, and ground fault trips.

7. Tripping system shall be equipped with an externally accessible test port for use with a Universal Test Set. Disassembly of the circuit breaker shall not be required for testing.

8. Design Make: Square D LX, MX, NX, PX

9. Acceptable Manufacturers:
   a) Square D
   b) General Electric
   c) Westinghouse
   d) Siemens ITE

2.2 240 VOLT BRANCH CIRCUIT PANELBOARDS

A. 240 Volt rated, maximum 400 amperes.

B. Copper bus bars with high dielectric thermoplastic insulators.

C. Provide continuous current ratings, short circuit current ratings, branch circuit breakers, main circuit breaker or main lugs, and flush or surface trims as called for on the Panelboard schedule.

D. Provide nameplate on each panelboard indicating voltage, current, phase, wire, and short circuit rating.

E. 100% rated neutral of the same material as the main bus.

F. Provide ground bus of the same material as the main bus.

G. Interior trim shall be dead front construction, with pre-formed metal twist-outs covering unused mounting space.

H. Enclosures shall be nominal 20” wide by 6” deep, galvanized steel construction with removable endwalls and knockouts.
I. Fronts
   1. Surface or flush mounted as called for on the Panelboard Schedule.
   2. ANSI 49 gray electrodeposited enamel.
   3. Fronts shall be one piece with door, and hinged to the enclosure.
   4. Provide cylindrical tumbler type lock with catch and spring loaded stainless steel door pull. All locks shall be keyed alike.
   5. Provide a clear plastic directory card holder on the inside of the door.

J. Design Make: Square D “NQOD”

K. Acceptable Manufacturers
   1. Square D “NQOD”
   2. General Electric “A” Series
   3. Cutler Hammer “CH”
   4. Siemens ITE “Sentron S1”

2.3 DISCONNECT SWITCHES

A. Three pole, single throw, or as called for on the drawings.
B. Quick-make, quick-break switch operating mechanism.
C. Heavy-duty, current rating as called for on the drawings, voltage rating as required by the equipment served.
D. All current carrying parts shall be plated to resist corrosion.
E. Lugs shall be removable and rated for 75°C temperature rating.
F. Switch blades shall be visible when the switch is in the open position and the door is open.
G. Switch shall be padlockable in the OFF and ON positions.
H. Provide fusible switches with rejection type fuse holders and fuses as indicated on the plans or as per fed equipment requirements.
I. Provisions for a field installable electrical interlock.
J. Provide external override mechanism to open the disconnect switch door without opening the disconnect switch.
K. Enclosure shall be steel with gray baked enamel paint.

L. Provide NEMA type enclosures as called for on the drawings.

M. NEMA type 1 enclosures shall be equipped with knockouts.

N. Design Make: Square D

O. Acceptable Manufacturers:
   1. Square D
   2. General Electric
   3. Cutler Hammer
   4. Siemens ITE

2.4 LOW VOLTAGE FUSES

A. All fuses rated 600 volts and below shall be rejection type dual-element, time-delay type. Provide one complete sets of fuses for all fusible disconnect switches, plus 3 spare fuses of each size. Deliver spare fuses to the Owner and obtain receipt.

B. Acceptable manufacturers: Fuses 600 amperes and below: Bussman Type FRN-R (300 volts), Type FRS-R (600 volts) or equivalent.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide identification for all equipment and devices as indicated in section 16100.

B. Provide miscellaneous bolts, washers, nuts, clips, lockwashers, hardware, etc. as required to install equipment.

C. Unload, move, handle, set in place, install, erect, assemble, connect, test etc. all items ad required.

D. Provide minimum NEC working clearance for all equipment.

E. Verify cable/lug sizes for terminations. Where a feeder is sized larger the lug provide replacement lug or in line splice as directed by Owner’s Representative.

3.2 CIRCUIT BREAKERS

A. Install circuit breakers in panelboards and switchboards as called for on the plans and as recommended by the manufacturer.

B. Adjust circuit breaker pick-up level and time delay settings to the values called for on the drawings indicated in the coordination study designated by the Engineer.
3.3 BRANCH CIRCUIT PANELBOARDS

A. Make all branch circuit and feeder connections.

B. Provide channel support between the wall and backbox for panelboards installed on outside walls.

C. Tighten all bolt and lug connections using a torque wrench or screwdriver per the manufacturer’s recommendations.

D. Measure steady state load currents on each panelboard feeder. Rearrange branch circuits in the panelboard to balance the load within 20% of each other. Maintain proper phasing.

E. Provide identification as required per section 260501.

3.4 DISCONNECT SWITCHES

A. Install disconnect switches in locations shown on plans. Install true and level.

B. Tighten all bolt and lug connections using a torque wrench or screwdriver per the manufacturer’s recommendations.

C. Provide identification as required per Section 260501.

D. Provide fuses in all fusible switches.

3.5 LOW VOLTAGE FUSES

A. Install low voltage fuses in disconnect switches as called for on the plans.

B. Turn all spare fuses over to the Owner and obtain receipt.

END OF SECTION
SECTION 265629
LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED
A. Provide complete interior systems, including luminaires, standards, hangers, supports, fittings, lamps, wiring, connections and controls, as indicated in the Contract Documents.

1.2 DESCRIPTION OF WORK
A. This section includes minimum requirements for the following:
   1. LED Lamp Assemblies and Drivers
   2. Light Poles and Standards

1.3 SUBMITTALS
A. Submit shop drawings as described in Section 260010. Luminaire shop drawings shall include photometric data for each luminaire utilizing the specified lens/louver type, lamp(s) and ballast(s). All luminaire types shall be submitted in a single complete brochure which shall be in the form of a soft cover binder with each luminaire separated by an identified index tab. Information on each luminaire shall include:
   1. Manufacturer and Catalog Number.
   2. Dimensioned Construction Drawing(s).
   4. Photometrics.
   5. Lens/Louver Type.
   6. Ballast Type and Rating.
   7. Socket Type.
   8. Lamp Type.
   9. Maintenance Data
   10. Light Poles and Standards
1.4 QUALITY ASSURANCE

A. Luminaires shall be standard products of manufacturers regularly engaged in the manufacture of the specific type luminaires specified and shall be the manufacturer's latest standard design that complies with specification requirements. Firms installing the luminaires shall have a minimum of five (5) years of successful installation experience on projects with interior lighting work similar to the requirements of this project.

B. Codes and Standards

1. NEC:
   a) Shall comply with Articles 220, 410 and 510 as applicable to installation and construction.

2. NEMA:
   a) Shall comply with Standard Publication Nos. LE 1 and LE 2 as applicable to lighting equipment.

3. UL:
   a) All interior lighting luminaires and components shall be UL listed and labeled.
   b) Comply with all applicable UL standards including UL 486A and B.

4. CBM:
   a) Fluorescent and HID ballasts shall comply with Certified Ballast Manufacturers Association standards and carry the CBM label.

5. All work shall comply with applicable local code requirements of the authority having jurisdiction.

C. Verify the availability of all luminaires proposed to be used in the execution of the work prior to submitting for approval. The discontinuance of production of any luminaire after such approval has been granted shall not relieve the Contractor from furnishing an approved luminaire of comparable quality and design at no additional cost.

D. Luminaires shall be as specified in the "Luminaire Schedule." Luminaire types, characteristics, photometrics, finishes, etc., correspond to the first manufacturer, and associated catalog number, listed in the "Luminaire Schedule." Provide a sample luminaire from the factory for any products not listed as acceptable for approval. The Director’s Representative reserves the right to disapprove any luminaire type submitted which is not equal in quality, appearance or performance to the luminaire specified.

E. All luminaires shall meet the Total Luminaire Efficiency (TLE) requirements of the New York State Energy Conservation Construction Code.
PART 2 - PRODUCTS

2.1 LAMPS
A. Type LED
B. Refer to Luminaire Schedule on drawings for requirements.

2.2 DRIVERS
A. Refer to Luminaire Schedule on drawings for requirements.

2.3 LIGHT POLES AND STANDARDS
A. Metal Pole Lighting Standards: Provide metal, raceway-type, lighting poles and standards, of sizes and types indicated, comprised of shafts and tenon joints. Equip with grounding connections readily accessible from handhole base access doors; and construct of the following materials and additional construction features:

B. Material: Galvanized steel.
   1. Configuration: Anchor base type with hand hole and cover.
   2. Metal Lighting Standard Accessories: Provide accessories for metal lighting standards, including anchor bolts, as recommended by lighting standard manufacturer, of sizes and materials needed to meet erection and loading application requirements.
   3. Provide metal seamless square anchor bolt cover to match pole construction.

C. Provide pole with adequately sized reinforced handhole complete with matching cover 18" above grade level. Weld 1/2' grounding nut on shaft with accessibility from handhole. Design poles to withstand loads developed by 100 MPH wind pressure, as adjusted for height above ground level, structural shapes and cable wire loading.

2.4 LUMINAIRE SCHEDULE
A. Luminaire schedule is found on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas and conditions, under which luminaires are to be installed, and substrate for supporting luminaires. Notify Architect in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.
3.2 COORDINATION

A. Refer to respective reflected ceiling plan for each area. Reflected ceiling plans indicate proper luminaire location only. Coordinate the proper arrangement with all other ceiling mounted devices. Contract Documents indicate luminaire characteristics (type), quality, quantity, etc. Verify with the ceiling supplier design of actual ceiling installed in each area and coordinate compatible luminaire flange.

B. General

1. Install interior luminaires at locations and heights as indicated, in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, NECA's 'Standard of Installation", NEMA standards, and with recognized industry practices.

2. Provide luminaires and/or luminaire outlet boxes with hangers to properly support luminaire weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Engineer.

3. Make installation such that the luminaire is free of finger marks, flaws, scratches, dents or other imperfections.

4. Arrangement
   a) Align edges of luminaires with walls or other building elements. Where indicated by dimensions or indicated on Drawings, maintain indicated arrangement.
   b) For wall to wall installed luminaires, field measure length required after completion of the wall construction and prior to ordering the luminaires. Fabricate in largest lengths allowable.

5. Surface Mounting
   a) Mount surface luminaires tight to surface without distorting surface. Space luminaires in continuous rows to correspond to ceiling joint intersections. Continuous row luminaires may be fed by a single outlet where luminaires contain approved wireways and suitable wiring is used. Provide hangers for each luminaire, each rated to support four times the luminaire weight.
   b) Fasten luminaires securely to structural supports.

3.3 LAMPS

A. Provide lamps in all luminaires.

B. Replace any lamp whose color is determined to be unsatisfactory. Replace all HID lamps or LED light bars lamps which are found to have failed during the 12 month warranty period.
C. All lamps shall be new and unused. If permanent lighting system is used for temporary construction lighting, lamps shall be replaced upon turn over to Director’s Representative.

D. Furnish stock or replacement lamps amounting to 15%, but not less than 4 lamps in each case, of each type and size lamp used in each type luminaire. Deliver replacement stock as directed to Director’s Representative storage space.

3.4 DELIVERY, STORAGE, AND HANDLING

A. Luminaires and equipment shall be delivered with UL and manufacturer's labels intact and legible in factory fabricated containers.

B. Luminaires and accessories shall be stored in protected dry locations in their original unbroken package or container. Luminaires shall be protected from dust and dampness both before and after installation. Luminaires shall be protected from paint and cleaning solvents during all phases of construction.

C. Handle interior lighting luminaires carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged luminaires or components; replace with new.

3.5 SEQUENCING AND SCHEDULING

A. Coordinate with other work including ceiling type, wires/cables, electrical boxes, fittings, and raceways, to properly interface installation of interior luminaires with other trades.

3.6 FINAL CLEANING

A. Prior to acceptance, damp clean diffusers, glassware, trim, reflectors, lamps, louvers, lens and similar objects of all luminaires. Remove all dirt, corrosion, foreign material, finger marks, blemishes. Replace all burned out lamps and failed components.

END OF SECTION