

SECTION 01 33 00

SUBMITTALS

PART 1 -- SUBMITTALS

1.01 GENERAL

- A. A submittal consists of descriptive literature, information, plans, calculations, test data, details and drawings for items proposed for the Work. Sufficient information shall be provided to demonstrate compliance with the Contract Documents. A sample or mock-up of a product or material shall be included with a submittal where required.
- B. A submittal is required for all materials, products, equipment, or systems that that will become part of the Work. Specific submittal requirements are indicated in the respective specification sections. Components or items that comprise a unit or system shall be packaged in a single submittal.
- C. Submittal information and drawings from subcontractors and suppliers shall be coordinated, reviewed and submitted by Contractor.
- D. District and Design Consultant will review submittals for conformance with the Contract Documents, codes and standards. Review does not indicate suitability or acceptability.
- E. A submittal does not relieve, alter, waive or change the requirements of the Contract Documents. Alternates or substitutions shall not be proposed in a submittal.
- F. District does not have a duty to identify inconsistencies, errors, fit-up requirements or to determine compatibility of the proposed items. Coordination and compatibility of individual submittals is the responsibility of Contractor. Contractor shall verify all dimensions, measurements and quantities required for a submittal.
- G. A resubmittal is required whenever a change occurs affecting a prior submittal.

1.02 PROCEDURE

- A. A complete list of submittals shall be furnished within 10 days following the Notice to Proceed. District will review the list and return within 10 days.
- B. Submittals shall be consecutively numbered. Resubmittals shall use the prior number with a sequential letter suffix.
- C. Sufficient information shall be provided to describe what is proposed. The applicable sections of the Contract Documents shall be listed.

- D. Submittals with more than one item shall have sections for the respective items. Items shall be clearly identified.
- E. Submittals shall be complete and shall be timely in submission to avoid delay of the Work. The priority of each submittal shall be indicated. The schedule shall provide time for preparation and review of submittals and resubmittals.
- F. All deviations and exceptions to the Contract Documents shall be conspicuously noted in the submittal and transmittal form.
- G. Two hard copies and one electronic copy shall be included with each submittal. Each copy shall include a transmittal form. Copies shall be high quality, full-size, legible with crisp lettering and lines. Hard copies shall be on plain bond paper. Maximum sheet size is 22 inches by 34 inches. It is recommended that drawings be produced using the most current AutoCAD software by Autodesk, Inc. One Compact Disc shall be provided for CAD generated drawings.
- H. Two submittal copies will be reviewed, rated and returned should mark ups be required to comment on a submittal. An electronic submittal comment sheet will be returned on submittals not requiring mark ups.
- I. All submittals shall be originals or first generation plain bond photo copies. Multiple generation photo copies and FAX transmittals are not acceptable if, in the opinion of the District's Representative, they are of reduced legibility. Minimum size lettering height on all submittals shall be 12 point for typewritten documents, 1/16 inch height for 8-1/2 x 11 inch and 11 x 17 inch documents, and 1/8 inch height for documents larger than 11 x 17. All magnetic media files shall be provided on Compact Disc(s).
- J. Shop drawings shall have drawing numbers, scale, revision date and number, Contractor name, subcontractor name, supplier name, name of detailer or engineer who prepared the document, relation to adjacent structures, materials, drawing cross references, standard references, Contractor's certification stamp, and registered engineer's stamp, if required, shown on them.
- K. Operation and maintenance instructions will not be submitted until approved equipment or material submittals are received.
- L. Submittals shall be transmitted with a transmittal form containing the following information as a minimum:
 - 1. Date.
 - 2. Submittal or resubmittal number.
 - 3. Contract title and number.
 - 4. Contractor's name and address.

5. List of documents being submitted, by preparer, number and version.
6. Contract documents references (including specific specification section and drawing numbers) for each submittal document.
7. Previous submittal number and item number for each submittal document.
8. Notification of deviation(s) from contract documents for each submittal document.
9. Contractor's certification of having reviewed and coordinated the submittal.
10. Description of intended use in this contract.

1.03 REVIEW

- A. Review time will be approximately 10 days. Additional review time will be required for complex submittals. Submittals for "or equal" items will require approximately 30 days for review. Resubmittals will require approximately 10 days for review.
- B. Submittals that are incomplete or do not demonstrate compliance with the Contract Documents will be returned without review.
- C. Review Criteria:
 1. "A" indicates the submittal conforms to the Contract Documents.
 2. "B" indicates the submittal would conform to the Contract Documents after review comments have been incorporated.
 3. "C" indicates that changes or additional information are necessary to comply with the Contract Documents. A resubmittal is required.
 4. "D" indicates that the submittal does not comply with the Contract Documents. A resubmittal is necessary.
 5. "E" indicates that the submittal has not been compared with the Contract Documents.
 6. "F" indicates that the submittal has been received and no action is needed by District.

****END OF SECTION****

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section specifies general requirements for electrical work. Detailed requirements for specific electrical items are specified in other sections but are subject to the general requirements of this section.
2. The electrical drawings and schedules included in the contract documents are based upon field conditions and indicate a constructible approach to installation of electrical systems. New raceways and/or cables shall be installed and identified as shown on the drawings.
3. Cables & Raceways are shown on the plan drawings. Other routes are reserved for future expansions. Raceway routing is shown on the plan drawings except for lighting and receptacle circuits. If the lighting or receptacle raceways are going to be embedded, submit and obtain approval of the embedded raceway and cable schedules prior to starting the work. Not all cable routes required for installation are shown on the drawings. The drawings do not show cables in trenches, or trays, unscheduled cables, or unscheduled raceways.
4. Existing partial single-line diagrams are included for reference. They define work or modifications to existing equipment as noted.

1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
NFPA-70	National Electrical Code (NEC)
CBC	California Building Code
CSC	Canadian Standards Association (CSA)
UL	Underwriters Laboratories Inc. (UL)
ETL	Electrical Testing Laboratories (ETL)

B. DEFINITIONS: (Not Used)

1.03 SUBMITTALS

A. The following information shall be submitted for review:

1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
2. Electrical test results.

B. GENERAL:

1. When required in the individual specification sections attend a pre-submittal meeting prior to preparing the submittals for work described in this division.
2. The shop drawings or data shall be submitted in one complete package for each electrical equipment or group of related equipment. Submittals shall consist of the data hereinafter specified and under individual specification sections.

C. SUBSTITUTIONS:

1. Substitution for specified equipment requires a written application.

2. CATALOG CUTS

- a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc. Catalog cuts shall be marked with bold arrows to identify the items, model numbers, and information that apply.
- b. Catalog cuts shall be assembled in a folder. Each folder shall contain a cover sheet, item index, equipment numbers, and reference to the specification section and paragraph that describes the item being submitted.

D. TEST RESULTS:

1. Provide the test results in accordance with the ACCEPTANCE TESTING OF ELECTRICAL SYSTEMS Section (26 08 10) for motors and electrical systems on the forms specified.

E. PROJECT RECORD DOCUMENTS:

1. Provide project record documents (also known as “as-built drawings”).

1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)

PART 2 -- PRODUCTS

2.01 IDENTIFICATION OF LISTED PRODUCTS

- A. Electrical equipment and materials shall be listed for the intended purposes by one or more of the following organizations: Underwriters Laboratories Inc. (UL), Canadian Standards Association (CSA), and Electrical Testing Laboratories (ETL). Other approved independent testing laboratories may be acceptable upon approval by the District Representative.

2.02 PROJECT/SITE CONDITIONS

- A. Equipment and materials shall be sized and rated for operation at full load in an ambient temperature of 40 degrees C at an elevation ranging from sea level to 1000 feet, or other ambient conditions as specified, without exceeding the manufacturer's stated tolerances and without failure.

2.03 MATERIALS/EQUIPMENT

A. GENERAL:

- 1. Equipment and materials shall be new and free from defects. All material and equipment of the same or a similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.

B. EQUIPMENT FINISH:

- 1. Unless otherwise specified in the particular equipment section, electrical equipment shall be finished using the manufacturer's standard factory finishing procedures.

PART 3 -- EXECUTION

3.01 GENERAL

A. CONSTRUCTION:

- 1. The work under Division 26 shall be performed in accordance with these specifications and National Electrical Code where applicable.
- 2. Electrical plan drawings of existing areas, equipment location and sizes, routing and space on conduit racks, tray routing and locations of existing conduit are in reasonable agreement with actual field conditions. Plan drawings are based upon equipment sizes and configuration of the first specified equipment. Coordinate the location of electrical material and equipment with equipment pad sizes, other process equipment, piping or structures. Coordination shall be based upon the actual approved equipment and the material being provided. Equipment shall be located to accommodate access requirements identified in the manufacturer's installations instructions. Minor adjustments and changes in location of electrical

material or equipment made to suit the installation shall be made at no cost to the District.

B. NAMEPLATES:

1. Nameplates shall be provided for all electrical equipment, including boxes, and shall be made from laminated phenolic plastic. The nominal size of the nameplates shall be 3/4 inch high by 2 inches long. Nameplates shall have black backgrounds with 3/16-inch white letters. If abbreviations are required because of space limitations, abbreviations shall be submitted to the District Representative prior to manufacture. The nameplate shall be engraved with the equipment number and description as shown on the drawings and specification schedules.

C. HOUSEKEEPING:

1. All electrical equipment including panels shall be kept dry, protected from dust, water, condensation and physical damage. Motor control centers, switchgear, and bus ducts shall be wiped free of dust and dirt on the outside, and shall be vacuumed on the inside before acceptance of the work.
2. Before final acceptance, touch up any scratches on equipment with factory supplied touchup paint of matching color.

3.02 INSTALLATION (NOT USED)

3.03 CORROSIVE AREAS AND HAZARDOUS AREAS

A. CORROSIVE AREAS:

1. The following areas are designated as corrosive:
 - a. Chemical Areas

3.04 SEISMIC

- A. Electrical equipment and supports shall be braced in accordance with CBC for Risk Category III, Site Class D, and Seismic Design Category D.

3.05 WET AREAS

All outdoor and indoor areas except architecturally finished, HVAC, switchgear and motor control center rooms shall be defined as wet areas and are subject to wash down by high pressure water.

3.06 STORAGE OF MATERIALS AND EQUIPMENT (NOT USED)

3.07 ELECTRICAL NUMBERING SYSTEMS

A. RACEWAY AND CABLE NUMBERS:

1. All raceways and cables are identified in the ELECTRICAL RACEWAY SCHEDULE shall be tagged, even if not identified as such on the drawings. Conflicts between the drawings and the raceway schedule shall be brought to the attention of the District Representative. Raceways shall be tagged at each segment end point and within 3 feet of each floor, ceiling or wall penetration. Where raceway numbers have not been assigned in the ELECTRICAL RACEWAY SCHEDULE, the Contractor shall assign raceway numbers in accordance with the following system.

3.08 TORQUEING ELECTRICAL CONNECTIONS

- A. All bolts and screws associated with electrical equipment for electrical connections shall be torqued in accordance with the manufacturer's instructions and in compliance with NEC Article 110. A torque wrench shall be used. The torque mechanism shall be the sensing type that automatically limits the torque to a preset value until it clicks. Beam type torque indicating wrenches are not acceptable. Torque wrenches shall be supplied in the following three ranges: a low range of 5-75 foot-pound, a medium range of 30 to 150 foot-pound, and a high range of 50 to 250 foot-pound, Klein 57000/57005/57010, or equal. Torque wrenches shall be available for each crew making connections.

3.09 PROJECT RECORD DOCUMENTS (NOT USED)

3.10 TESTING

A. GENERAL:

1. Equipment acceptance testing shall be performed in accordance with the requirements of the COMMISSIONING Section (01 91 00). Installation acceptance testing shall be performed in accordance with the requirements of the ACCEPTANCE TESTING OF ELECTRICAL SYSTEMS Section (26 08 10).

B. CONDUCTOR & CABLE TEST:

1. Continuity and insulation resistance measurements shall be made on conductors. The test specified herein shall be performed prior to energizing. Conductor to conductor and conductor to ground insulation resistance shall be measured for all circuits 120V and above except lighting and receptacle circuits. Measurements shall be made after wire pulling and prior to connecting equipment. Insulation with a resistance of less than 50 megohms is not acceptable.

C. PRE-OPERATIONAL TESTING:

1. Prior to operational testing, all protective devices shall be adjusted and made operative. Prior to energizing of equipment, perform pre-operational testing of each device and control circuit. Pre-operational testing shall consist of energizing each control circuit and operating each control, alarm or malfunction device and

each interlock in turn to verify that the specified action occurs. Submit pre-operational tests procedures and results in accordance with the COMMISSIONING Section (01 91 00).

2. Verify that all fixtures and devices operate and are correctly polarized, that motors have correct rotation, and that all three-phase receptacles have correct phase sequence and polarity. Verification may be accomplished by momentarily energizing the motor, provided that neither the motor nor the driven equipment will be damaged by reverse operation.

3.11 TRAINING (NOT USED)

****END OF SECTION****

SECTION 26 05 21

ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section specifies conductors and cables rated 600 volts used for power, lighting, receptacle, and control circuits.

1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM B3	Soft or Annealed Copper Wire
ASTM B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 1248	Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 3349	Standard Test Method for Absorption Coefficient of Ethylene Polymer Material Pigmented with Carbon Black
ICEA S-58-679	Standard for Control Cable Conductor Identification
IEEE 802 series	Local and Metropolitan Area Networks
IEEE 1202	Standard for Flame Propagation Testing of Wire and Cable
NEMA WC5	Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC8	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA/ICEA WC 57/S-73-532	Standard for Control Cables

<u>Reference</u>	<u>Title</u>
NEMA/ICEA WC 70/S-95-658	Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
NFPA 70	National Electrical Code (NEC)
NFPA 262	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
UL 44	Rubber-Insulated Wires and Cables
UL 83	Thermoplastic-Insulated Wires and Cables
UL 486A	Wire connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	Splicing Wire Connectors
UL 486D	Insulated Wire Connectors for Use with Underground Conductors
UL510	PVC and Rubber insulating Tape
UL 758	Appliance Wiring Methods
UL 910	Test Method of Fire and Smoke Characteristics of Electrical and Optical Cables Used in Air Handling Spaces

1.03 SUBMITTALS

A. The following information shall be submitted for review.

1. GENERAL:

- a. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
- b. Manufacturers catalog data showing manufacturer's general information on the conductors and cable to be supplied.
- c. Manufacturers catalog data on terminations, taps, splices, tapes, insulation type, insulation voltage, American Wire Gauge (AWG) size, conductor material, pulling compound, and compression tools.
- d. SHOP DRAWINGS: Show splice locations for each proposed splice. Provide written justification describing why the splice is necessary.
- e. TEST REPORTS: Submit test reports for meg-ohm tests.

1.04 STORAGE OF MATERIALS AND EQUIPMENT (NOT USED)

1.05 QUALITY ASSURANCE (NOT USED)

1.06 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Provide the type, size and number of conductors as shown and as specified in the raceway and cable schedule included in the ELECTRICAL RACEWAY SCHEDULE. Unscheduled lighting system and receptacle circuit conductors shall be provided.

2.02 COLOR CODING

A. CONTROL CONDUCTORS:

- 1. SINGLE CONDUCTOR: Single conductor No. 14 AWG minimum control cable shall be violet except neutrals which shall be white.

B. POWER CONDUCTORS:

- 1. Power conductors shall have the following colors for the indicated voltage:

	<u>120/208V</u>	<u>277/480V</u>	<u>5kV to15 kV</u>
Phase A	Black	Brown	Red
Phase B	Red	Orange	White
Phase C	Blue	Yellow	Blue
Ground	Green	Green	
Neutral	White	White/Red Tracer	

- 2. Cables sized No. 4 AWG and larger shall be black with phase colored 3/4-inch vinyl plastic tape.

2.03 LIGHTING AND RECEPTACLE CONDUCTORS

- A. Lighting and receptacle conductors shall be stranded. Minimum size conductor shall be No. 12 AWG.
- B. Conductors shall be provided with the following characteristics:

VOLTAGE: 600 volts.

CONDUCTOR: Bare annealed copper; stranded, annealed copper per ASTM B8.
INSULATION: THHN/THWN, 90 degree C dry, 75 degree C wet, polyvinylchloride (PVC) per UL 83.
JACKET: Nylon
FLAME RESISTANCE: UL 83
MANUFACTURER: Houston Wire & Cable type THHW/THWN: Southwire, Type THHN/THWN, or equal.

2.04 POWER AND CONTROL CONDUCTORS AND CABLE, 600 VOLT

A. SINGLE CONDUCTOR (P&C SC):

1. Single conductor cable shall be stranded and shall be used in conduits for power and control circuits above grade.

a. Conductors shall be provided with the following characteristics:

VOLTAGE: 600 volts.
CONDUCTOR: Coated, Class B, stranded, annealed copper per ASTM B8.
INSULATION: THWN/THHN, 90 degrees C dry, 75 degrees C wet, polyvinylchloride (PVC), per UL 83.
JACKET: Nylon
FLAME RESISTANCE: UL 83
MANUFACTURER: Houston Wire & Cable type THHW/THWN; Southwire type THHN/THWN, or equal.

2. Single conductor cable shall be stranded and shall be used in conduits for power and control circuits below grade.

a. Conductors shall be provided with the following characteristics:

VOLTAGE: 600 volts.
CONDUCTOR: Coated, Class B, stranded, annealed copper per ASTM B8.
INSULATION: XHHW-2, 90 degrees C dry, 90 degrees C wet, cross-linked polyethylene (XLP), per UL 44.
JACKET: Nylon
FLAME RESISTANCE: UL 44
MANUFACTURER: Houston Wire & Cable type XHHW-2; Southwire type XHHW-2, or equal.

2.05 600V CONNECTORS, TAPS AND SPLICES

- A. One- and two-way connectors shall be tool applied compression types for stranded conductors conforming to UL 486A. The compression tool shall be designed to prevent the tool from releasing until the proper compression force is reached. The tool and connectors shall be of the same manufacture. Connectors shall be constructed with tin-plated high conductivity wrought copper. Connectors for wire sizes #8 AWG and larger shall be long barrel. One-way connectors shall be one-hole lugs up to size #3/0 AWG, and two-hole or four-hole lugs for size #4/0 and larger. Furnish T&B #549xxBE, #548xxBE, and #548xx series with hydraulic TBM tools, or equal. Mechanical clamp, dimple, screw-type one and two-way connectors are not acceptable.
- B. Tap connectors shall be split-bolt with spacer type conforming to UL 486A. Hex-head split-bolt and pressure bar shall be constructed of copper alloy. Spacer shall be contoured and constructed of electrolytic copper or bronze alloy. All pieces shall be tin-plated. Furnish T&B Blackburn xxHPS series, or equal.
- C. Connectors for wire sizes #10 AWG and smaller shall be nylon self-insulated locking forks or rings of high conductivity electrolytic copper conforming to UL 486A. Crimping tool shall be of the same manufacture as the connector. Furnish T&B RB22xx & RB14xx series with ERG tools, or equal. Standard spring connectors for #10 AWG and smaller conductors shall be flame-retardant winged nylon shells with a fixed square-wire plated steel spring conforming to UL 486C. Furnish 3M Ranger 512 series, or equal. Waterproof spring connectors shall be the same as the standard type, except filled with silicone sealant. Furnish King Safety Inc. King 3,4,5 sealed pro line series, or equal.
- D. Insulating tapes shall be weather resistant, flame retardant, rated for 80° C and 600 volts conforming to UL 510. Electrical tape shall be 7-mil vinyl plastic black. Phase tape shall be 7-mil vinyl plastic color code as specified herein. Furnish 3M Scotch 33, 35, or equal. Varnished cambric shall be 9-mil cotton tape impregnated with yellow insulating varnish and adhesive backed. Furnish 3M Scotch 2520, or equal. High temperature tape shall be rated for 130° C temperatures, linerless rubber, suitable for 1kV through 69kV. Furnish 3M Scotch 130C, or equal. Heat shrinkable insulators shall be rated 600v and 90° C conforming to UL 486D. Heat shrinkable tape, tubing, boots, and end caps shall be made of thermally stabilized cross-linked polyolefin with internal moisture sealant. Furnish T&B Shrink-konHSxx series, or equal.

PART 3 -- EXECUTION

3.01 GENERAL

- A. Each power, control, signal, data and fiber optic conductor shall be identified at each terminal to which it is connected. The marking system shall comply with the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00).

- B. Wire and cable shall not be pulled into conduits until conduits have been cleaned, and the associated interconnection diagrams have been approved.
- C. Pulling wire and cable into conduit or trays shall be completed without damaging or putting undue stress on the cable insulation. UL listed pulling compounds, American Polywater J or Ideal Yellow77, are acceptable lubricants for pulling wire and cable. Grease is not acceptable. Raceway construction shall be complete and protected from the weather before cable is placed.
- D. Whenever a cable leaves a raceway, a cable support shall be provided such that no cable weight is transferred on the termination point.
- E. When flat bus bar connections are made with unplated bar, the contact areas shall be cleaned to a smooth bright metal. Bolts shall be torqued to the bus manufacturer's recommendations.
- F. Each field connection shall be connected to an individual terminal block, except for signal circuits where no more than two conductors shall be inserted into a terminal.
- G. Spare power and control conductors shall be identified with wire markers as "spare". A minimum of 12 inches of conductor length shall be coiled inside electrical equipment or pull boxes. Spare conductors shall be insulated with half lapped vinyl plastic tape on each end.
- H. Install cables and conductors so that the radius of bends is larger than the manufacturer's recommended minimum bending radius.

3.02 600 VOLT CONDUCTOR AND CABLE

A. ELECTRICAL PANELS:

1. Conductors in panels and electrical equipment, No. 6 AWG and smaller, shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing shall be made up with plastic cable ties. Lacing is not necessary in plastic panel wiring duct.
2. Conductors crossing hinges shall be bundled into groups not exceeding 12. Groups shall be so arranged that they will be protected from chafing and rotate instead of bend when the hinged member is moved.
3. Stranded conductors shall be terminated using connectors and tools described in herein. Where terminals will not accept such terminations, conductors shall be terminated directly on the terminal block.
4. Conductors landing on current transformers shall be terminated with ring lugs.

B. JUNCTION AND PULL BOXES, HANDHOLES AND MANHOLES:

1. Slack shall be provided in junction and pull boxes, handholes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls of the box.
2. Cable racks shall be placed at 2-foot intervals along the walls of large pull boxes, handholes, and manholes. Cables shall be secured to the racks by plastic cable ties arranged in three phase circuits or control groups.
3. Splices shall be installed only in junction boxes, pull boxes, outlets, or cabinets. Splices shall not be permitted in conduit bodies except for connecting solenoid valves where the conduit body is rigidly supported.
4. Indoor lighting fixtures, 120v receptacles, and solenoid pigtails shall be terminated with standard spring connectors. Outdoor lighting fixtures, 120v receptacles, and solenoid pigtails shall be terminated with waterproof spring connectors.
5. Two-way and split-bolt taps in manholes, handholes, and outdoor boxes shall be insulated and waterproofed with heat shrink tubing or heat shrink boots. Two-way and split-bolt taps in indoor boxes shall be insulated with heat shrink tubing, heat shrink boots, or hand wrapped. Hand wrapping shall be varnished cambric first layer, high temperature tape second layer, and vinyl-plastic tape top layer.

C. MOTORS AND TRANSFORMERS:

1. Terminations at transformers and motors with conductors #8 and larger shall be made by bolting together the lugs to the cable compression connectors. Terminations shall be insulated with varnished cambric first layer, high temperature tape second layer, and vinyl-plastic tape top layer. Terminations at motors with conductors #10 and smaller shall be made by installing two-piece motor connectors, slip-on insulators, and tyraps.
2. When necessary to correct 3-phase rotation, it shall be accomplished by leaving the phase tape in place and reversing two terminations at the motor or transformer.

D. MOTOR CONTROL CENTERS:

1. Cables entering MCCs shall be bundled into groups of power and control for each starter or feeder unit with plastic cable ties. Each group shall also be supported within the vertical and horizontal wire troughs with plastic cable ties to the trough sides.

3.03 PHASE INSTALLATION AND IDENTIFICATION

- A. The phase installation on three-phase buses or terminals shall be A,B,C from front to back, top to bottom, or left to right, as viewed from the front of the electrical power distribution equipment.

3.04 UNSCHEDULED CONDUCTORS

- A. The unscheduled conductors shall be sized by the Contractor to limit voltage drop to 3percent and shall be sized in accordance with the NEC. The wire shall not be sized less than No.12 AWG.

3.05 CONDUCTOR CODE COLOR

- A. Control conductors shall have violet colored insulation except neutrals that shall be white and ground conductors that shall be green. Control conductors shall include all wires inside "C" conduits. Control conductors shall include 120v power conductors switched inside control panels and routed to motors, valves, etc. Control conductors shall also include 120v power derived from control power transformers inside MCCs, starters, and control panels.
- B. Power conductors #6 AWG and smaller shall have the specified colored insulation throughout the circuit. Power conductors #4 AWG and larger shall have phase colored tape installed at the feeder termination and all utilization equipment terminations.
- C. Phase tape shall be half lapped approximately 3 inches long near each termination. Phase tape shall not be removed. Devices shall be re-terminated as necessary for correct three-phase rotation.

3.06 TESTING

A. GENERAL:

- 1. Test all conductors and cable unless otherwise specified herein. Test results shall be submitted under the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00) for power, control, signal and data conductors.

B. CONDUCTORS:

- 1. Conductor-to-conductor and conductor-to-ground insulation resistance shall be measured for all circuits, 120 volts and above, except lighting and receptacle circuits. Measurements shall be made after the wire has been pulled and prior to connecting the equipment.

3.07 TRAINING (NOT USED)

****END OF SECTION****

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section specifies the system for grounding electrical equipment, exposed metal surfaces of equipment that could possibly become energized and metal structures. The grounding and bonding system is intended to minimize touch potential and to provide a safe and effective path for dissipation of lightning and fault currents. The grounding system is intended to provide a low resistance path (less than or equal to 2 ohms) to earth ground.

1.02 REFERENCES

- A. REFERENCE STANDARDS: The publication referred to hereinafter forms a part of this specification to the extent referenced. The publication is referred to in the text by the basic designation only. The latest edition of the referenced publication in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed reference, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM	Standard specification for Concentric-Lay Copper Conductors, Hard, Medium-Hard, or Soft
NFPA 70	National Electrical Code (NEC)
NEC 250	National Electrical Code (NEC) Grounding
UL 467	Grounding and Bonding Equipment

B. DEFINITIONS: (Not Used)

1.03 SUBMITTALS

A. The following information shall be submitted for review:

1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations shall be submitted.
2. Manufacturer's catalog and application data for each material shall be submitted in accordance with this specification.

3. Manufacturer's installation instructions shall be submitted.

1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)

PART 2 -- PRODUCTS

2.01 GROUND RODS AND CLAMPS

- A. Ground rods shall be copper-clad steel, 5/8-inch diameter and 10 feet long conforming to UL 467. Electrolytic copper 10-mils thick shall be mechanically bonded to the rigid steel core. Each ground rod shall be supplied with a steel driving stud. Ground rod clamps shall be cast high strength copper alloy with hex head screw. Furnish T&B Blackburn 6260, 60DSNT, JAB34C, JAB58H or equal. Ground rod clamps shall be Burndy YGHC Series or equal.

2.02 EXOTHERMIC CONNECTORS

- A. Exothermic connections shall consist of a molecular weld utilizing the reaction of copper oxide and aluminum powder in a semi-permanent graphite mold. Exothermic connectors shall be as manufactured by Erico Products Cadweld, Thermoweld, or equal.

2.03 COMPRESSION CONNECTORS

- A. Compression connectors shall be the irreversible type and be constructed with tin-plated high conductivity wrought copper conforming to the ELECTRICAL POWER CONDUCTORS AND CABLES Section (26 05 21). Burndy YSCM Series, or equal.

2.04 GROUND PLATES

- A. Ground plates shall be a cast copper alloy with four 1/2-inch-13 threaded holes, 1/2-inch deep, and plastic plugs, Cadweld B164-2Q Series, or equal.

2.05 GROUND WELL

- A. Provide a 13-inch inside diameter, 9-inch nominal throat, concrete ground rod box, minimum 12 inches deep, with a cast iron traffic cover embossed or engraved "GROUND." Ground rod box shall be Oldcastle Christy G08T box with G05CT lid with grade ring and extensions as required, or equal.

PART 3 -- EXECUTION

3.01 GENERAL

- A. The grounding electrode system consists of the bonding together of the ground ring conductors with the ground rods, duct bank grounding conductors, foundation rebar,

metal frame of the building(s), metal underground water pipes and other made electrodes. The ground ring conductors shall be buried a minimum of 30 inches deep.

3.02 INSTALLATION

A. CONNECTIONS:

1. Embedded or buried ground connections shall be made by exothermic weld type connectors. Conductors and molds shall be prepared in accordance with manufacturer's instructions. Exposed connections between grounding conductors shall be made by either exothermic or compression connectors. Compression connections will be made utilizing diamond or hexagon dies and a hand compression tool for wire sizes 2 AWG and smaller and a hydraulic pump and compression head for wire sizes larger than 2 AWG. Tools and dies shall be approved for this purpose; dimple compressions are not acceptable. Compression connections shall be prepared in accordance with the manufacturer's instructions.
2. Accessible connections to structural members shall be made by exothermic or bolted connection. Exposed ground connections to equipment shall be made by bolted connections torqued in accordance with the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00). No solder shall be used in any part of the ground circuits.
3. Where the ground cables cross the top of tunnels and cannot be buried to the required 30 inches, the cable shall be buried as deep as possible.
4. Where the grounding system is required to be connected to the existing grounding system, the connection shall be made accessible. Underground connections shall be enclosed in a concrete junction box. Grounding connections to existing concrete structures shall be made by chipping into the structure and installing a ground plate connection which shall be exothermically connected to the rebar. The plate shall be mounted on the surface of the structure. The surface of the structure shall be repaired to the original condition.
5. District shall inspect exothermic process molds before starting first exothermic connection. Molds shall be replaced at intervals recommended by the manufacturer.

B. EMBEDDED GROUND CABLES:

1. Ground cables embedded in slabs or pads shall be laid underneath the top layer of reinforcing steel. Ground cables shall be securely attached to reinforcing steel with tie wires to prevent displacement from the steel during concrete placement. Ground cables shall be bonded by exothermic welds to the reinforcing steel at 40-foot intervals but in two places at a minimum.
2. Ground cables embedded in duct banks shall be bonded together in manholes and handholes. Duct bank ground cables shall also be bonded to distribution equipment

served by the duct bank. Manhole ground cables shall be connected by exothermic weld.

3. The District shall be notified 24 hours prior to backfilling or encasing in concrete any part of a ground system.

C. EXPOSED GROUNDING CONDUCTORS:

1. Grounding conductors which extend beyond concrete surfaces for connection to equipment shall be extended a sufficient length to reach the final connection point without splicing. The minimum extension shall be 6 feet. Grounding conductors which project from a concrete surface shall be located as close as possible to the equipment grounding pad and shall be protected from mechanical damage by a conduit sleeve. Exposed grounding conductors shall be supported by noncorrosive metallic hardware at 4-foot intervals or less. Grounding conductors for substation transformers and future equipment shall be terminated using a four-hole copper flush mounted grounding plate.

D. ELECTRICAL EQUIPMENT GROUNDING:

1. Ground conductors, except signal conductor shields, entering metallic enclosures shall be bonded together to the enclosure or ground bus. Prior to making ground connections or bonds, the metal surface at the point of connection shall be cleaned to a smooth bright metal.
2. Lightning arresters shall be directly connected to the ground system using copper conductors.
3. Metal device boxes shall be drilled and tapped and fitted with a grounding screw for the terminating of the equipment grounding conductor.
4. Metallic sheaths or shields of shielded power cable shall be terminated by connecting the cable sheath or shield grounding strap (provided with the cable termination or splice kit or connector) to the grounding system.
5. All motors shall be grounded by bonding the grounding conductor within the raceway to the motor frame. Motors 100 HP and larger shall also have a supplemental grounding conductor bonded to the reinforcing steel in the immediate area of the motor.
6. Nonmetallic liquidtight conduit shall be provided with a bonding jumper sized in compliance with NFPA 70.

E. RACEWAY GROUND:

1. Metallic conduits shall be assembled to provide a continuous ground path from the point of supply to the utilization equipment. Metallic conduits shall be bonded to

the ground system using insulated grounding bushings and conductors sized in compliance with NFPA 70.

2. An insulated (green) stranded copper equipment grounding conductor shall be installed in conduits that contain circuits operating above 50 volts. The equipment grounding conductor shall provide a continuous ground path from the point of supply to the utilization equipment. When the size of the equipment grounding conductor is not shown on the drawings or cable schedules, the equipment grounding conductor shall be sized in accordance with Table 250-95 of NFPA 70.
3. Metal parts of nonmetallic boxes and plastic coated boxes shall be bonded to the conduit system.
4. Cable trays shall have No. 2/0 AWG bare copper bonding jumper looped on the outside of each tray. The ground conductor shall be connected to each section or fitting.

F. EQUIPMENT AND ENCLOSURE GROUND:

1. Nonelectrical equipment shall be connected to the grounding system as specified by NEC 250 and as shown on the drawings. Cables shall be sized as specified in the Cable Schedule.
2. Metal fences shall be grounded where they are as shown on the drawings. Use flexible connections at each gate.

G. BUILDING GROUND:

1. Building structural steel shall be connected to the plant grounding mat where shown. Accessible connections to structural members shall be made by bolted connections. Connection shall be exothermic wherever final installation is inaccessible.

3.03 CABLE SIZES

- A. Ground cable shall be annealed bare or insulated copper, concentric stranded as shown on the drawings. If ground cable sizes are not shown on the drawings, the minimum sizes shall be in accordance with NEC Article 250 and as follows:

<u>Item</u>	<u>Ground Cable Size</u>
5 and 15 kV switchgear	4/0 AWG
5 kV motors and controls	4/0 AWG
12 kV transformers	4/0 AWG
5 kV transformers	4/0 AWG
480V switchgear	4/0 AWG
Duct banks (medium voltage)	4/0 AWG
Duct banks (low voltage)	2/0 AWG
Duct banks (signal/communication)	2/0 AWG
480V MCCs	2/0 AWG
Cable tray	2/0 AWG
Lighting panels	2 AWG
Exposed metal (possibly energized)	2 AWG
480V motors(100 HP and larger)	2 AWG

3.04 TESTING

A. GROUNDING SYSTEM TESTS:

1. The grounding system shall be tested in accordance with the ACCEPTANCE TESTING OF ELECTRICAL SYSTEMS Section (26 08 10). The measurements shall be recorded on appropriate forms.

3.05 TRAINING (NOT USED)

****END OF SECTION****

SECTION 26 05 34

RACEWAYS, BOXES, MANHOLES, AND HANDHOLES FOR ELECTRICAL SYSTEMS

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section specifies raceways, fittings and supports, manholes, handholes and boxes for electrical conductors and cables.

1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/NFPA 70	National Electric Code (NEC)
ANSI C80.1	Electric Rigid Steel Conduit-Zinc Coated (ERSC)
ASTM A123	Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products
ASTM 153	Zinc (Hot Dipped) Coating on Iron and Steel Hardware
ASTM A240	Heat-Resisting Chromium and Chromium-Nickel Stainless Plate, Steel and Strip
ASTM A570	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
ASTM A576	Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A193	Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service
ASTM B633	Electrodeposited Coating of Zinc and Iron and Steel
ASTM C857	Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM D2564	Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems
ASTM E814	Methods for Fire Tests of Through-Penetration Fire Stops
NEMA ICS-6	Enclosures for Industrial Controls and Systems
NEMA RN-1	Polyvinyl Chloride (PVC) Externally Coated Galvanized

<u>Reference</u>	<u>Title</u>
	Rigid Steel Conduit
NEMA TC2	Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
NEMA TC3	Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
NEMA VE1	Cable Tray Systems
UL 6	UL Standard for Safety, Rigid Metal Conduit, 10th Edition
UL 50	Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 360	Liquidtight Flexible Steel Conduit
UL 467	Grounding and Bonding Equipment
UL 514A	Metallic Outlet Boxes
UL 514B	Fittings for Conduit and Outlet Boxes
UL 651	Schedule 40 and 80 Rigid PVC Conduit
UL 870	Wireways, Auxiliary Gutters, and Associated Fittings
UL 886	Outlet Boxes and Fittings for Use in Hazardous Locations
UL 1479	Fire Tests of Through-Penetration Fire stops

B. DEFINITIONS: (Not Used)

1.03 SUBMITTALS

A. The following information shall be submitted for review:

1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
2. Shop drawings for all large fabricated pull boxes.
3. Raceway support seismic and safety factor calculations
4. MANUFACTURERS CATALOG DATA:
 - a. Galvanized rigid steel conduit, conduit bodies, seals, and fittings.
 - b. PVC coated rigid steel conduit, fittings, and accessories.
 - c. Liquidtight flexible conduit, explosionproof flexible conduit, and fittings.
 - d. Rigid nonmetallic conduit, elbows, endbells, adapters, and duct bank spacers.

- e. Wireways, wireway fittings, cable trays, and cable tray fittings. Cable tray deflection data.
 - f. Boxes grouped by NEMA classification and size.
 - g. Wiring trough.
 - h. Expansion, wall, and roof fittings.
 - i. Handholes and manholes.
 - j. Individual, embedded and suspended raceway supports.
 - k. Raceway markers, firestops, and duct cable seals.
 - l. Raceway plaque engraving material, adhesive and double sided tape.
5. Handholes and manhole schedule, sizes, construction details, and cable racks.
 6. Manhole penetration details and waterproofing system.
 7. Manhole structural details and calculations stamped by registered Civil engineer.
 8. Manhole and handhole raceway plaque schedule.

1.04 OPERATION AND MAINTENANCE INSTRUCTIONS(NOT USED)

PART 2 -- PRODUCTS

2.01 STEEL CONDUIT, BODIES AND FITTINGS

A. GALVANIZED RIGID STEEL CONDUIT:

1. Galvanized rigid steel conduit and elbows shall comply with ANSI C80.1 and UL 6; minimum size shall be 3/4 inch. Zinc coating shall be applied after fabrication and then coated with a chromate finish. Conduit shall be as manufactured by Allied Tube and Conduit, Type GRC;Western Tube, Type GRS; or equal.

B. CONDUIT OUTLET BODIES:

1. Conduit outlet bodies shall be oversized type and shall conform to ANSI C80.1 and UL 514B. They shall be fabricated from cast iron alloy with zinc electroplate. The finish shall be aluminum acrylic paint. The covers shall be the same materials as the body material with neoprene gasket and stainless steel screws. Manufacturer shall be Cooper Crouse-Hinds, Form 8 Condulets, or equal.

C. FITTINGS:

1. Locknuts shall be extra heavy electro galvanized steel for sizes up to 2 inches. Locknuts larger than 2 inches shall be electro galvanized malleable iron. Bonding and grounding bushings shall be threaded, insulated locking type (set screw) and shall be provided with a feed-through compression lug for securing the ground cables. Unions 3/4 inch to 1 inch shall be steel, zinc plated three piece types. Unions 1 1/4 inch and larger shall be malleable iron; zinc plated three piece types. Furnish Emerson O-Z Gedney type UNF/UNY series, or equal. Threaded hubs for connection of conduit to junction, device or terminal boxes shall be made of zinc electroplated cast ferrous alloy or nickel chrome-plated zinc and shall have insulated liner with a grounding locknut. The hubs shall utilize a neoprene O-ring and shall provide a watertight connection. Manufacturers shall be Emerson O.Z. Gedney, Type CHM-T, or Thomas & Betts 370/106 series, Cooper Crouse-Hinds STG series.

D. HAZARDOUS LOCATION FITTINGS

1. Conduit seals and unions shall conform to UL 886 and the requirements of Class I, Division 1, Group D hazardous atmospheres per NEC Articles 500 series. The seal fittings shall be fabricated from cast ferrous alloy finished with zinc electroplate and aluminum acrylic paint. All vertical fittings shall be provided with stainless steel drain fittings. Seal fittings shall be Cooper Crouse- Hinds EYS series, EYD series, or equal. Unions shall be electrogalvanized ferrous alloy type Emerson Appleton UNF or UNY, Cooper Crouse-Hinds UNF or UNY, or equal.

2.02 PVC COATED RIGID STEEL CONDUIT, FITTINGS AND ACCESSORIES

- A. PVC-coated conduit shall be rigid steel conduit as specified herein to which a 40-mil thick polyvinylchloride coating has been bonded to the exterior and shall conform to NEMA RN-1. A urethane coating of 2-mil thickness minimum shall be applied to the interior of all conduits and fittings plus all threads. Coating shall be free of pinholes. Bond strength shall exceed the tensile strength of the plastic coat. Conduit bodies, junction bodies, elbows and fittings shall be factory made and coated to the same thickness as the conduit. Minimum size shall be 3/4 inch. PVC coating patching material shall be as provided by the manufacturer. Manufacturers shall be Robroy Industries; Plasti-Bond Red; Thomas & Betts; Ocal-Blue; or equal.

2.03 FLEXIBLE CONDUIT

A. LIQUIDTIGHT TYPE:

1. Liquidtight flexible steel conduit shall be formed from spirally wound galvanized steel strip with successive convolutions securely interlocked with integral copper ground wire and jacketed with ultraviolet resistant liquidtight plastic cover. Fittings for liquidtight conduit shall have cadmium-plated malleable iron body and gland nut with cast-in lug, steel grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit and box connection and insulated throat. Straight, 45- and 90-degree fittings shall be used where applicable. Liquidtight

flexible conduit shall be Type U.A. in conformance with UL 360. Manufacturers shall be Anaconda Sealtite, Emerson Appleton Type STB, Emerson O.Z. Gedney Series 4QT, or equal.

B. EXPLOSIONPROOF TYPE:

1. Explosionproof flexible conduit shall conform to requirements of Class I, Division 1, Group D hazardous atmosphere per NEC Articles 500 series. Flexible length shall consist of asphalt impregnated woven cloth duct, brass inner core, and bronze braid covering. End fittings shall be forged brass or cast bronze. Furnish Cooper Crouse-Hinds #ECGJH series, or equal.

2.04 RIGID NONMETALLIC CONDUIT

- A. Rigid nonmetallic conduit, endbells and fittings shall conform to requirement of UL 651 and NEMA TC2, type EPC-40-PVC, high impact, polyvinylchloride (PVC). Duct bank spacers shall high impact plastic interlocked 2-inch spacers for PVC ducts. Joint glue shall be medium grade gray, solvent cement. Minimum size shall be 1 inch. Manufacturer shall be Thomas & Betts Carlon 49000 (Sch. 40) or 49400 (Sch. 80) series, Thomas & Betts Carlon Snap-Loc Spacers series, or equal. All rigid nonmetallic 2-inch and larger elbows and bends (22.5- through 90-degree) shall be factory made with a 48-inch radius minimum and shall be Thomas & Betts Carlon UA/BxHx series, or equal.

2.05 WIREWAYS

A. NEMA 12:

1. Feed-through wireways shall conform to UL 870 and NEMA ISC6, type 12. Wireways shall be hinged, oiltight, with flanged connectors constructed of 14-gauge steel with 10-gauge end flanges. All bolted connections shall be gasketed. Finish shall be ANSI 61 gray inside and outside. Manufacturers shall be Schneider electric Square D Type LJ; Hoffman, Bulletin F-20; or equal.

B. NEMA 4X:

1. Feed-through wireways shall conform to UL 870 and NEMA ICS6, type 4X. Wireways shall be constructed of 304 stainless steel, 14-gauge body, 14-gauge hinged cover, and 10-gauge flanges. All bolted connections shall have oil-resistant gaskets. All fasteners shall be stainless steel. The manufacturer shall be Hoffman, Bulletin F-22, or equal.

2.06 EXPANSION, WALL AND ROOF FITTINGS

A. SURFACE CONDUITS:

1. Expansion fittings in conduit racks shall be hot-dip galvanized malleable iron providing 4-inch conduit movement. Expansion fittings shall be provided with

insulated bushings and bonding jumpers. Surface expansion fittings shall be Emerson O.Z. Gedney Type AX series, or equal.

B. EMBEDDED CONDUITS:

1. Expansion fittings for conduits embedded in concrete on the centerline of the expansion joint shall provide 3/4-inch movement and 30 degree deflection in all directions. Fittings shall be rated NEMA ICS6 type 4. Materials shall include HDG ductile iron or bronze end couplings, neoprene sleeve, stainless steel bands and copper braid bonding jumper. Embedded expansion fittings shall be Emerson O.Z. Gedney Type DX series, Emerson Appleton Type DX series, or equal.

C. WALL FITTINGS:

1. Wall fittings for conduits shall be hot-dipped galvanized bodies and pressure clamps, 304 stainless steel pressure rings and tightening bolts with neoprene sealing grommets. For newly poured walls, furnish Emerson O.Z. Gedney WSK series and for existing core bored concrete furnish Emerson O.Z. Gedney CSMI/CSMC series, or equal.

D. ROOF JACKS:

1. Roof jacks shall be fabricated from 22-gauge galvanized steel. Counterflashing shall be 24-gauge collar umbrella with stainless steel draw band or rubber storm collar sized for the conduit outside dimension.

2.07 RACEWAY SUPPORTS

A. INDIVIDUAL CONDUIT SUPPORTS:

1. **STANDARD DUTY:** Individual conduit supports shall include strap and clamp backs, beam clamps, tray clamps and jay hangers. Supports shall be fabricated from malleable iron finished with hot-dipped galvanization or zinc electroplate and aluminum paint. Furnish Emerson Appleton BH series, CL/B series, CH/D series, TCC/D series, Uni-strut J12XX series, or equal.
2. **CORROSIVE DUTY:** Corrosive duty individual conduit supports shall be the same as standard duty; except shall have 40 mil PVC jacket and #316 stainless steel hardware. Furnish Robroy Industries Plasti-Bond Redh2ot, C149 series, RA series, PAR series, CLB-M series, or equal.

B. EMBEDDED SUPPORTS:

1. **STANDARD DUTY:** Concrete inserts shall include; spot inserts and framing channels. Embedded supports shall be fabricated from cold rolled 12-gauge steel conforming to ASTM A570 GR33 with hot-dipped galvanized finish conforming to ASTM A123. Dimension shall be nominal 1-5/8-inch width with 1-1/2-inch welded

tabs on 4-inch centerlines. Channels shall be Styrofoam filled with welded tab end caps. Furnish Uni-strut P3245, P3704, P3270 series, or equal.

2. CORROSIVE DUTY: Corrosive duty concrete inserts shall be the same as standard duty; except shall be 1-5/8-inches wide by 7/8-inch deep and be fabricated from 12-gauge stainless steel conforming to ASTM A240 type 316. Furnish special order Uni-strut P335X-SS, P3703-SS, P3370-SS series, or equal.

C. SUSPENDED RACEWAY SUPPORTS:

1. STANDARD DUTY: Suspended raceway supports shall be trapeze type consisting of threaded rods, nuts, square washers, fittings, framing channels, cable tray clamps and conduit clamps. Fittings and framing channels shall be fabricated from cold rolled 12-gauge steel conforming to ASTM A570 GR33 with hot-dipped galvanized finish conforming to ASTM A123. Channels shall have nominal 1-5/8-inch square slot with inturned lips. Double strut shall be two channels welded back to back. Hardware shall be fabricated from case hardened mild steel in conformance with ASTM A576, GR 1015 with electrogalvanized finish conforming to ASTM B633, Type III SC1. Threads shall be American coarse screw threads UNC, Class 2A/B. Channel conduit clamps shall be two-piece steel with hex head screw and nut. Plastic end caps shall be made specifically for framing channel ends. Furnish Uni-strut P1000/P1001 series, P11XX/P15XX series, P286X series, P2860-XX series and HTHRXXX series, Legrand P W Industries Cablofil 1811 series, or equal.
2. CORROSIVE DUTY: Corrosive duty suspended raceway supports shall be the same as standard duty; except they shall have a 40-mil PVC jacket and all rods, nuts and hardware shall be #316stainlesssteel. Furnish Robroy Industries Plasti-Bond RedH2OT, P1000 series, C105 series, or equal.

2.08 RACEWAY MARKERS

- A. Raceway markers shall be 1/2-inch wide by 2-inch-long stainless steel tape embossed with 1/4-inch characters. Markers shall be attached to the raceway with No. 16 AWG, 316 stainless steel wire.

2.09 RACEWAY PLAQUES

- A. Raceway plaques shall be located in manholes and handholes to identify each conduit number and their arrangement for each group of conduits entering the manhole or handhole. The plaque shall be a minimum of 12 inches wide by 8 inches high, made from 2-ply microsurfaced impact acrylic, 1/16-inch thick. Plaque shall have white background with 1/2-inch high black engraved letters. Retagging of conduits inside existing manholes or handholes shall follow the same requirements with the new "retagged" label sized to fit over the existing conduit label. Furnish Rowmark LaserMax LM922-204 or equal.

2.10 DUCT CABLE SEALS AND PLUGS

- A. Duct cable sealing system for data, signal, and 600v conductors shall consist of an inflatable metallic laminate bladder with sealing strips, cable clips, and high temperature mastic. Duct seals shall be manufactured for specific duct sizes and number of cables. Inflation kit shall consist of on-off switch, pressure regulator, and CO2 cylinders. Furnish Raychem Corp. RDSS-xxx series, RDSS-CLIP-xxx series, RDSS-IT-16, or equal.
- B. Duct plug shall be a two-piece nonmetallic reusable stopper consisting of a rigid plug and sealing-ring. Plug shall be fabricated from reinforced polypropylene and the sealing ring shall be thermoplastic rubber or polyurethane elastomer. Duct plugs shall be manufactured specifically for PVC schedule 40 pipes. Furnish ETCO Specialty Products, Inc. "T"-cone expandable stopper ST-x02 series, or equal.
- C. Medium voltage cable sealing tape shall be 125-mil conformable mastic rated for 80 degrees C. Sealing tape shall form an environmental seal around wrapped conductors. Furnish 3M Scotch-Seal 2229 compound, or equal.

PART 3 -- EXECUTION

3.01 GENERAL

- A. CONDUIT RUNS BETWEEN BOXES: The Contractor shall limit the number of directional changes of the conduit to total not more than 270 degrees in any run between pull boxes. Conduit runs shall be limited to a maximum of 400 feet, less 100 feet for every 90 degrees of change in direction. Bends and offsets shall be avoided where possible but, where necessary, shall be made with a hickey or conduit bending machine, or shall be factory preformed bends. Turns shall be made with cast metal fittings or conduit bends. Welding, brazing or otherwise heating of conduit is not acceptable.
- B. JUNCTION AND PULL BOXES: Where required for pulling cable and as necessary to meet the requirements specified herein, the Contractor shall provide condulets, cast junction or pull boxes. Pull boxes used for multiple conduit runs shall not combine circuits fed from different MCCs, switchboards, or switchgear. All junction and pull boxes shall be identified with the number shown on the drawings with spray painted stenciled numerals.
- C. CONDUIT TERMINATIONS: Conduit entering NEMA 1 type sheet steel boxes or cabinets shall be secured by a locknut on the exterior of the box or cabinet and an insulated bonding and grounding bushing on the interior side. Steel conduit entering all other boxes shall be terminated into a threaded hub. Boxes without threaded hubs shall be provided with conduit hubs with a grounding locknut for each conduit entry. Joints shall be made with standard couplings or threaded unions. Running threads shall not be used in lieu of conduit nipples, nor shall excessive thread be used on any

conduit. The ends of conduit shall be cut square, reamed, and threaded with straight threads. Rigid steel conduit shall be made up tight and without thread compound. Exposed male threads on rigid steel conduit shall be coated with electrically conductive zinc-rich paint. All underground conduits that terminate at junction boxes, panels, switchgear, MCCs or structures shall be sealed with approved duct seal to prevent the transfer of moisture.

- D. **MATCHING EXISTING FACILITIES:** When new conduit is added to areas that are already painted the conduit and its supports shall be painted to match the existing facilities. Where new conduit is used to replace existing conduit, the existing conduit and supports shall be removed, resulting blemishes shall be patched and repainted to match original conditions. Similarly, if existing conduits are to be reused and rerouted, resulting blemishes shall be corrected in the same manner.
- E. Each conduit, wireway and tray shall be identified by a specified number. The numbering system is specified in the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00). All raceways identified in the ELECTRICAL RACEWAY SCHEDULE shall be tagged, even if not identified as such on the drawings.
- F. **CONDUIT SEPARATION:**
 - 1. Signal conduits shall be separated from AC power or control conduits. The separation shall be a minimum of 12 inches for metallic conduits and 24 inches for nonmetallic conduits.
 - 2. Underground medium voltage ductbanks shall be separated from 480V ductbanks by 3 feet minimum for parallel alignments, and 1 foot minimum for crossing alignments.
 - 3. Underground 480V ductbanks shall be separated from signal ductbanks by 2 feet minimum for parallel alignments, and 1 foot minimum for crossing alignments.

3.02 INSTALLATION (NOT USED)

3.03 CONDUIT

A. CONDUIT LOCATIONS:

- 1. Unless otherwise specified in Table A below, conduit shall be galvanized rigid steel.

Table A. Conduit Locations	
Conduit type	Location
Galvanized rigid steel	All exposed noncorrosive areas.
Schedule 40 PVC	Encased in concrete duct banks, concrete capped lighting and receptacle underground raceways
PVC coated rigid steel	Exposed in corrosive areas and conduits which are stubbed-up through the soil or concrete
Liquidtight flexible	Final raceway connections to equipment subject to vibration or adjustment in nonhazardous areas
Explosionproof flexible	Final raceway connections to equipment subject to vibration or adjustment in hazardous areas

2. Examine equipment outline and dimension drawings to coordinate routing of conduit with manufacturer's installation instructions. Conduit routing shall not interfere with subsequent maintenance activities. Position of new conduit within conduit racks shall be adjusted as necessary to minimize interference with existing raceways, boxes, piping, structural openings, future equipment and other equipment. Conduit shall not block access to boxes, equipment, or unused rack space. In general, conduits shall be located at positions near the top of racks and near walls where possible. Any conduit that interferes with maintenance activities shall be removed and rerouted at the Contractor's expense. The Contractor shall make allowance in his bid to make minor changes in routings at no additional cost to the District.

B. CONDUIT SUPPORT:

1. Exposed rigid steel or plastic coated conduit shall be run on supports spaced not more than 10 feet apart, within 3 feet of 90 degree turns and junction boxes and shall be constructed with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceiling. No conduit shall approach closer than 6 inches to any object operating above the rated temperature of the cable insulation it contains. Where three or more conduits are located in a parallel run, they shall be spaced out from the wall using framing channel or suspended raceway supports. All framing channel conduit support systems shall be oversized to allow for 25 percent additional conduit space. All exposed ends of framing channels shall be protected with plastic end caps. Exposed expansion fittings shall be installed where conduit crossed building expansion joints.

2. Steel conduit shall be supported away from the structures using standard duty individual or suspended raceway supports. PVC coated conduit shall be supported away from the structure using corrosive duty individual or suspended raceway supports.
3. Conduit racks shall be secured to concrete walls and ceilings by means of standard duty embedded supports. Plastic inserts or gunpowder-driven inserts are not acceptable as a base to secure conduit supports. Stainless steel expansion anchors shall be used to support individual conduit supports in exterior areas.

C. RACEWAY PENETRATIONS:

1. Raceway routed perpendicular through floors, walls or other concrete structures shall pass through cast-in-place openings. In cases where cast-in-place openings are not possible, appropriate size holes shall be bored through the concrete to accommodate the raceway and sealing fitting. The size and location of the holes shall not impair the structure's integrity. After completion, grout or caulk around raceway and finish to match surroundings. A 3½-inch-high concrete pad with a sloping top shall protect raceway that rises vertically through a floor or slab. All penetrations shall be fire stopped.
2. Conduits entering manholes and handholes shall be horizontal. Conduits shall not enter through the concrete bottom of handholes and manholes.
3. Wherever individual conduits penetrate concrete walls or ceilings to outdoors or below grade, the Contractor shall provide a watertight link seal installed as shown on the drawing details. Install roof jacks and storm collars around all conduits penetrating roof surfaces prior to completing the conduit system. Split roof jacks or split collars are not acceptable. Leave roof jacks loose for installation into the roofing membrane per Division 7 requirements.

D. PVC COATED CONDUIT:

1. PVC coated conduit shall be made up tight with strap wrenches. All conduit threads shall be covered by a plastic overlap sleeve that shall be coated and sealed per manufacturer's recommendations. Pipe wrenches and channel locks shall not be used for tightening PVC coated conduits. The conduit coating shall be protected from damage when conduit is threaded in the field. Damaged areas shall be patched, using manufacturer's recommended material. The area to be patched shall be built up to the full thickness of the coating. Painted fittings are not acceptable. Conduit hubs shall be used for entering boxes.

E. FLEXIBLE CONDUIT:

1. Length of flexible conduit shall not exceed 36 inches.

F. UNSCHEDULED RACEWAY:

1. The lighting system and receptacle circuits are unscheduled and shall be provided.
2. The raceway shall be sized by the Contractor in accordance with the NEC Table C8 (RH insulation). Minimum size shall be 3/4 inch for exposed and 1 inch for embedded raceway; minimum size in duct bank interconnecting manholes or handholes shall be 2 inches.

G. SCHEDULED RACEWAY:

1. Provide the raceways as shown and specified in the ELECTRICAL RACEWAY SCHEDULE shown on the drawings.
2. The Contractor shall bring all conflicts to the attention of the District Representative prior to installation of the raceways.

H. CONDUIT SEALS:

1. Conduit seals shall be provided for hazardous (classified) locations in accordance with the NFPA 70 Chapter 5 Article 501-5. The conduit seals shall be filled with appropriate "A" compound prior to final acceptance.
2. Conduit bodies shall be provided for all conduits entering and leaving corrosive areas. The conduit bodies provided for corrosive areas shall be filled with a nonsetting compound such as electrical duct seal putty to prevent the migration of corrosive gases from the area.

3.04 RACEWAY SUPPORT SYSTEM

A. DESIGN:

1. The Contractor shall submit design calculations for raceway support systems and seismic bracing prior to installation. The design weight shall be increased by 25 percent to account for future loads. Seismic forces shall be as described in the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00). A minimum safety factor of 3 shall be applicable to design values for all hardware and fasteners. All calculations shall be stamped and signed by a registered civil or structural engineer licensed to practice in the State of California.

B. MATERIALS:

1. Standard duty raceway supports shall be installed in all areas; except for areas identified as corrosive in the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00). In corrosive areas, corrosive duty raceway supports are required. Corrosive duty embedded supports are required in manholes.

3.05 RACEWAY NUMBERING

A. CONDUIT IDENTIFICATION:

1. A tag with number shall be fixed to each end of each conduit segment and at each manhole, pull box and handhole. Tags shall also be placed within 3 feet of every wall, ceiling, or floor penetration or firestop.

B. WIREWAY AND TRAY IDENTIFICATION:

1. Wireway and trays shall be identified by stencils at intervals not exceeding 50 feet, at intersections, and at the end of each run. Lineal footage shall be shown every 10 feet starting at the beginning of the tray end nearest the served area control center (ACC).

3.06 DEVICE, PULL AND JUNCTION BOXES

A. LOCATION:

1. Unless otherwise specified in Table B, boxes shall be NEMA 3R cast ferrous alloy type.

Table B. Box Locations

Box type	Location
NEMA 1	Concealed in sheet rock and masonry walls only
NEMA 3R cast	Exposed indoor or outdoor locations in noncorrosive and nonhazardous areas
NEMA 3R cast PVC jacket	Embedded in outdoor or indoor nonhazardous areas
NEMA 4	Exposed in process areas below 7 feet in nonhazardous, non-corrosive areas
NEMA 4X	Corrosive nonhazardous areas
NEMA 7	Hazardous areas
NEMA 12	Exposed in conduit racks in nonhazardous, noncorrosive areas above 7 feet. Exposed in switchgear rooms.

3.07 DUCT CABLE SEALS AND PLUGS

- A. Duct banks entering buildings and all other structures from manholes and handholes shall be sealed on the high side of each duct to prevent the entrance of water from the duct bank system. Empty ducts shall be sealed with duct plugs. Duct plugs shall be installed hand-tight and then wrench tightened an additional one-half turn to seal watertight. Ducts with data, signal, or 600v rated conductors shall be sealed with the

duct cable sealing system after all conductors are installed following the manufacturer installation instructions.

- B. Duct bank cable seals and plugs shall be tested for leakage into buildings and structures by flooding the adjacent manhole or handhole with water. Replace all cable seals or plugs that leak. Pump out all water after one hour.
- C. Ducts containing medium voltage cables terminating under switchgear or panels shall be sealed after the conductors are installed with metallic covers and sealing tape.

3.08 TESTING (NOT USED)

3.09 TRAINING (NOT USED)

****END OF SECTION****

SECTION 26 06 20.21

ELECTRICAL RACEWAY SCHEDULE

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section lists raceway to be provided or existing raceway to be reused. Raceway numbering system is described in the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00).

1.02 REFERENCES (NOT USED)

1.03 SUBMITTALS (NOT USED)

1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.01 GENERAL

A. EXISTING RACEWAY

1. Existing conduits shall only be reused where specified. Existing cable trays, wireways, and conduits in duct banks shall be reused as noted on the schedules or the drawings. Cables listed in the "Contains" column of existing raceways only lists cables added under this Contract. Other cables may exist in these raceways. Existing conduit identification tags shall be removed and replaced and generally treated as installed raceway in accordance with the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00) and this specification section.

3.02 INSTALLATION (NOT USED)

3.03 TESTING (NOT USED)

3.04 TRAINING (NOT USED)

3.05 RECORD KEEPING

- A. The raceway schedule shall be maintained in as-built status in accordance with the PROJECT RECORD DOCUMENTS Section (01 78 79).

3.06 NEW RACEWAY SCHEDULE

- A. EXPLANATION OF DATA FIELDS:

<u>FIELD</u>	<u>EXPLANATION</u>
Rev:	Revision and change status of change. Format is "XN" where "X" is change status code, A=addition, C=change, D=deletion; and "N" is addendum issue number.
Raceway Designation:	Unique raceway identification per the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00).
From:	Origination of raceway.
To:	Destination of raceway.
Size in.:	Nominal diameter or size of raceway (in inches).
Contains:	List of cables/conductors routed through the raceway.
Dwg Ref.:	Plan drawing reference.

- B. New raceway schedule follows.

RACEWAY SCHEDULE

PROJECT NUMBER

<u>REV</u>	<u>RACEWAY DESIGNATION</u>	<u>FROM</u>	<u>TO</u>	<u>SIZE IN.</u>	<u>CONTAINS</u>	<u>DWG REF</u>
	C94344A	JB94344A	CSTN94344A	1.00	94PC344A1, 94PC344A2	E04
	C94344B	JB94344A	CSTN94344B	1.00	94PC344B1, 94PC344B2	E04
	C94344C	JB94344A	JB94344B	1.00	94PC344A2, 94PC344B2	E04
	C94344D	JB94344B	MOV94344A	1.00	94PC344A2	E04
	C94344E	JB94344B	MOV94344B	1.00	94PC344B2	E04
	C94345A	JB94345A	CSTN94345A	1.00	94PC345A1, 94PC345A2	E04
	C94345B	JB94345A	CSTN94345B	1.00	94PC345B1, 94PC345B2	E04
	C94344C	JB94345A	JB94345B	1.00	94PC345A2, 94PC345B2	E04
	C94344D	JB94345B	MOV94345A	1.00	94PC345A2	E04
	C94344E	JB94345B	MOV94345B	1.00	94PC345B2	E04
	P94340A	PNL94A	JB94340	1.00	94PC344A1, 94PC344B1, 94PC345A1, 94PC345B1	E04
	P94340B	JB94340	JB94344A	1.00	94PC344A1, 94PC344B1, 94PC345A1, 94PC345B1	E04
	P94340C	JB94344A	JB94345A	1.00	94PC345A1, 94PC345B1	E04

****END OF SECTION****

SECTION 26 06 20.25

ELECTRICAL CABLE SCHEDULE

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section lists cables to be provided or existing cable to be reused or modified. Cable numbering system is described in the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00). Cable types are specified in the ELECTRICAL POWER CONDUCTORS AND CABLES Section (26 05 21) and in this specification section.

1.02 REFERENCES (NOT USED)

1.03 SUBMITTALS (NOT USED)

1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.01 GENERAL

A. EXISTING CABLE

1. Existing cable shall only be reused where specified and in such cases only when a device is to be relocated and the location results in a shorter cable.

3.02 INSTALLATION (NOT USED)

3.03 TESTING (NOT USED)


3.04 TRAINING (NOT USED)

3.05 RECORD KEEPING

- A. The cable schedules shall be maintained in as-built status in accordance with PROJECT RECORD DOCUMENTS Section (01 78 39).

3.06 NEW CABLE SCHEDULE

A. EXPLANATION OF DATA FIELDS:

FIELD	EXPLANATION
Rev:	Revision and change status of change. Format is “XN” where “X” is change status code, A=addition, C=change, D=deletion; and “N” is addendum issue number.
Cable ID:	Unique cable identification tag, assigned to the aggregation of one or more conductors or cables of the type listed in the “type” column and the ground conductor as listed.
From:	Origination of cable.
To:	Destination of cable.
Routing:	Listing of raceways cable route must take to get from origination to destination
Type:	
	Abbreviation Conductor or Cable Type
	P&C SC Power & Control Single Conductor
	P&C MC _x Power & Control Multi-conductor, <i>x</i> indicates number of conductors within the cable
	P&C DB Power & Control Direct Buried Cable
	MV _x Medium Voltage Cable, <i>x</i> indicates voltage rating of cable
	MB DB Medium Voltage Direct Buried Cable
	SC SPR Signal Cable Single Pair
	SC STR Signal Cable Single Triad
	SC MPR _x Signal Cable Multiple Pair, <i>x</i> indicates number of pairs within the cable
	SC MTR _x Signal Cable Multiple Triad, <i>x</i> indicates number of triads within the cable
	FA-1 Fire Alarm Cable for Indoor Application
	FA-2 Fire Alarm Cable for Outdoor Application
	SP-1 RS-485 Serial Communication Cable
	SP-2 Twin-axial Shielded Computer Cable
	SP-3 RG 58/U Coaxial Cable
	CAT-5 Category 5 Cable
	CAT-6 Category 6 Cable
	SP-HVAC1 HVAC N2 and XT Network Cable
	PA-1 Public Address Cable Inside
	PA-2 Public Address Cable Outside
	FOS _x Fiber Optic Single-Mode fiber cable  <i>x</i> indicated number of fibers within the cable

FIELD	EXPLANATION
FOM _x	Fiber Optic Multi-Mode fiber cable, $\overline{F_x}$ indicated number of fibers within the cable
FPC _x	Fiber Optic Buffered Cable, $\overline{F_x}$ indicated number of fibers within the cable
P-DP	Profibus DP cable
P-PA	Profibus PA cable

Quantity: Quantity of conductors or cables listed in the "type" field
Size: Size of conductors (AWG or Kcmil)
GRD Size: Size of grounding conductor (AWG or Kcmil)
Volts: Conductor insulation rating
Notes: Notation regarding raceway or cable installation.

B. New Cable schedule follows.

CABLE
SCHEDULE
PROJECT
NUMBER

REV	CABLE	FROM	TO	ROUTING	TYPE	QTY. COND	SIZE COND	SIZE GRD	VOLTS
	94PC344A1	PNL94A	CSTN94344A	C94344A	P&C SC	3	12	12	600
	94PC344A2	CSTN94344A	MOV94344A	C94344A	P&C SC	6	14	14	600
	94PC344B1	PNL94A	CSTN94344B	C94344B	P&C SC	3	12	12	600
	94PC344B2	CSTN94344A	MOV94344B	C94344B	P&C SC	6	14	14	600
	94PC345A1	PNL94A	CSTN94345A	C94345A	P&C SC	3	12	12	600
	94PC345A2	CSTN94344A	MOV94345A	C94345A	P&C SC	6	14	14	600
	94PC345B1	PNL94A	CSTN94345B	C94345B	P&C SC	3	12	12	600
	94PC345B2	CSTN94344A	MOV94345B	C94345B	P&C SC	6	14	14	600

****END OF SECTION****

SECTION 26 08 10

ACCEPTANCE TESTING OF ELECTRICAL SYSTEMS

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section specifies the acceptance testing of electrical materials, equipment and systems as specified in this section and in each section of Division 26 except the following:
 - a. Insulation resistance of cable/motor tests and cable continuity tests in accordance with the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00).
 - b. Pre-operational checkouts in accordance with the COMMON WORK RESULTS FOR ELECTRICAL Section (26 05 00).
2. Engage the services of an independent testing firm for the purpose of performing all tests and inspections specified herein. Testing firm shall also perform the inspecting, setting, testing and calibrating applicable devices as specified herein.
3. Provide all labor, tools, material, power and technical supervision to perform the specified tests and inspections.

1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
NETA ATS	International Electrical Testing Association, Inc.; Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
ANSI/NETA ETT	Standard for Certification of Electrical Testing Personnel

- B. DEFINITIONS: (Not Used)

1.03 SUBMITTALS

- A. The following information shall be submitted for review:
1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
 2. Test procedures and forms in accordance with the COMMISSIONING Section (01 91 00). The test forms shall be in accordance with NETA standards.
 3. Submit proof that the independent testing firm and testing personnel qualifies as specified herein.
 4. Provide one original copy of the latest issue of NETA ATS Acceptance Testing Specifications Manual.
 5. Completed test report no later than 30 days after completion of the tests.

1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)

PART 2 -- PRODUCTS

2.01 DOCUMENTATION

A. GENERAL:

1. The collection and documentation of test data shall be provided in accordance with the COMMISSIONING Section (01 91 00).

B. DEFECTS:

1. Notify the District Representative of any material or workmanship found defective within 24 hours of discovery in accordance with the COMMISSIONING Section (01 91 00).

C. TEST REPORT:

1. Provide the test report with all items required in NETA ATS, paragraph 5.4.
2. All blanks on the test forms shall be filled in. If the item is not applicable, enter "N/A". All disparities and irregularities in the test results shall be noted on the test form and addressed and evaluated in accordance with industry standards in the report Recommendations. Where defective material is noted on the test form, the item shall be initialed and dated when the issue has been resolved and the item re-tested.

2.02 TEST EQUIPMENT AND MATERIALS

- A. Test instruments shall be calibrated to references traceable to the National Bureau of Standards and shall have a current sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required. Test instruments shall be provided in accordance with the COMMISSIONING Section (01 91 00).

2.03 INDEPENDENT TESTING FIRMS

A. QUALIFICATIONS OF TESTING ORGANIZATION:

1. The testing organization shall be independent, third party, testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing organization.
2. The testing organization shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
3. The testing organization shall utilize technicians who are regularly employed for testing services.
4. An organization having a "Full Membership" classification issued by the International Electrical Testing Association meets these criteria.

B. QUALIFICATIONS OF TESTING PERSONNEL:

1. Test technicians performing electrical tests, inspections, and calibrations shall be trained and experienced with the apparatus and systems being evaluated. Technicians shall conduct tests in a safe manner with complete knowledge of the hazards involved.
2. Technicians shall be certified in accordance with ANSI/NETA ETT. Each site crew shall have a technician with certification Level III, or higher.

C. ACCEPTABLE TESTING FIRMS:

1. The following firms qualify as independent testing agencies. Other firms that qualify shall be considered as equal.
 - a. Apparatus Testing & Engineering, Rancho Cordova, CA
 - b. Electrical Reliability Services, Pleasanton, CA

PART 3 -- EXECUTION

3.01 GENERAL

- A. All testing shall be performed by an independent electrical testing laboratory in strict conformance with the electrical acceptance tests specified NETA ATS except as specified herein. Acceptance testing shall be performed, test report submitted and approved prior to energizing of the tested equipment.
- B. Requirements for testing in accordance with this section are specified in other sections of Division 26. All discrepancies shall be noted on the test sheets, shall be resolved to the satisfaction of the District and then re-tested. All failed tests resulting in adjustment, repair, or replacement shall be re-tested, re-submitted, and approved prior to acceptance of material, equipment or systems.

3.02 INSTALLATION (NOT USED)

3.03 TESTING

- A. The following tests, calibrations and inspections conforming to the requirements of NETA ATS (Chapter 7- Inspection and Test Procedures) shall be performed:
 - 1. Grounding Systems; Visual and mechanical inspections, electrical tests evaluated to required test values.
 - 2. Low voltage motor starters: Visual and mechanical inspections, electrical tests evaluated to required test values.

3.04 TRAINING (NOT USED)

****END OF SECTION****

SECTION 40 05 57

ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section specifies manual operators and powered actuators for valves and gates, and appurtenances.

1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM A276	Stainless Steel Bars and Shapes
AWWA C542	Electric Motor Actuators for Valves and Slide Gates
AWWA C561	Fabricated Stainless Steel Slide Gates
NEMA ICS2	Industrial Control Devices, Controllers and Assemblies

B. DEFINITIONS:

OPERATOR & ACTUATOR CODES					
X	X	X	X	X	X
Power Source M – Manual E – Electric P – Pneumatic H – Hydraulic	Transmission C – Cylinder D – Diaphragm G – Gear L – Lever M – Motor S – Acme Stem	Stroke L – Linear M – Multiturn Q – Quarter turn	(Optional) A – AWWA F – Floor box O – Open/close T – Throttling M – Modulating	(Optional) S – Small M -- Medium L – Large	(Optional) D – Digital fieldbus

1. ANTIFRICTION BEARING: The term “antifricition bearing” shall mean rolling element type bearing.
2. OPEN/CLOSE: To move to the fully open or fully closed position.
3. THROTTLING: To move to the fully open or fully closed position, or to move to and maintain an intermediate position between fully open and fully closed in response to a manually initiated control.

4. MODULATING: To move to the fully open or fully closed position, or to move to intermediate positions in response to a variable control signal.

1.03 SUBMITTALS

- A. The following information shall be submitted for review.
 1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations
 2. Manufacturer's information and catalog data showing compliance with this specification and a full description of the product.
 3. A copy of the contract document control diagrams and process and instrumentation diagrams that apply to the equipment in this section marked to show specific changes necessary for the supplied equipment. If no changes are required, the drawings shall be marked "No Changes Required."

1.04 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Submit operation and maintenance (O&M) instructions in accordance with the OPERATION AND MAINTENANCE DATA Section (01 78 23) by submitting a copy of the OPERATION AND MAINTENANCE DATA Section (01 78 23) with each paragraph check marked to show compliance. O&M instructions shall be submitted after all submittals specified above have been returned mark "No Exceptions Taken" or "Make Corrections Noted." O&M instructions shall reflect the approved materials and equipment.

PART 2 -- PRODUCTS

2.01 TYPE EMQOS(D) ACTUATORS

- A. ACCEPTABLE PRODUCTS:
 1. Bray series 70;
 2. Remote Control series RCEL;
 3. EIM series HQ; Rotork series Q;
 4. or equal, modified as required to meet the specifications.
- B. MATERIALS/EQUIPMENT:
 1. GENERAL:

- a. Type EMQOS actuators are electric motor, quarter turn, open/close, small actuators. Torque range: 150 to 2500 in-lbs.
- b. Speed per 90 degree rotation: 8 to 70 seconds
2. VOLTAGE:
 - a. 120V, 1 phase, 60HZ.
3. MOTOR:
 - a. High starting torque motor, minimum 25% duty, with auto reset thermal sensor.
4. HOUSING:
 - a. Die cast aluminum, epoxy coated, rated NEMA 4-4X.
5. GEARING:
 - a. All powertrain gears shall be metallic and shall be machine cut. Non-metallic gears are not acceptable.
6. POSITION SWITCHES:
 - a. Two standard end of travel switches, SPDT, rated 10 amps @ 120 VAC.
7. ROTATION:
 - a. Nominal 90 degrees, with ± 5 degree adjustable mechanical travel stops. Stops shall be able to withstand maximum actuator torque.
8. SIZE:
 - a. Size actuator for 2,200 in-lbs peak operating torque.
9. ENCLOSURE:
 - a. Dual conduit openings.
10. CONTROLS:
 - a. Provide OPEN/CLOSE pushbuttons to enable local operations.
11. OTHER FEATURES:
 - a. Handwheel manual override, visual position indicator, heater.

2.02 MOUNTING ADAPTERS

A. MATERIALS/EQUIPMENT:

1. Mounting adapters shall include operator or actuator housing, stem and bonnet extensions, adapter plates, and connections to the valve. Design and fabricate stem and bonnet extensions according to the general details shown on the drawings. Adjust dimensions as required to comply with sizing criteria. Submit mounting adapter design calculations and shop drawings.
2. For mounting adapter sizing purposes, assume the valve is jammed. Size mounting adapters to withstand the maximum operating torque of the operator or actuator, and for a minimum safety factor of 5 based on the yield strength of the material used. For hydraulic actuators base calculations on 3000 psig hydraulic pressure.
3. Do not attach mounting adapter utilizing valve bonnet bolts, thereby providing for removal of the adapter without taking the valve out of service.

2.03 APPURTENANCES

A. MATERIALS/EQUIPMENT:

- a. Valve boxes shall be cast iron or concrete, Christy G05T, Brooks 3-RT, or equal. Valve box extensions shall be AWWA C900 PVC DR 18 pipe. Hot-dip galvanize covers. Label box covers with the symbol of the particular service, as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
2. FLOOR BOXES:
 - a. Floor boxes shall be hot-dip galvanized. Where the operating nut is in the concrete slab, the floor box shall be bronze bushed. Where the operating nut is below the slab, the opening in the bottom of the box shall be sufficient for passage of the operating key. Label box covers with the symbol of the particular service, as specified in the COMMON WORK RESULTS FOR PIPING SYSTEMS Section (40 05 03).
 3. REMOTE CONTROL STATION:
 - a. Provide remote control station for valves where shown on the Drawings. The enclosure shall be rated NEMA 4X for unclassified areas or NEMA 7 for Class I, Div 1 or 2 areas with the following:
 - 1) Open/Close Selector Switch
 - 2) Full open light.
 - 3) Full close light.

- b. Provide control enclosure to accept:
 - 1) Remote open/close switches.
 - 2) Full open contact.
 - 3) Full close contact.
- c. Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.
- d. Remote control stations shall be Allen Bradley Bulletin 800R with 30.5 mm Bulletin 800H (type 4/4X/13) operators with sealed contact blocks or approved equal.

2.04 NAMEPLATES

- A. Nameplates shall be provided on each item of equipment. Equipment nameplates shall be 16-gauge aluminum bearing the equipment name and equipment number legibly engraved in $\frac{3}{4}$ inch high letters. Nameplates shall be attached to the equipment in an accessible location with stainless steel screws.

PART 3 -- EXECUTION

3.01 GENERAL (NOT USED)

3.02 INSTALLATION

- A. Equipment specified in this section shall be installed in accordance with the manufacturer's instructions.
- B. MANUAL OPERATORS:
 - 1. ACCESSIBILITY:
 - a. Position operators so that they can readily be operated.
 - b. Provide specified handle for operators with centerlines up to 7 feet 6 inches above the operating level. Where these operators are not readily accessible, provide either rigid shaft extensions with universal joints, or flexible shaft extensions so that the handles can be remotely mounted in an accessible location.
 - c. Unless otherwise shown on the plans, replace specified handwheels with chain wheels for operators with centerlines more than 7 feet 6 inches above the operating level. Where these chain wheels are not accessible, provide either

rigid shaft extensions with universal joints, or flexible shaft extensions so that the chain wheels can be remotely mounted in an accessible location.

2. AWWA NUTS: Provide 2 inch AWWA nuts on buried valves and on valves operated through floor boxes. Extend nut if necessary so nut will be within 6 inches of the valve box cover.

C. APPURTENANCES:

1. Extend valve box to finished surface for buried valves.
2. Provide floor boxes for AWWA nut operation of valves located below concrete slabs. Each floor box and cover shall be of the depth required for installation in the slab.

3.03 TESTING

A. For all 120 VAC and 480 VAC electric actuators, employ and pay for services of valve actuator manufacturer's field service representative to:

1. Inspect valve actuators covered by this Specification Section.
2. Supervise adjustments and installation checks:
 - a. Open and close valves electrically under local manual and demonstrate that all limit switches are properly adjusted and the valve is functioning properly by verifying the inputs are received at the PLC panels.
 - b. Position modulating valves electrically under local manual control and demonstrate that the valve position feedback is properly adjusted and that the feedback signal is received at the PLC.
 - c. Simulate a valve position command signal at the PLC or local control panel as appropriate and demonstrate that the valve is controlled to the desired position without excessive hunting.
3. Provide Owner with a written statement that the valve actuator manufacturer has verified that the actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted and that the valve actuator responds correctly to the valve position command.

****END OF SECTION****

SECTION 40 05 61.43
KNIFE GATE VALVES

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section specifies knife gate valves.

1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed references, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASME B16.5	Pipe Flanges and Flanged Fittings
MSS SP 81A	Stainless Steel, Bonnetless, Flanged Knife Gate Valves

- B. DEFINITIONS: (Not Used)

1.03 SUBMITTALS

- A. The following information shall be submitted for review:
1. A copy of this specification section, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.
 2. Manufacturer's product data.
 3. Certified factory leakage tests.
 4. The manufacturer's recommended spare parts and special tools lists.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE PRODUCTS

- A. Knife gate valves shall be manufactured by DeZURIK, Wey, FNW, or equal, modified to meet the specified requirements.

2.02 MATERIALS/EQUIPMENT

A. MATERIALS:

<u>Component</u>	<u>Material</u>
Body	Cast iron or fabricated steel
Wetted interior parts	Stainless steel, type 316
Seat rings	Neoprene or resilient polyurethane
Slide	Stainless steel, type 316
Stem	Stainless steel, type 316

B. VALVE CONSTRUCTION:

1. GENERAL:

- a. Knife gate valves shall have cast iron or fabricated steel lug bodies conforming to the general requirements of MSS SP 81. Valves shall be provided with 125- or 150-pound flanges conforming to ASME B16.5.
- 2. Knife gate valves shall be provided for the sizes and locations shown on the drawings.
- 3. Valves shall be suitable for 150 psi service and capable of withstanding a back pressure head of at least 110 psi.
- 4. All valves shall be capable of zero leakage shutoff in either flow direction where required and dead-end isolation service with the downstream pipe flange removed.

5. LINING AND SEATING:

- a. The interior of the body shall have a machined seating area to provide a smooth, uniform contact with the knife gate edge. The face of the seating area shall be fitted with a molded, replaceable reinforced neoprene ring secured to the valve body interior. The seating ring shall be designed to allow zero leakage when the valve is closed hand tight at the rated head. Seating wedges and chest buttons shall be provided to position the knife gate securely against the seating ring.

6. PACKING:

- a. The valve shall be sealed against external leakage by braided Teflon or flax packing with an adjustable packing gland.

7. SLIDE:

- a. The slide be beveled and machined to evenly match the seating area in the valve body.

2.03 NAMEPLATES

- A. Nameplates shall be provided on each item of equipment. Equipment nameplates shall be 16-gauge stainless steel bearing the equipment name and equipment number legibly engraved in 3/4-inch high letters. Nameplates shall be attached to the equipment in an accessible location with stainless steel screws.

PART 3 -- EXECUTION

3.01 GENERAL (NOT USED)

3.02 INSTALLATION

- A. Valves shall be installed to provide seating in the direction of flow.

3.03 TESTING

- A. The installed gate and operator assemblies shall be tested for proper alignment, balancing, and smooth operation.
- B. Valves shall be factory tested and certified for zero leakage.
- C. The Contractor shall provide temporary blind flanges or other means acceptable to the District Representative prior to pressure testing downstream piping.

3.04 TRAINING – NOT USED

****END OF SECTION****

SECTION 40 06 40

SCHEDULES FOR PROCESS PIPING AND EQUIPMENT PROTECTION

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section lists the type of insulation and location for exposed piping, equipment, and appurtenances. The insulation is specified in the PROCESS PIPING AND EQUIPMENT INSULATION Section (40 42 00).

1.02 REFERENCES (NOT USED)

1.03 SUBMITTALS (NOT USED)

1.04 OPERATION AND MAINTENANCE INSTRUCTIONS (NOT USED)

PART 2 -- PRODUCTS

2.01 PIPING INSULATION

A. PIPING INSULATION SCHEDULE:

1. See attached Table A.

2.02 EQUIPMENT INSULATION

A. EQUIPMENT INSULATION SCHEDULE

1. See attached Table B.

PART 3 -- EXECUTION

3.01 GENERAL (NOT USED)

3.02 INSTALLATION (NOT USED)

3.03 TESTING (NOT USED)

3.04 TRAINING (NOT USED)

Table A – Piping Insulation Schedule

PIPING SERVICE	LOCATION	INSULATION TYPE	INSULATION THICKNESS FOR PIPE SIZES IN INCHES					JACKET	COVER
			1 inch and less	1.25 to 2 inches	2.50 to 4 inches	5 to 6 inches	8 inches and larger		
SBIS & CSO	ALL	Elastomeric	½	¾	1	1	1	PVC	PVC
WP	ALL	Elastomeric	½	¾	1	1	1	PVC	PVC

Table B – Equipment Insulation Schedule

EQUIPMENT	LOCATION	INSULATION TYPE	INSULATION THICKNESS	JACKET	COVER
Miscellaneous	Outdoor	Reusable Fitting Blanket	1”		

****END OF SECTION****

SECTION 40 42 00

PROCESS PIPING AND EQUIPMENT INSULATION

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section specifies insulation for exposed piping, equipment, and appurtenances.

1.02 REFERENCES

- A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed standards, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C533	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534/C534M	Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C547	Standard Specification for Mineral Fiber Pipe Insulation
ASTM E84 Rev B	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	Standard Test Methods for Water Vapor Transmission of Materials

1.03 SUBMITTALS

- A. The following information shall be submitted for review in accordance with SUBMITTAL PROCEDURES Section (01 33 00):
1. A copy of this specification, with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

2. Manufacturer's information and catalog data showing compliance with this specification and a full description of the product.

1.04 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Submit operation and maintenance (O&M) instructions with each paragraph check marked to show compliance. O&M instructions shall be submitted after all submittals specified above have been returned mark "No Exceptions Taken" or "Make Corrections Noted." O&M instructions shall reflect the approved materials and equipment.

PART 2 -- PRODUCTS

2.01 GENERAL (NOT USED)

2.02 PIPING INSULATION

A. PIPING INSULATION SCHEDULE:

1. Refer to Table A of the SCHEDULES FOR PROCESS PIPING AND EQUIPMENT PROTECTION Section (40 06 40).

B. ELASTOMERIC TYPE:

1. ACCEPTABLE PRODUCTS: Aeroflex USA series Aerocel-SSPT; or equal, modified as required to meet the specifications.
2. MATERIAL:
 - a. EPDM closed-cell foam insulation shall conform to the requirements of ASTM C534/C534M, Type I. Temperature range: -40°F to +220°F. Insulation shall be UV-rated for installation outdoors without a jacket or coating.
 - b. Insulation seam tape shall be pre-installed in both the seam and overlap.
 - c. Include low VOC contact adhesive for end seams and custom seams.
 - d. Include seam tape for sealing all end seams and custom seams.
 - e. Include high-density foam thermal pipe hanger shields designed specifically for the elastomeric foam pipe insulation.

C. FIBERGLASS TYPE:

1. ACCEPTABLE PRODUCTS: Johns Manville Micro-Lok HP; CertainTeed Snap*On with ASJ; CertaBlue Bond SSL; or equal, modified as required to meet the specifications.
2. MATERIALS:
 - a. Fiberglass type insulation with all service jacket and self-sealing lap shall conform to the requirements of ASTM C547. Temperature range: -20°F to 850°F.

D. EXPANDED POLYSTYRENE TYPE:

1. ACCEPTABLE PRODUCTS: Dow Plastics model STYROFOAM®; or equal, modified as required to meet the specifications.
2. MATERIALS:
 - a. Expanded polystyrene rigid closed-cell foam insulation. Temperature range: -297°F to +165°F.

E. POLYISOCYANURATE TYPE:

1. ACCEPTABLE PRODUCTS: Dow Plastics model TRYMER®; or equal, modified as required to meet the specifications.
2. MATERIALS:
 - a. Polyisocyanurate closed-cell foam insulation. Temperature range: -297°F to +300°F.

F. CALCIUM SILICATE TYPE:

1. ACCEPTABLE PRODUCTS: Johns Manville Thermo-12/Gold; or equal, modified as required to meet the specifications.
2. MATERIALS:
 - a. Calcium silicate type insulation shall conform to the requirements of ASTM C533, Type I. Temperature range: +100°F to +1200°F.

2.03 EQUIPMENT INSULATION

A. EQUIPMENT INSULATION SCHEDULE:

1. Refer to Table B of the SCHEDULES FOR PROCESS PIPING AND EQUIPMENT PROTECTION Section (40 06 40).

B. ELASTOMERIC TYPE:

1. **ACCEPTABLE PRODUCTS:** Aeroflex USA series Aerocel sheet and roll insulation; or equal, modified as required to meet the specifications.
2. **MATERIALS:**
 - a. EPDM closed-cell foam insulation shall conform to the requirements of ASTM C534/C534M, Type II. Temperature range: -40°F to +220°F. Insulation shall be UV-rated for installation outdoors without a jacket or coating.
 - b. Include low VOC contact adhesive for all seams and joints.
 - c. Include seam tape for sealing all seams and joints.

C. FIBERGLASS TYPE:

1. **ACCEPTABLE PRODUCTS:** Johns Manville 800 Series Spin-Glas; CertainTeed IB Board; or equal, modified as required to meet the specifications.
2. **MATERIALS:**
 - a. Fiberglass board type insulation with FSK facing shall conform to the requirements of ASTM E84 Rev B (25/50). Temperature range: -20°F to 450°F.

2.04 INSULATION JACKETS

A. ALUMINUM JACKETS:

1. **MATERIALS:**
 - a. Aluminum jackets shall be constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 5005, temper H16, with integral vapor barrier. Jackets shall be 0.016 inch thick.
 - b. Sheet metal screws shall be aluminum or stainless steel.
 - c. Jackets shall be secured with 0.020 by 3/4 inch type 304 stainless steel expansion bands.

B. POLYVINYLCHLORIDE (PVC) JACKETS:

1. **ACCEPTABLE PRODUCTS:** Johns Manville Zeston® 300 Series PVC; or equal, modified as required to meet the specifications.
2. **MATERIALS:**

- a. PVC jackets shall be UV-resistant polyvinylchloride, 20 mil thickness, rated flame spread = 5 in accordance with ASTM E84.

2.05 INSULATION FITTING COVERS

A. POLYVINYLCHLORIDE (PVC) FITTING COVERS:

1. ACCEPTABLE PRODUCTS: John Manville Zeston® 300 Series PVC; or equal, modified as required to meet the specifications.
2. MATERIALS:
 - a. PVC fitting covers shall be one piece, pre-molded UV-resistant polyvinylchloride, 20 mil thickness, rated flame spread = 5 in accordance with ASTM E84 Rev B.

B. ALUMINUM FITTING COVERS:

1. MATERIALS:
 - a. Aluminum covers shall be constructed of smooth finish aluminum sheet conforming to ASTM B209, Alloy 5005, temper H16, with integral vapor barrier. Covers shall be 0.016 inch thick.

2.06 REUSABLE FITTING BLANKETS

A. MATERIALS:

1. Reusable fitting blankets shall be designed for access to valves, flanges, etc. The reusable blanket shall be custom sewn, with TFE-coated fiberglass cloth jacket and liner, fiberglass insulation and stainless steel lacing anchors.

2.07 SHIELDS

- ### **A. Thermal pipe hanger shields shall be provided at pipe supports. Thermal hanger shields shall be as specified in the HANGERS AND SUPPORTS FOR PROCESS PIPING Section (40 05 57).**

2.08 ANTI-CONDENSATION COATING

- ### **A. ACCEPTABLE PRODUCTS: Chemicoat Inc. model Aquaban; or equal, modified as required to meet the specifications.**

B. MATERIALS:

1. Water-based coating for direct application to galvanized steel, mild steel, bonderite steel, PVC, masonite, concrete, wood, and aluminum. Coating shall be non-toxic

and fire resistant. Coating shall prevent condensation from forming on the coated surface.

PART 3 -- EXECUTION

3.01 GENERAL (NOT USED)

3.02 INSTALLATION

A. PIPING:

1. Install insulation in accordance with the drawings and the manufacturer's recommendations. Seal off ends of fiberglass insulation with vapor barrier coating.
2. Install jacketing and fitting covers in accordance with the drawings and the manufacturer's recommendations. Locate seams on underside of piping. Form aluminum caps to fit over the adjacent jacketing and to completely cover coated insulation ends. Secure caps in place with a jacket strap.
3. Install reusable fitting blankets on valves and on flanges where access is required. Seal ends of pipe insulation.

B. PUMPS:

1. Do not insulate pumps.
2. Coat chilled water pumps with anti-condensation coating in accordance with the manufacturer's recommendations. Surface preparation shall be in accordance with the manufacturer's recommendations.

C. MECHANICAL EQUIPMENT:

1. Install insulation in accordance with the drawings and the manufacturer's recommendations.
2. Install jacketing and fitting covers in accordance with the drawings and the manufacturer's recommendations. Locate seams on underside of piping. Form aluminum caps to fit over the adjacent jacketing and to completely cover coated insulation ends. Secure caps in place with a jacket strap.
3. Install reusable fitting blankets on piping connections to equipment where access is required. Seal ends of pipe insulation.

****END OF SECTION****