

**FRESNO UNIFIED SCHOOL DISTRICT**

**Duncan Polytechnical High School**

**A. SCOPE OF WORK**

1. In support of the Duncan Polytechnical High School Welding CTE program, the project involves the addition of (27) outlets for (9) new welding stations and (8) other three-phase welding outlets at various locations in the welding shop. Two new panels will be installed and some existing panels modified. Additionally, one cord reel will be relocated some 10 feet from its current location.
2. The contractor shall provide all labor and materials to accomplish the work shown on the plans and described in the specifications.

**B. RELATED SECTIONS**

1. SECTION 260500 COMMON WORK RESULTS FOR ELECTRICAL

**C. QUALITY ASSURANCE**

1. Contractor Qualifications:
  - a. The CONTRACTOR must have a current California C10 contractor's license at time of bid.
2. Warranty:
  - a. The CONTRACTOR/MANUFACTURER must supply a one-year (12 month) guarantee against faulty workmanship and materials.

**D. PRODUCT**

1. For Product Substitutions please refer to; Fresno Unified School District's General Conditions 01 25 13.01 Product Substitution Procedures.
2. Panel Boards
  - a. Panel boards shall be bolt-on type, UL listed.
  - b. Bussing shall be copper.
  - c. Voltage is 120/208V 3-phase 4-wire.
3. Feeder Conductor
  - a. Conductors shall be copper.
  - b. Insulation shall be THWN-THHN or XHHW.

**E. CONTRACTOR RESPONSIBILITIES**

1. Contractor is responsible for removal and disposal of existing removed panels & unused electrical items unless claimed by district during construction. Costs associated with repairs to infrastructure shall be the responsibility of contractor.
2. Responsible for testing & final connections.
3. Supply and install all required electrical equipment & per CEC requirements.
4. Responsible for energizing all replaced electrical.

**F. DISTRICT RESPONSIBILITIES**

1. To provide coordination of required power shut down time & coordinating availability of site accessibility.
2. District is responsible for providing underground utility locating.

## COMMON WORK RESULTS FOR ELECTRICAL

### SECTION 26 05 00

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION:

- A. This Section provides the Electrical Requirements, which supplement the General Requirements of Division 1 and apply to all Sections in Division 26.

##### 1.02 BASIC ELECTRICAL REQUIREMENTS:

###### A. Drawings and Specifications coordination:

1. For purposes of clearness and legibility, the electrical drawings are essentially diagrammatic. The size and location of equipment is shown to scale whenever possible. The Contractor shall verify all conditions, data and information as indicated on the drawings and in Specifications Sections where electrical work is required prior to installation.
2. The Electrical Drawings show size and points of termination of the conduits, the number and size of wires, and suggest the proper route for the conduit. It shall be the responsibility of the Contractor to install the conduits with minimum number of bends to conform to the structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and meet all applicable Code requirements. The routing of conduits may be changed, if approved by the District Electrical Inspector.

If the length of a conduit run is increased more than 10% of the length shown on the drawings, the Contractor shall consider worst case voltage drop and adjust wire and conduit size accordingly in compliance with Code. If the length of a conduit run is decreased more than 10% of the length shown on the drawings, the Contractor shall offer a credit to the District for the length and size of the conduit and wire deleted.

3. It is intended that outlets be located symmetrical with Architectural elements notwithstanding the fact that locations shown on the drawings may be distorted for clarity.
4. The Architectural and Structural Drawings take precedence over the electrical drawings in the representation of the general construction work. The drawings of the various trades take precedence in the representation of the work of those trades. The Contractor shall refer to all drawings to coordinate the electrical work with the work of other trades to eliminate all conflicts.

###### B. Terminology:

1. The term "low voltage" shall apply to systems operating at 600 volts and under.

2. The terms “provide”, “furnish”, “install”, or similar terms used on the drawings and elsewhere in the Specifications shall be considered to mean furnish and install.
3. The term “U.L.” means Underwriters Laboratories, Inc.

C. Ordinances and Regulations:

1. Electrical work shall meet requirements of local authorities having jurisdiction, including municipal ordinances, City and/or County Building Codes, the California Administrative Code Title 24, the Safety Orders of the State Division of Industrial Safety, and the Fire and Panic Safety Standards of the California State Fire Marshal. Material and labor shall conform to the Regulations of the National Board of Fire Underwriters for Electrical Wiring and Apparatus. All new material shall be U.L listed. The latest Electrical Ordinance of the local jurisdiction, including amendments thereto, effective on the date of opening bids for the work, is hereby made a part of this Specification, and shall apply to all work, except for those portions which conflict with the requirements of the local authorities.
2. Meet the requirements of the 2019 edition of the California Electrical Code adopted by the local jurisdiction.
3. Electrical work shall comply with the American National Standards Institute (ANSI), which includes the National Electrical Installation Standards (NEIS).

D. Structural Considerations for Conduit Routing:

1. Where conduits are to pass through or will interfere with any structural member, or where notching, boring or cutting of the structure is necessary, or where special openings are required through walls, floors, footings, or other building elements to accommodate the electrical work, such work shall conform to State Building Code, Title 24, for conduits and pipes embedded in concrete and for notches and bored holes in wood; for steel and when detailed on the Structural Drawings.
2. Where a concrete encasement for underground conduit abuts a foundation wall or underground structure which the conduits enter, the encasement shall rest on a haunch integral with the wall or structure, or shall extend down to the footing projection, if any, or shall be doweled into the structures unless otherwise indicated. Underground structures shall include manholes, pull boxes, vaults or buildings.

E. Electrically Operated Equipment and Appliances:

1. Equipment and appliances furnished by the Contractor:
  - a. The electrical work shall include furnishing and installing wiring enclosures for and the complete connection of all electrically operated equipment and appliances and any electrical control devices which are specified to be furnished and installed in this or other electrical Sections of the Specifications, except electrical work specified or indicated, to be in the Mechanical Work. All wiring enclosures shall be installed concealed, except where exposed work is indicated on the electrical drawings.

- b. Connections shall be made as necessary to completely install the equipment ready for use. The equipment shall be tested for proper operation and, if motorized, for proper rotation. If outlets of incorrect electrical characteristics or if any equipment fails to operate properly, the Contractor shall report to the District's Inspector in writing, listing the buildings and rooms in which located, the name, make and serial number of the equipment, and a description of the defect.
2. Equipment and appliances furnished by others:
    - a. Equipment and appliances shown on the drawings as Not in Contract, Furnished by Others, or Furnished by the District, will be delivered to the Site. Required electrical connections shall be made for all such equipment and appliances in accordance with accepted trade practices under the direction of the District Inspector. All motorized equipment will be furnished factory wired to a motor starter or junction box, unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.
    - b. Connections to equipment furnished under other Sections shall be part of the electrical Work. Work shall include internal wiring, installation, connection and adjustment of bolted drive motors in which the motor is supplied as a separate unit and connections only for equipment furnished with factory installed internal wiring, except as further limited by the drawings and other portions of the Specifications. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push-button stations, selector switches, conduit, junction boxes, and the wiring necessary for a complete electrical installation. The work shall also include furnishing and installing the conduit and outlet box, if needed for the control system, furnished under Mechanical. Devices and equipment furnished shall be of the same type used elsewhere on the job or as specified.
    - c. Electrical equipment furnished under other Sections for installation and connection under work of this Section shall be delivered to the installation location by the Contractor furnishing the equipment.
    - d. Mechanical equipment furnished under other Sections and requiring electrical connection under this Section, will be set in place by Contractor furnishing the equipment.
    - e. Suitability and condition of equipment furnished by other Sections shall be determined in advance of installation. Immediate notice shall be given to the District of damage, unsuitability or lack of parts.

F. Protection of materials:

1. Provide for the safety and good condition of all materials and equipment until final acceptance of the project by the District. Protect all materials and equipment from

damage and provide adequate and proper storage facilities during the progress of the work. All damaged and defective work shall be replaced prior to final inspection.

G. Cleaning:

1. Exposed parts of the electrical work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be un-blemished and metal surfaces shall be polished.
2. Thoroughly clean all parts of the apparatus and equipment. Exposed parts, which are to be painted, shall be thoroughly cleaned of cement, plaster and other materials. Remove grease and oil spots with solvent. Such surfaces shall be wiped and all corners and cracks scraped out. Exposed rough metal work shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.
3. The Contractor shall remove from the Site all debris and rubbish occasioned by the electrical work. He shall thoroughly clean the building of dirt, debris, rubbish, and marks caused by the performance of the work.

## PART 2 – PRODUCTS

### 2.01 RACEWAYS, FITTINGS, AND SUPPORTS:

A. Conduit Materials:

1. Metallic conduit and tubing shall be manufactured under the supervision of Underwriters' Laboratory, Factory Inspection and Label Service Program. Each 10' length of conduit and tubing shall bear the Underwriters' Laboratory label and manufacturer's name.
2. Rigid steel conduit shall be heavy wall, mild steel, zinc coated, with an inside and outside protective coating. Couplings, elbows, bends and other fittings shall be the same materials and finish as the rigid steel conduit. Fittings, connectors, and couplings shall be threaded type.
3. Electrical metallic tubing shall be steel tubing, zinc coated with a protective enamel coating inside. Fittings, couplings and connectors shall be gland compression type. Electrical metallic tubing is designated herein after as "EMT".
4. Flexible steel conduit shall be of flexible interlocking steel strip construction with continuous zinc coating on the strips. Connectors and couplings shall be approved fittings of the type which thread into the convolutions of the flexible conduit or clamp type.
5. Liquid-tight flexible metal conduit shall be galvanized, heavy wall, flexible locked steel strip construction with a smooth moisture and oil proof, abrasion-resistant, extruded plastic jacket. Connectors shall be approved for use with liquid-tight flexible conduit and shall be installed to provide a liquid-tight connection.
6. Acceptable Manufacturers: Crouse Hinds or Appleton.
7. No metal clad (MC) cable allowed as alternate.

B. Sleeves for Conduits:

Sleeves shall be adjustable type, of 26 gauge galvanized iron, Adjusto Crete

Company, Adjusto-Crete, or Jet Line Products Inc., Jet-Line.

C. Expansion Joints:

Where conduits embedded in masonry or concrete cross seismic separations between buildings, expansion joints or at locations indicated, the Contractor shall provide sliding or a sliding and deflecting fitting, as conditions require in each conduit. Sliding fittings shall be O-Z Electrical Manufacturer Company, Inc., Type AX, with bonding strap and clamps. At exterior locations use O-Z Electrical Manufacturer Company Inc., Type EX.

D. Penetration in Fire Rated Structures:

Provide Dow Corning No. 3-6548, RTV silicone foam for making fire rated seals around penetrations through floors or walls.

2.02 WIRES, CABLES AND CONNECTOR:

A. Pull Wires: A 1/8" polypropylene cord shall be installed in each empty conduit. A 1/8" polypropylene cord shall be installed in each underground service conduit unless otherwise required by the utility company.

B. 600 Volts or Less Wires:

1. Wire shall be NEC type THHN/THWN in sizes No. 10 and smaller and NEC type THWN-2 in sizes No. 8 and larger, unless otherwise indicated. All wire shall have copper conductors. Wires No. 14 and larger shall be stranded. Wires smaller than 12 gauge shall not be used in the lighting and power systems.

C. Color Code, Signal and Communications Systems:

All wires for signal and communication systems shall be color coded per District standards and shall be installed under the direction of the District's Electrical Inspector. Request a copy of the District Standards for color coding prior to ordering wiring—black, red, blue, white – 208-240; brown, orange, yellow – 480/277.

2.03 BOXES, ENCLOSURES, KEYS AND LOCKS:

A. Outlet Boxes and Fittings:

1. Outlet boxes used in concealed work shall be galvanized or sherardized steel, pressed or welded type, with knockouts.
2. In exposed work, outlet boxes and conduit fittings required and where conduit runs change direction or size, shall be cast metal with threaded cast hubs cast integral with the box or fitting. Boxes and fittings shall not have unused spare hubs, except as otherwise indicated or approved manufacturer.
3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium plated or zinc galvanized. The castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal and shall be free of cracks, gas holes, flaws, excessive shrinkage and burnt out sand.
4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for the fitting with which used.
5. For all receptacle, clock, bell, fire station, speaker, security and telephone outlets, use 4" square boxes or larger with single gang plaster rings. For television outlets, use 4-gang deep boxes and 4-gang plaster rings. For communication switch, use 4" square boxes with single gang or larger plaster rings.

6. Plaster rings shall be provided on all flush mounted outlet boxes, except where otherwise indicated or specified. All plaster rings shall be same depth as the finished surface.
7. Factory made knock-out seals shall be installed to seal all box knock-outs, which are not intact.
8. At each location where flexible conduit is extended from a flush outlet box, provide and install a weatherproof universal box extension adapter by Bell Electric Company.
9. No more than one box extension or cuffs used anywhere.

**B. Junction and Pull Boxes:**

1. Junction and pull boxes, in addition to those indicated, shall only be used where absolutely necessary with the specific approval of the District's Electrical Inspector in each case.
2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded and shall be rigid under torsional and deflecting forces. Boxes shall have auxiliary angle iron framing where necessary to ensure rigidity. Covers shall be fastened to the box with a sufficient number of brass or stainless steel machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws at the site if the boxes are not installed plumb. All surfaces of pull and junction boxes and covers shall be given one coat of metal primer, and one coat of aluminum paint, and shall have permanent labels with box designation or system or circuit numbers.
3. Weatherproof pull and junction boxes shall conform to the foregoing for interior boxes with the following modifications: The cover of flush mounting boxes shall have a weather-tight gasket cemented to and trimmed even with the cover all around. Surface or semi-flush mounting pull and junction boxes shall be Underwriters' Laboratory approved as rain-tight and shall be complete with threaded conduit hubs. All exposed portions of boxes shall be galvanized and finished with a prime coat and standard coat of baked-on enamel. For underground pull-boxes, the cast iron cover shall be permanently marked Electrical, Power, Signal, Telephone or Ground.
4. All junction and pull-boxes shall be rigidly fastened to the structure and shall not depend on the conduits for support.

**2.04 RECEPTACLES:**

- A. Receptacle shall be industrial Specifications grade, back and side wired with binding screws and plaster ears with captive mounting screws. Receptacle bodies shall be phenolic, plastic or bakelite with ivory colored faces, unless otherwise indicated. Receptacles shall have heavy duty, current carrying contacts and double wipe flat ground contacts. Receptacles shall be Hubbell, Arrow-Hart, Bryant or Leviton.
1. Duplex receptacles shall be 20 amps (NEMA 5-20R), 125 volts, two-pole, three-wire with parallel slots, U-ground.
  2. Single receptacles shall be of the voltage, rating and configuration shown on the drawings.
  3. Ground fault interrupting type receptacles shall consist of a duplex receptacle with a test and a reset device manufactured in a standard configuration for use with a duplex cover plate. Receptacles shall be 20 amps (NEMA 5-20R) or as indicated on the drawings. Exterior receptacles shall be weatherproof.

4. Weatherproof receptacles, except where otherwise indicated or specified, shall consist of a duplex receptacle, as specified herein, and a metal plate with die cast hinged lid and weatherproof mat.

## 2.05 IDENTIFICATION AND SIGNS:

### A. Name Plates:

1. The following equipment shall be provided with name plates unless otherwise specified: Switchboards, motor control centers, control panels, push button stations, time switches, contractors, motor starters, motor switches, relays, panel boards and terminal cabinets.
2. Name plates shall give equipment designation and adequately describe the function, voltage and phase of the particular equipment involved. For panel boards, the nameplates shall indicate the panel designation, voltage and phase of the panel. For terminal cabinets, the nameplates shall indicate the system housed therein.
3. Nameplates shall be black and white nameplate stock of bakelite with characters cut through the black exposing the white. Plates shall have beveled edges and shall be securely fastened in place with No. 4 Phillips head, cadmium plated steel, self tapping screws. Characters shall be 3/16" high, unless otherwise indicated.

### B. Markings:

The following equipment and controls shall have markings: Pull and junction boxes, and other devices controlling motors and appliances. Abbreviations acceptable to the District's Electrical Inspector, along with an identifying number, shall be used. Markings shall be done with locking type stencils using paint of a contrasting color. Figures shall be 3/8" high unless otherwise indicated.

### C. Warning Signs:

1. Provide a warning sign firmly secured to the outside of each door or gate to enclosures containing high voltage equipment over 600 volts A.C. The signs shall read: "Danger High Voltage Keep Out ". Signs shall be 7" x 14" with all lettering 1" high, except the word "Danger", which shall have 1 1/2" high letters.
2. Signs shall be of standard manufacturer 18 gauge steel, with porcelain enamel finish. Letters shall be red on white background.

## PART 3 – EXECUTION

### 3.01 CONDUIT INSTALLATION:

#### A. General Requirements:

1. Provide complete and continuous systems of rigid steel conduit, outlet boxes, junction boxes, fittings and cabinets for all systems of electrical wiring including lighting, power, communications, control and signal systems, except as otherwise specified.
  - a. Interior electrical distribution conduit sizes shall be:
    1. Electrical power and lighting, and control systems distribution – 3/4" minimum.
    2. Signal and communications distribution - 1" minimum.

- b. Site electrical distribution conduit sizes shall be:
  1. Electrical power and lighting, and control systems distribution - 1" minimum.
  2. Signal and communications distribution - 2" minimum and separate conduit for each system.
- c. Site underground pullboxes minimum – Christy N30.
2. Within buildings EMT may be used in lieu of rigid steel conduit where permitted by ordinance. EMT shall not be used in the following cases: exposed below 8 feet elevations; in concrete; underground.
3. Within buildings flexible steel conduit may be used in lieu of rigid steel conduit where permitted by ordinance, but no metal clad (MC) cable. Flexible steel conduit shall not be used for runs longer than 6 feet or for exposed conduits.
4. Flexible steel conduit shall be used, except where otherwise specified, for final connection of all motor terminal boxes and shall be of sufficient length (not to exceed 36") to allow full travel or adjustment of the motor on its base.
5. Underground feeder distribution conduits for all systems may be nonmetallic polyvinyl chloride (PVC) Schedule 40 conduit in lieu of rigid steel conduit, except where otherwise specified or indicated.
6. Conduit shall be concealed, unless otherwise indicated. Conduits exposed to view (except those in attic spaces and under buildings) shall be installed parallel or at right angles to structural members, walls, or lines of the building. Conduits shall be routed to clear access openings.
7. Bends or offsets will not be permitted, unless absolutely necessary. The radius of each conduit bend or offset shall be as required by ordinance, except for underground conduits, for public telephone conduits, and where otherwise indicated or specified. Bends and offsets shall be made with standard tools and equipment made especially for the purpose or may be factory made bends or elbows complying with the requirements for radius of bend specified herein. Public telephone conduit bends and offsets shall have a radius, which is not less than ten times the trade size of the conduit, unless otherwise approved by the telephone company. Refer to "Underground Conduit Installation" for the radius of bends and offsets required for underground installations.
8. Running threads will not be permitted. Provide approved conduit unions where union joints are necessary. Conduits shall be kept at least 6" from the coverings on hot water and steam pipes and 18" from flues and breechings. The open ends of conduits shall be kept closed with approved conduit seals during construction of the buildings and during the installation of underground systems.
9. The joints in conduits installed in concrete, wet locations, exposed to the weather or underground shall be made liquid tight.
10. Conduits run exposed on roofs shall be rigid conduit (no EMT).
11. Where auxiliary supports, saddles and brackets are required to meet special conditions, they shall be made rigid and secure before the conduit is attached thereto.
12. Conduit in ceiling spaces, in stud walls and under floors, shall be supported with factory made pipe straps or shall be suspended with pipe hangers or pipe racks. The pipe straps shall be attached to and shall hold the conduit tight at the point of support against the ceiling, floor joists, rafters, wall studs or 2" x 4" headers fitted between the joists or wall studs.
13. Conduits installed on exposed steel trusses and rafters shall be fastened with factory made conduit straps or clamps, which shall hold the conduit tight against the supporting member at the point of support.

14. Conduits under buildings shall be buried below the surface of the ground.
15. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, and shall securely hold the conduit, or shall be springable wrought steel. Rings shall be bolted to or interlocked with the suspension rod socket. Rods shall be 3/8" for 2" conduit hangers and smaller and shall be 1/2" for 2 1/2" conduit hangers and larger.
16. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapezed type and shall consist of a cross channel, Steel City Kindorf No. B-900 or Unistrut No. P-1000 suspended with a 3/8" minimum diameter steel rod at each end. Each rod shall be fastened with nuts, top and bottom to the cross channel and with a square washer on top of the channel. Each conduit shall be clamped to the top of the cross channel with conduit clamps, Steel City Kindorf No. C-105 or Unistrut Nos. P-1111 through P-1124. Conduits shall not be stacked one on top of the other, but a maximum of two tiers may be on the same rack by providing an additional cross channel. Where a pipe rack is to be longer than 18" or if the weight it is to support exceeds 500 pounds, submit details of the installation to the Architect for approval.
17. Conduits, which are suspended on rods more than 2' long, shall be rigidly braced per State Seismic Regulations to prevent horizontal motion or swaying.
18. Factory made pipe straps shall be one- or two-hole formed galvanized clamps, heavy duty type, except as otherwise specified.
19. Hangers, straps, rods or pipe supports under concrete shall be attached to inserts set at the time the concrete is poured. Under wood, use bolts, lag bolts or lag screws; under steel joists or trusses, use beam clamps.
20. Conduits shall be supported at intervals required by ordinance, but not to exceed 10'. One inch and smaller conduits installed exposed shall be fastened with 2-hole straps. Perforated strap and plumber's tape shall not be used in the support of conduits.
21. Each conduit stubbed up through a roof or an arcade shall be flashed with a waterproof flashing. The base of the flashing shall extend on the roof not less than 10" from the conduit. Flashing shall extend up the conduit not less than 6" and shall be in contact with the conduit for minimum 1" at the top. Refer to Division 7, Sections 07310, 07510, and 07541.
22. Bushings for all sizes of rigid steel conduits shall be threaded insulating type. Set screw bushings are not acceptable.
23. All flex conduits shall be cut square and not at an angle.
24. It shall be the responsibility of the Contractor to install the conduits with a minimum number of bends in such a manner as to conform to the structure and meet all applicable code requirements.
25. The routing of conduits may be changed if approved by the District Inspector, providing the length of any conduit run is not decreased more than 10% of the length shown on the drawings.
26. Minimum size conduit for all signal and communication systems shall be 3/4".
27. A minimum of two 1" conduits shall be installed (stubbed) into nearest accessible ceiling space from each panelboard, terminal cabinet, distribution panelboard, backboard or switchboard. Cap conduits with appropriate conduit caps.
28. Conduits installed vertically on the outside surface of buildings shall be strapped tight to the building surface with no space behind.

B. Underground Requirements:

1. All conduits installed underground shall be entirely encased in concrete 3" thick on all sides with multiple conduits spaced not less than 1 1/2" apart, unless otherwise specified. Provide approved conduit spacers as required to prevent any deflection of the conduits when concrete is poured and to preserve the position and alignment of the conduits in the concrete. Conduits shall be tied to the spacers. Anchors shall be installed to prevent floating of conduits during pouring of concrete. Red colored concrete shall be used to encase conduits of systems operating above 600 volts.
2. All underground conduits shall be buried to a depth of not less than 24" below finished grade to the top of the concrete envelope, unless otherwise specified.
3. Assemble the sections of conduit with approved fittings and stagger all joints. Cut ends of conduit shall be reamed to remove all rough edges. The joints in all conduits shall be made liquid tight. All bends at risers shall be completely below the surface where possible.
4. Two or more conduit runs in a common trench shall be separated by at least 1 1/2" of concrete. Electric conduit runs installed in a common trench with other utility lines shall be separated from such lines by at least 12" horizontally. Public telephone conduits shall be separated from electric conduits or other utility lines by not less than 3" of concrete, 2' horizontally and 1' vertically.
5. The District's Electrical Inspector shall be called to the site for approval of all underground installations before and during concrete pour. Where considered necessary by the District's Electrical Inspector, a mandrel shall be drawn through each run of conduit in the presence of the Inspector, before and after pouring concrete. The mandrel shall be 6" in length minimum and have a diameter which is within 1/4" of the diameter of the conduit to be tested.
6. Nonmetallic conduit installations shall comply with the following additional requirements: All joints in PVC conduit shall be sealed by means of approved solvent-weld cement supplied by the conduit manufacturer. All nonmetallic conduit bends and deflections shall comply with the requirements of the applicable Electrical Code, except that the minimum radius of any bend or offset for conduits sized from 1/2" to 1 1/2" inclusive shall not be less than 24". All 90° Ell's, 1" and larger, shall be rigid conduit. All 90 degree bends, bends at risers, and the risers shall be rigid steel conduit and shall comply with the requirements specified herein for underground rigid steel conduit installations. The radius of the curve of any bend or offset in non-metallic conduit for the Public Telephone System shall be not less than ten times the trade size of the conduit, unless otherwise specifically approved by the Public Telephone Utility Company.
7. Rigid steel conduit installations shall comply with the following additional requirements: Where sweeps are specified or indicated, the radius shall be not less than 10'. The radius of the curve of the inner edge of any bend or offset shall be not less than is permitted in the Conduit Bend Radii table for rigid steel conduit field bends in the applicable Electrical Code, unmodified by any exemptions, bulletins, or amendments. The radius of the curve of bends or offsets for the Public Telephone System shall be not less than ten times the trade size of the conduit, unless otherwise specifically approved by the Telephone Utility Company. Rigid conduit underground to be double wrapped with 10 mill tape.

C. In Slabs on Grade:

1. Unless specifically approved by the Office of the State Architect, conduits 1 1/4 size and larger shall not be installed in structural concrete slabs. Where conduits are

permitted, and are installed in concrete slabs on grade, the slabs shall be thickened at the bottom where conduits occur to provide 3" of concrete between the conduit and earth. Conduits shall clear all rebar. The required excavation shall be part of the work of this Section.

2. If the concrete slab is 5" or more in thickness with a moisture barrier plastic sheet between the earth and the slab, the 1" and smaller conduits shall be installed in the slab with a minimum of 1" concrete between earth and conduit.
- D. Penetration in Concrete Walls, Beams and Floors: Provide sleeves where conduits pierce concrete walls, beams and floors, except floor slabs on earth. Sleeves shall have 1/2" clearance around conduits. Sleeves shall not extend beyond the exposed surfaces of the concrete and shall be securely fastened to the forms. Where conduits pass through walls below grade, calk with District approved sealant and provide backer materials between the conduit and the sleeve to obtain a water tight joint.

### 3.02 STUBS:

- A. Floor: At each point where floor stubs are indicated in open floor areas for connections to equipment, the conduits shall be terminated with couplings, the tops flush with the finished floor. Stubs shall extend above the couplings the indicated distance, but in no case less than 6" high. Where capped stubs are called for, the couplings shall be closed with cast iron plugs with screw drive slots.
- B. Underground:
  1. Underground conduit stubs shall be terminated at the locations indicated, but minimum 5' beyond building foundations, steps, arcades, concrete walks and paving, unless otherwise noted. Rigid steel conduit stubs and nonmetallic conduit stubs shall be capped by installing a coupling flush in the end wall of the concrete encasement and plugging with an approved plug or terminated stub in a concrete box (Christy). The As-Built Record drawings shall show the location of the ends of underground conduit stubs fully dimensioned with reference to the buildings or permanent landmarks. These dimensions, including depth below finished grade, shall be marked on the "As-Built" Record Drawings in the presence of the District's Inspector before backfilling in the trench.

### 3.03 WIRE INSTALLATION:

- A. Wire shall not be installed until all plastering throughout the building is completed, and all debris and moisture removed from the conduits, boxes, and cabinets.
- B. Wire-pulling compounds used as lubricants in installing conductors in raceways shall only be compounds approved and listed by Underwriters' Laboratory. No oil, grease, graphite, or similar substances may be used. Pulling of No. 1/0 or larger conductors shall be done only with an approved cable pulling machine.
- C. The District's Inspector shall be called to the site and shall supervise the installation of all feeder cables. The District shall be notified not less than two working days in advance of the proposed time of installation.

- D. At all outlets for light, power, communications, control, and signal equipment, pigtail splices with 8" circuit conductor leads shall be provided for connection to fixtures, equipment and devices.
- E. Pressure cable connectors, pre-insulated "Scotchlok" Type "Y", "R", or "B" spring loaded twist-on type, may be used for splicing 8 gauge or smaller conductors, in lieu of soldered connectors for all wiring systems, except the public address, District owned telephone system, or system clocks.
- F. All joints, splices, taps and connections for cables 6 gauge and larger, shall be made with high-pressure cable connectors approved for use with copper conductors.
- G. Wire in switchboards, panels, terminal cabinets, pull boxes and other cabinets (except public address) shall be neatly grouped and tied in bundles with nylon ties at 10" maximum intervals. At switchboards, panels and terminal blocks, wires shall be fanned out to the terminals.
- H. Each neutral conductor larger than 6 gauge which is not color identified throughout its entire length shall be painted white or taped white wherever it appears in a switchboard, cabinet, gutter or box. Neutral conductors 6 gauge and smaller shall be white color identified throughout their entire length.
- I. All systems of wiring shall be so installed that when completed, the systems will be free from short circuits and from grounds, other than required grounds. The Contractor shall provide all instruments for testing and shall demonstrate in the presence of the District's Electrical Inspector that each system of wiring meets the following minimum requirements for insulation resistance:
  - 1. For circuits of No. 12 AWG wiring or smaller: 1,000,000 ohms.
  - 2. For circuits of No. 10 or larger conductors, a resistance shall be based on the following allowable current-carrying capacities of conductors:

25 to 50 amperes inclusive	250,000 ohms
51 to 100 amperes inclusive	100,000 ohms
101 to 200 amperes inclusive	50,000 ohms
201 to 400 amperes inclusive	25,000 ohms
401 to 800 amperes inclusive	12,000 ohms
Over 800 amperes inclusive	5,000 ohms
  - 3. The above values shall be obtained with all switchboards, panel boards, fuse holder, switches, and overcurrent devices in place and connected, and with all switches closed.
  - 4. If lamp holders, receptacles, fixtures and appliances for a system are also connected, the minimum insulation resistance permitted shall be one-half the values specified above.
- J. The Contractor shall provide a "Meager" insulation tester, which will apply a minimum of 500 volts direct current for these tests when requested by the District's Inspector.
- K. 120 volts and 277 volts circuits shall be routed in separate conduits, raceways and enclosures.

- L. Other conductors in raceway or cable: Conductors, other than service conductors, shall not be installed in the same service raceway or service cable.

All low voltage wiring regardless of insulation voltage rating shall be in a separate raceway. It shall not be in the same raceway or pullbox with systems 100 volt or more.

### 3.04 FEEDER IDENTIFICATION:

Lighting, power, and low voltage feeder wires and cables shall be identified at each point of termination and at each point the conduit run is broken by a cabinet, box and gutter. Identification shall be by means of wrap around type markers, E-Z Code or Brady Perma-Code, and shall include the feeder designation, size and description.

### 3.05 TAPE:

Splices, joints and connectors joining conductors shall be covered with insulation equivalent to that on the conductors. Free ends of conductors connected to an energized source shall be taped. The voids in irregular connectors shall be filled with insulating compound before taping. Thermo plastic insulating tape approved by Underwriters' Laboratory for use as the sole insulation of splices shall be used and shall be applied according to the manufacturer's printed specifications. Heat shrink tubing may be used as per manufacturer's specifications.

### 3.06 BOXES INSTALLATION AND SUPPORT:

- A. Outlet boxes shall be flush with finished surface of wall or ceiling. They shall be plumb and securely fastened to the structure independent of the conduit. Except where otherwise indicated, factory made bar hangers shall be used to support outlet boxes.
- B. Outlet boxes installed in ceilings suspended or furred with steel runner and/or furring channels shall be supported (except where otherwise indicated) by a Unistrut No. P-4000 channel spanning the main ceiling runner channels. Each box shall be supported from its channel by a 3/8" 16 threaded steel rod with a Unistrut No. P-4008 nut and a Tomic No. 711-B Adapta-Stud. The rod shall be tightened to a jamb fit with the channel and its nut. The box shall be locked to the rod by means of a 1/2" locknut on the stud and a 3/8" 16 hex nut locking the stud to the rod.
- C. The heights of outlets and equipment indicated on the drawings shall govern, but in the absence of such indications, the following heights shall be maintained. Heights are to centerline from finished floor surface, unless otherwise noted:
  - 1. Communication switch, pushbutton, light switch, other switches, and fire station outlets: 48".
  - 2. Bell and/or horn outlets in corridors: 12" below ceiling.
  - 3. Clock, speaker, and bell outlets in classrooms and offices: 8' 0".
  - 4. Outside bell and yard light outlets: 12" below the top plate level for one-story buildings without covered porch or arcade, and 12" below covered porch and arcade ceilings.
  - 5. Desk public telephone, television, desk interphones, and receptacle outlets 12".
  - 6. Panel boards and terminal cabinets: 6' 6" to top.

- D. Receptacle outlet boxes shall not be located within 6' of water sinks, except where a ground fault interrupter circuit breaker or ground fault type receptacle is provided to protect receptacle outlets located within 6' of water sinks.

### 3.07 PLATES:

- A. Provide an appropriate plate on each outlet. Plates shall be of stainless steel, unless otherwise specified. Public telephone plates shall have single bushed openings. Sectional plates will not be accepted.
- B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless steel plates. Flush lighting outlets to be capped shall be covered with Wire mold No. 5736 steel covers, painted to match the surrounding finish. Surface-mounted outlets indicated to be capped shall be covered with blank stainless steel covers.
- C. Switch and receptacle plates shall be provided with engraved designations under any one of the following:
  - 1. Switches so located that the operator cannot see one of the fixtures or items for equipment controlled with his hand on the switch.
  - 2. Receptacles operating at other than 120 volts.
  - 3. Where so indicated on the drawings.
- D. The designations shall be as indicated on the drawings or as specified and shall be engraved in the plates with 3/16" high block type letters filled with black enamel. Where designations are not indicated or specified they shall be requested from the Engineer. For estimating purposes, they may be assumed 12", not to exceed more than ten letters per gang.

### 3.08 IDENTIFICATION OF CIRCUITS AND EQUIPMENT:

- A. Switchboards, motor control centers, transformers, panel boards, circuit breakers, disconnecting switches, starters, pushbutton control stations and other apparatus used for the operation or control of circuits, appliances or equipment, shall be properly identified by means of descriptive nameplates or tags permanently attached to the apparatus or wiring.
- B. Nameplates shall be engraved laminated bakelite. Shop Drawings with dimensions and format shall be submitted to the District or Architect for approval before installation. Attachment to equipment shall be with self-tapping screws. Self-adhering or adhesive backed nameplates shall not be used.
- C. Tags shall be attached to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Circuit, phase and function shall be indicated. Branch circuits shall be tagged in distribution boards, panel boards, and motor control centers. Tags shall be made of pressure sensitive plastic or embossed self-attached stainless steel or brass ribbon.
- D. Cardholders and cards shall be provided for circuit identification in panel boards. Cardholders shall consist of metal frame retaining a clear plastic cover permanently

- attached to the inside of panel door. List of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit, area and connected load.
- E. Junction and pull boxes shall have covers stenciled with box number when shown on the drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.
  - F. Name as described in part 2A shall be correctly engraved with a legend showing function or areas when required by Codes or shown on the drawings.
  - G. Provide identity tags as to source and destination of all underground feeder cables in underground boxes.
  - H. Underground feeder cables not to exceed 200 feet without a pull box.

**END OF SECTION**