

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, Division 0, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

1. Existing work
2. Grounding and bonding
3. Connection of utilization equipment
4. Supports
5. Identification
6. Conduit and fittings
7. Surface raceway
8. Wireway
9. Electrical boxes
10. Wire and cable
11. Cords and caps
12. Wiring devices
13. Service fittings
14. Electrical tape
15. Terminations

1.03 RELATED SECTIONS

1. Section 16010, Basic Electrical Requirements
2. Section Div 2 - Earthwork: Excavation, Backfilling, and Compacting for Utilities
3. Section 03300, Cast-in-Place Concrete

1.04 SUBMITTALS

- A. Product Data: Provide catalog data for the following:

1. Grounding and bonding devices
2. Supports
3. Anchors
4. Conduit and fittings
5. Surface raceway
6. Wireway
7. Electrical boxes
8. Wire and cable
9. Wiring devices
10. Mounting brackets/ceiling channels
11. Service fittings

- B. Submit product data and shop drawings in booklet form with a separate sheet for each product. Indicate clearly on each sheet product manufacturer, catalog number, product description and other pertinent data.

1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of National Electrical Code (NEC) ANSI-C1/NFPA 70-2002.
- B. Conform to requirements of National Electrical Safety Code (NESC) ANSI C2-1997.
- C. Furnish products listed by Underwriters Laboratories, Inc., or other testing firm acceptable to authority having jurisdiction.

1.06 PROJECT CONDITIONS

- A. Existing project conditions indicated on drawings are based on casual field observation and existing record documents.
- B. Verify field measurements and circuiting arrangements are as shown on drawings.
- C. Verify removal of existing electric work.
- D. Report discrepancies to Engineer before disturbing existing installation.

1.07 COORDINATION

- A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections to determine connection locations and requirements.
- B. Sequence rough-in of electrical connections to coordinate with installation and start up of equipment furnished under other sections.

PART 2 - PRODUCTS

2.01 GROUNDING MATERIALS

- A. Ground Rod: Copper clad steel, 3/4" diameter x 10' length. Die-stamp each near the top with the name or trademark of the manufacturer and the length of the rod in feet. The rods shall have a hard, clean, smooth, continuous, surface throughout the length of the rod.
 - 1. Galvanized steel rods are permitted where required by Utility Company.
- B. Mechanical Connectors: Bronze.
- C. Thermit Welds: Cadweld.

2.02 BASIC MATERIALS

- A. Steel Channel: Galvanized or painted steel.
- B. Anchors:
 - 1. Masonry Anchors: Rawl-Stud, Lok-Bolt, Saber-Tooth, or equal by Arro, Diamond, or Redhead.
 - 2. Hollow-Wall Anchors: Toggle bolt by Rawl or equal by Arro, Diamond, or Redhead.
 - 3. Anchors shall have sufficient holding power for intended use.
 - 4. Plastic anchors and powder actuated anchors are not permitted.
- C. Miscellaneous Hardware: Treat for corrosion resistance.
- D. Nameplates: Engraved three layer laminated plastic (lamicoid), white letters on black background. Embossed adhesive tape labels, with 3/16" white letters on black background.

- E. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

2.03 METAL CONDUIT

- A. Acceptable Manufacturers:
 1. Allied Tube and Conduit
 2. Wheatland Tube Company
 3. Jones and Laughlin
 4. Republic Steel
 5. Triangle PWC
- B. Conduit:
 1. Metal Conduit and Tubing: Hot dipped galvanized or sheradized steel.
 2. Flexible Conduit: Galvanized steel.
 3. Liquidtight Flexible Metallic Conduit: Flexible conduit with PVC jacket.

2.04 PLASTIC CONDUIT

- A. Acceptable Manufacturers:
 1. Carlon
 2. National
 3. American Pipe & Plastics, Inc.
- B. Plastic Conduit:
 1. Plastic Conduit: NEMA TC 2; PVC. Use Schedule 40 conduit.
 2. Liquidtight Flexible Non-Metallic Conduit: Flexible conduit with hard PVC spiral and flexible jacket, Carlon Carflex or approved equal.

2.05 FITTINGS

- A. Manufacturers:
 1. Appleton
 2. Bridgeport
 3. O-Z/Gedney
 4. Raco
 5. Steel City
 6. Thomas and Betts
 7. Carlon
 8. American Pipe & Plastics, Inc.
- B. Conduit Fittings:
 1. Metal Fittings and Conduit Bodies: NEMA FB 1.
 2. Plastic Fittings and Conduit Bodies: NEMA TC 3.
 3. Fittings and Conduit Bodies for RSC: Galvanized steel or malleable iron, couplings and fittings threaded.
 4. Fittings for EMT: Watertight, concrete tight, compression style with galvanized or zinc-plated steel body and cadmium plated steel or malleable iron nut like O-Z/Gedney #7075S connector and #6075S coupling for 3/4" trade size. Set screw held connectors and fittings of any type are not permitted.
 5. Conduit Bodies for EMT: Cast aluminum, galvanized iron or malleable iron bodies.
 6. Insulated Bushings: Appleton "BBU".
 7. Grounding Bushings: O-Z/Gedney "BLG".
 8. Fittings for Liquidtight Flexible Metallic Conduit: Galvanized steel or malleable iron, couplings and fittings threaded.
 9. Conduit Clamps: Galvanized malleable iron equivalent to O-Z/Gedney 14-G and 15-G Series with clamp back spacer for RSC, and single hole #15-75G malleable or #15-75S galvanized steel clips for EMT.

- C. Tray Cable Fittings:
 - 1. Strain Relief Connectors: OZ Gedney Type SR Grip Tight, use on all multiconductor tray cable at box and equipment entrances.
 - 2. Conduit Sealing Bushings: OZ Gedney Type CSB installed in conduit, or in Type GL cabinet adapter.

2.06 SURFACE METAL RACEWAY

- A. Manufacturers:
 - 1. Walker/Wiremold
- B. Description: One piece surface metal, Wiremold 500 & 700, and suitable for use as surface raceway.
 - 1. As shown on drawing.
 - 2. Finish: Ivory enamel.
- C. Telepower Poles: Two channel steel, ivory enamel finish, nominal 3" square cross-section, suitable for housing power and communications wiring and mounting convenience power and communications outlets. Refer to drawings for additional requirements.

2.07 MULTI-OUTLET ASSEMBLY

- A. Manufacturers:
 - 1. Walker/Wiremold
- B. Description: Sheet metal channel with fitted cover, Wiremold #2000 with prewired receptacles, and wired ground, suitable for use as multi-outlet assembly.
 - 1. Size: 3/4" x 1 9/32". As indicated on drawing.
 - 2. Receptacles: Convenience receptacle mounted in cover, 12" on center or as shown on drawings.
 - 3. Finish: Ivory enamel.

2.08 ELECTRICAL BOXES

- A. Manufacturers:
 - 1. Appleton
 - 2. Crouse Hinds
 - 3. Hoffman
 - 4. Killark
 - 5. Lee Products
 - 6. Raco
 - 7. Square D
 - 8. Steel City
- B. Boxes:
 - 1. Sheet Metal: NEMA OS 1; galvanized steel, 4" x 4" x 2" with raised plaster ring and non-gangable 3" H x 3 1/2" D x 2" W per section masonry boxes. Gangable or sectionalizing boxes are not permitted.
 - 2. Cast Metal: Aluminum or cast alloy, deep type "FD", gasket cover, threaded hubs, "Bell" boxes not permitted.
- C. Mounting Brackets and Adjustable Ceiling Channels: Galvanized steel of substantial construction to support boxes by bridging between hollow wall studs or ceiling channels, like Caddy #SGB24 screw gun bracket, Caddy #H4 mounting bracket, and B-Line #BA-12 box hanger, or approved equal.
- D. Floor Boxes for Installation in Poured Concrete Floors: Semi-adjustable, formed steel.
- E. Pull Boxes: Code gauge galvanized steel, no prepunched knockouts.
- F. Hinged Cover Enclosures: NEMA 250, Type 1, steel enclosure with manufacturer's standard enamel finish and continuous hinge cover, held closed by flush latch operable by screwdriver.

- G. Large Cast Metal Boxes:
1. Surface-Mounted Type: NEMA 250; Type 4 and Type 6, flat-flanged, surface mounted junction box; cast aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
 2. Underground Type: NEMA 250; Type 4, Outside flanged, recessed cover box for flush mounting; galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.

2.09 SERVICE FITTINGS

- A. Manufacturer:
1. Hubbell
 2. Walker
- B. Gymnasium/Multi-Purpose Room Floor Boxes: Hubbell #B4314 shallow cast iron; provide complete with matching cover and required devices.
- C. Multi-Service Floor Boxes: Hubbell #3FBSS stamped steel for above grade applications, and #3SFBC cast iron on/below grade, recessed metallic multi-service floor box, with outlet mounting service plates , and ABS plastic cover #3SFBCXX, Architect to select color to match carpet.
- D. Large Capacity Floor Boxes: Hubbell #LCFBSS stamped steel for above grade applications, and #LCFBC cast iron on/below grade, recessed metallic multi-service floor box, with outlet mounting service plates, and ABS plastic cover #LCFBCXX, Architect to select color to match carpet.

2.10 WIRE AND CABLE

- A. Manufacturers:
1. Anaconda
 2. Rome Cable
 3. General Cable
 4. Okonite
 5. Phelps Dodge Cable
 6. Triangle PWC
 7. Alcan Cable
- B. Building Wire:
1. Feeders and Branch Circuits Larger Than 6 AWG: Stranded annealed copper conductor, 600 volt insulation, XHHW, or for panelboard feeders, copper equivalent ampacity annealed Stabiloy compact stranded A.A. 8000 series aluminum alloy, XHHW-2, by Alcan, increase conduit size to accommodate. Do not use aluminum conductors to or from motors, transformers or other vibrating equipment.
 2. Feeders and Branch Circuits 6 AWG and Smaller: Annealed copper conductor, 600 volt insulation, THHN/THWN or XHHW, stranded conductor; use compression set terminals.
 3. Control Circuits: Copper, stranded conductor, 600 volt insulation, THHN/THWN.
- C. Metal Clad Cable:
1. Metal Clad Cable, Size 12 through 10 AWG: Interlocked galvanized steel armor, copper conductor, 600 volt insulation, rated 60E C, with separate green ground wire, NEC Type MC.
- D. Remote Control and Signal Cable:
1. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60E C, individual conductors twisted together, shielded, and covered with PVC jacket.
 2. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60E C, individual conductors twisted together, shielded, and covered with PVC jacket; UL listed.
 3. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60E C, individual conductors twisted together, shielded, and covered with nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.11 TAPE AND TERMINATIONS

- A. Manufacturers, Tape:
 - 1. 3M Co., Scotch #33 and #88
- B. Manufacturers, Terminations:
 - 1. Dossert
 - 2. Ideal
 - 3. 3M Co.
 - 4. Thomas and Betts
- C. Wire Connection Devices/Terminations: Compression set or twist-on type with integral molded insulation and internal metallic compression ring or spiral screw-on connecting device. Twist-on type shall be like Ideal "Wing Nut" series.
- D. Wire Terminals, Butt Splices: Crimp set with integral insulated sleeve, electro tin plated, fully annealed copper.

2.12 WIRING DEVICES AND WALL PLATES

- A. Manufacturers:
 - 1. Bryant
 - 2. Hubbell
 - 3. Arrow-Hart
 - 4. Pass and Seymour
 - 5. General Electric
- B. Wall Switch: AC general use, specification grade, quiet operating snap switch rated 20 amperes and 120/277 volts AC, with plastic toggle handle, ivory color, Hubbell Model 1221.
 - 1. Pilot Light Type: Lighted handle, Model 1221-1L manufactured by Hubbell, or strap mounted lamp in adjacent gang, Model 48071-R manufactured by Bryant.
- C. Receptacle:
 - 1. Provide straight blade receptacles to NEMA WD 1.
 - 2. Provide locking blade receptacles to NEMA WD 5.
 - 3. Convenience Receptacle Configuration, general use: Type 5-20 R, specification grade, plastic face, ivory color, Bryant Model 5352.
 - 4. GFCI Receptacle, general use: Specification grade duplex convenience receptacle with integral ground fault current interrupter, ivory color, Bryant Model GFR53FT.
 - 5. Isolated Ground Receptacle: Specification grade back and side wired, orange face, Bryant Model 5262-IG.
 - 6. Specific Purpose Receptacle: Configuration indicated on drawings with ivory nylon face.
- D. Decorative Cover Plate: Ivory smooth rigid nylon or high impact plastic.
- E. Weatherproof Covers: Die cast, gasketed, spring held, double cover for duplex receptacle.

2.13 CORDS AND CAPS

- A. Straight-blade Attachment Plug: NEMA WD 1.
- B. Locking-blade Attachment Plug: NEMA WD 5.
- C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: Oil resistant thermoset insulated Type SJOW multiconductor flexible cord with identified equipment grounding conductor, suitable for extra hard usage in damp location.
- E. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.01 EXISTING ELECTRICAL WORK

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Disconnect existing electrical systems in walls, floors, and ceilings indicated for removal.
- C. Coordinate utility service outages and reconnections with Utility Company and Owner.
- D. Provide temporary wiring and connections to maintain existing systems in service during construction until replacement circuits and systems are ready for service.
 - 1. Existing electrical service.
 - 2. Existing electrical feeders and branch circuits.
 - 3. Existing fire alarm system.
 - 4. Existing telephone system.
- E. Remove, relocate, and repair existing installations to accommodate new construction.
 - 1. Remove abandoned wiring to source of supply.
 - 2. Remove exposed abandoned conduit and boxes, including abandoned conduit above accessible ceiling finishes.
 - 3. Disconnect abandoned outlets and remove devices.
 - 4. Provide blank cover for abandoned outlets which are not removed.
 - 5. Disconnect and remove abandoned panelboards and distribution equipment.
 - 6. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
 - 7. Disconnect and remove abandoned luminaires, brackets, stems, hangers, and other accessories.
 - 8. Disconnect and remove underfloor wiring, patch and restore floor surfaces.
- F. Repair adjacent construction and finishes damaged during removal of existing electrical work.
- G. Maintain access to existing, active electrical installations.
- H. Existing wiring, the need for which remains, found in good condition, properly located, and conforming to the specified wiring standard, may continue in service.
- I. Clean and repair existing materials and equipment within limits of work which remain or are to be reused.
 - 1. Panelboards: Clean and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Revise circuit directory.
 - 2. Luminaires: Clean exterior and interior surfaces. Replace lamps and broken parts.
 - 3. Do not reuse conduit, wire, and other materials except as specifically noted on the drawings.
- J. Extend existing installations using materials and methods compatible with existing electrical installations, and as specified.

3.02 EXAMINATION AND PREPARATION

- A. Verify that the interior of the building has been physically protected from weather.
- B. Verify that supporting surfaces are ready to receive work.
- C. Electrical boxes are shown on drawings, locations are approximate unless dimensioned.
 - 1. Obtain verification from Engineer of floor box locations, and locations of outlets in office and work areas, prior to rough-in.
 - 2. Elevator System: Determine location of outlets for lights, cab circuits, machines, and equipment installed in elevator pit, shaft, and machine rooms with elevator system installer prior to rough-in.

- D. Make electrical connections to utilization equipment in accordance with equipment manufacturer's instructions.
 - 1. Verify that wiring and outlet rough-in work is complete and that utilization equipment is ready for electrical connection, wiring, and energization.
 - 2. Make wiring connections in control panel or in wiring compartment of prewired equipment. Provide interconnecting wiring where indicated.

3.03 GROUNDING

- A. Install grounding electrodes and conductors at locations indicated. Install additional rod electrodes as required to meet Regulatory Requirements.
- B. Provide ground bonding as indicated and to meet Regulatory Requirements. Include a separate green ground wire in each branch and feeder circuit and bond to grounding system.
- C. Maintain isolation between neutral and ground conductors in accordance with NEC.
- D. Install grounding system so all conductive materials operate at ground potential and there is a low impedance path to ground in the event of a fault.

3.04 SUPPORT SYSTEMS

- A. Install support systems sized and fastened to accommodate weight of equipment and conduit, including wiring, which they carry.
 - 1. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, beam clamps, and spring steel clips as appropriate for the application.
 - 2. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
 - 3. Do not fasten supports to piping, ceiling support wires, ductwork, mechanical equipment, or conduit.
 - 4. Do not use powder actuated anchors.
 - 5. Do not drill structural wood or steel members.
 - 6. Fabricate supports from structural steel or steel channel.
 - 7. Install free standing electrical equipment on concrete pads.
 - 8. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 9. Provide steel channel supports to stand cabinets 1" off wall in wet locations.
 - 10. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

3.05 CONDUIT

- A. Size raceways for conductor type installed or for type THW conductors, whichever is larger.
 - 1. Minimum Size Conduit: 3/4".
 - 2. Maximum Size Conduit in Slabs Above Grade: 1"; for conduits larger than 3/4", route so they do not cross each other.
- B. Install all conduit concealed in walls or above finished ceilings except where specifically indicated to be surface mounted. Arrange conduit to maintain headroom and to present neat appearance. Install conduit in accordance with the following:
 - 1. Route exposed raceway parallel and perpendicular to walls and adjacent piping.
 - 2. Maintain minimum 6" clearance to piping and 12" clearance from parallel runs of flues, steam pipes, and heating appliances. Install horizontal raceway runs above water and steam piping.
 - 3. Complete raceway installation before installing conductors.
 - 4. Maintain required fire, acoustic, and vapor barrier rating when penetrating walls, floors, and ceilings. Where indicated on drawings, sleeve penetrations through concrete walls, floors, and ceilings.

5. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof with pitch pocket.
6. Group in parallel runs where practical and install on steel channel support system. Maintain spacing between raceways or derate circuit ampacities to NFPA 70 requirements.
7. Use conduit hangers and clamps; do not fasten with wire or perforated pipe straps.
8. Use conduit bodies to make sharp changes in direction.
9. Terminate conduit stubs and box connections with insulated bushings.
10. Steel conduit joints shall be threaded; clamp on or set screw fittings are not permitted. Thermoweld or cement PVC joints.
11. Use suitable caps to protect installed raceway against entrance of dirt and moisture.
12. Provide No. 12 AWG insulated conductor or suitable pull string in empty raceways, except sleeves and nipples.
13. Install expansion joints where raceway crosses building expansion joints, and where necessary to compensate for thermal expansion.
14. Install plastic conduit and tubing in accordance with manufacturer's instructions.
15. Use flexible or liquidtight conduit, short as possible, maximum 72 inches, for motor and equipment hookup; always include a separate green ground wire.
16. Use liquidtight conduit for flexible connections in damp or wet locations.
17. Install conduit so condensation will drain and not be trapped.
18. Prevent lodgement of dirt, trash, and mortar; swab all raceways prior to installation of wire and cable.

C. Conduit embedded in slab:

1. Install in middle 1/3 of slab with a minimum of 2" of cover.
2. Arrange to minimize crossovers and disperse to prevent weakening of slab. Review installation with Engineer prior to pouring concrete.
3. Secure conduit to reinforcing steel to prevent movement during concrete placement.
4. Change from plastic to RSC before conduit rises above floor where not concealed in a wall or otherwise suitably protected.
5. Branch circuits in RSC or PVC in or below floor/grade may be spliced to EMT (where permitted) in walls.

D. Surface Raceways and multi-outlet assemblies:

1. Always install as inconspicuously as possible following corners where ever possible, mount plumb and level.
2. Securely anchor to mounting surfaces using methods specified in Section 16050.
3. Use fittings and accessories designed for use with raceway system, and install in accordance with manufacturer's instructions.
4. Use suitable insulated bushings and inserts at connections to outlets and corner fittings in metal raceway.

3.06 BOXES

A. General:

1. Install electrical boxes where shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and regulatory requirements.
2. Locate and install electrical boxes to maintain headroom and to present neat mechanical appearance.
3. Align wall mounted outlet boxes for switches, thermostats, and similar devices.
4. Coordinate mounting heights and locations of outlets above counters, benches, and back splashes.
5. Install lighting outlets to locate luminaires as shown on reflected ceiling plan.
6. Use expansion anchors, shields, or toggle bolts to fasten boxes in place. Do not use explosive powder driven anchors, except where specifically permitted by Engineer. Do not use nails or wire for permanent support.
7. Secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness; select raised cover depth to as sure proper fit.
8. Do not install boxes back-to-back in walls; provide 6" separation, minimum; except provide 24" separation, minimum in acoustic rated walls.
9. Use hinged cover enclosure for interior pull and junction boxes larger than 12 inches in any dimension. Install in an accessible location that will allow easy access.

10. Field punch openings in pull boxes using punch/dies of appropriate size. Provide knockout closures for unused openings.
- B. Surface mounted applications:
1. Use cast "FD" outlet boxes for all surface mounted applications to 10 feet above finished floor, and for exterior and wet locations.
 2. Where pull boxes must be installed in finished areas, consult Engineer to select location, style, and finish. The location shall always be as inconspicuous as possible.
- C. Concealed above ceilings:
1. Install 4" x 4" x 2" or larger steel boxes for general wiring.
 2. Octagon boxes, 3 1/2" or 4" by 1 1/2" or larger depth, are permitted for flush mounted lighting fixture outlets, use adjustable steel channel fasteners for support.
 3. Locate and install electrical boxes to allow access. Provide access panels where required for practical access, and as required by the NEC.
- D. Concealed in Masonry Walls:
1. Install 4" x 4" x 2" steel box; select raised plaster ring and set box so that outer edge is not less than 1/8" below finished wall surface.
 2. For applications more than 3 gang wide, 3 3/4" h x 3 1/2" d x 2"/gang wide non-gangable masonry boxes are permitted.
 3. Locate boxes to require cutting corner only. Coordinate masonry cutting to achieve neat openings for boxes, mortaring and plastering shall completely seal the box walls to the wall surface and solidly secure the box in place. Coordinate with masonry and plastering sections to accomplish this requirement.
- E. Concealed in GWB or plaster walls:
1. Install 4" x 4" x 2" steel box; select raised plaster ring and set box so that outer edge is not less than 1/8" below finished wall surface.
 2. Use stamped steel mounting bracket for flush outlet/device boxes in hollow stud wall.
 3. Align wall mounted outlet boxes for switches, thermostats, and similar devices.
 4. Coordinate mounting heights and locations of outlets above counters, benches, and back splashes.
- F. Floor boxes and service fittings:
1. Set boxes level and flush with finish flooring material, in accordance with manufacturer's instructions.
 2. Install service fittings in accordance with manufacturer's instructions.
 3. Drill floor opening and install poke through fittings in accordance with manufacturer's instructions.

3.07 INSTALLATION OF WIRES AND CABLES

- A. Verify that interior of building has been physically protected from weather, that mechanical work which is likely to injure conductors has been completed and completely and thoroughly swab raceway system before installing conductors.
- B. Use wire not smaller than 12 AWG for power and lighting circuits, and not smaller than 14 AWG for control wiring.
1. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet; and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
- C. Neatly train and secure wiring inside boxes, equipment, and panelboards.
- D. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.

- E. Where allowed by Wiring Standard, Section 16010, or in another Division 16 Section, install according to the wiring standard, or as directed in applicable section. Protect and support exposed cables (where allowed) above accessible ceilings to keep them from resting on ceiling tiles. Use channel, or running boards as necessary to provide support. Do not support wiring on ceiling support wires, unless ceiling installer has provided certification that ceiling support system is rated to carry the additional load of the cables. Install cables to run parallel and perpendicular to building lines; do not run diagonally, leave ample slack cable at turns.
- F. Make splices, taps, and terminations to carry full ampacity of conductors without perceptible temperature rise.
- G. Terminate spare conductors with electrical tape.
- H. Terminate aluminum wire in accordance with manufacturer's instructions.
 - 1. Use tin plated, aluminum body with copper pigtail compression connectors like Mac-Adapts. Fill with anti-oxidant compound prior to installation of conductor.
- I. Color code all service, feeder, branch, control, and signalling circuit conductors. Color shall be green for grounding conductors and white for neutrals, except where neutrals of more than one system are installed in same raceway or box, the other neutral shall be white with a colored (not green) stripe. Color code ungrounded conductors operating at 120 volts to ground black, red, and blue for Phases A, B, and C and at 277 volts, brown, orange, and yellow respectively.
- J. Terminate all wire joints #10 AWG or smaller with crimp set or twist-on wire terminating device. Use crimp set or bolted "Burndy" or suitable alternate bolted or crimp set device for conductors larger than #10 AWG.
- K. Cover all joints made with non-insulated connecting devices with electrical tape; use Type #88 at any time or #33 whenever the temperature of the joint or the room is above 60°F. Triple wrap joints, each wrap having a 50% overlay.

3.08 CORDS AND CAPS

- A. Install prefinished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain relief clamps.
- B. Provide suitable strain relief clamps for cord connections to outlet boxes and equipment connection boxes.
- C. Make wiring connections in control panel or in wiring compartment of prewired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
- D. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

3.09 DEVICES

- A. Install wiring devices in accordance with manufacturer's instructions.
 - 1. Install wall switches 48" above floor, OFF position down.
 - 2. Install wall dimmers 48" above floor. Derate ganged dimmers as instructed by manufacturer. Do not use common neutral.
 - 3. Install convenience receptacles 18" above floor, 6" above counters and backsplash or as indicated, with grounding pole on top.
 - 4. Install specific purpose receptacles at heights shown on Drawings.
 - 5. Install cord and attachment plug caps on equipment. Size cord for connected load and rating of branch circuit overcurrent protection.

- B. Install wall plates flush and level.
 - 1. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using oversized plates for outlets installed in masonry walls.
 - 2. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.10 IDENTIFICATION

- A. Identify electrical distribution and control equipment, and loads served, to meet regulatory requirements and as scheduled.
 - 1. Degrease and clean surfaces to receive nameplates and tape labels.
 - 2. Secure nameplates to equipment fronts using screws, rivets, or adhesive, with edges parallel to equipment lines. Secure nameplate to inside face of recessed panelboard doors in finished locations.
 - 3. Use embossed tape nameplates with 3/16" lettering to identify individual switches and circuit breakers, wall switches, receptacle circuits, and loads served.
 - 4. Use lamicoid nameplates with minimum 1/4" lettering to identify distribution and control equipment.
 - 5. Nameplate information shall suitably identify the device or circuit. Any nameplate that is not suitably descriptive in the opinion of the Engineer shall be replaced as directed.
- B. Install wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connections.
 - 1. Use branch circuit or feeder number to identify power and lighting circuits.
 - 2. Use control wire number as indicated on schematic and interconnection diagrams and equipment manufacturer's shop drawings to identify control wiring.

3.11 UNDERGROUND ELECTRICAL

- A. Install ducts in trenches furnished under Div 2, minimum 30" below grade or as indicated and slope 3" minimum per 100 feet away from buildings toward drainage points. Run ducts in straight lines except where change in direction is necessary. Protect ducts and bedding material from damage and displacement until backfilling has been completed.
- B. Prior to installing conductors, clean ducts with bristle brush. Pull a test mandrel having a diameter 1/4" less than pipe diameter through duct to verify pipe is clear. Follow with a swab to clean out any remaining dirt or foreign matter.
- C. Install yellow plastic warning tape above ducts approximately 12" below finish grade.
- D. Cables shall be one piece unspliced between connections, except where distance exceeds available cable length, it may be spliced at accessible locations.
- E. Install transformer pad as indicated and set level within 1/4" in 10'-0".
- F. Coat metal conduit installed underground with two coats of Bitumastic allowing 24 hours drying time between coats. After installation is complete, coat joints and touch up nicks and scratches.

3.12 FIELD QUALITY CONTROL

- A. Perform field inspection and testing of wiring as follows:
 - 1. Inspect wire and cables for physical damage and proper connection.
 - 2. Torque test conductor connections and terminations to manufacturer's recommended values.
 - 3. Perform continuity and insulation resistance (megger) test on all power and equipment feeder and branch circuit conductors. Submit test report tabulating the test performed and the results.
 - 4. Verify proper phasing connections; check rotation of all motors.

END OF SECTION