SECTION 16123 – WIRE AND CABLE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Building wire.

B. Underground feeder and branch circuit cable.

C. Instrumentation cable.

D. Wiring connectors and connections.

1.02 RELATED SECTIONS

A. Section 16050 - Electrical General Requirements.

B. Section 16110 - Raceways.

1.03 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. Underwriters' Laboratories Standard UL-83.

C. Federal Specification JC-30A.

D. ANSI Standard C33.80.

E. ICEA - Insulated Cable Engineers Association.

F. ASTM - American Society for Testing and Materials.

1.04 SUBMITTALS

A. Product Data: Provide for all cables.

B. Test Reports: Indicate procedures and values obtained.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.

1.05 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Wire and cable routing shown on Drawings is approximate. Route wire and cable as required to meet Project Conditions.

C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.06 COORDINATION

A. Determine required separation between cable and other work.

B. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.01 GENERAL

A. All wires and cables shall be permanently identified, at intervals not exceeding 3 feet, indicating type, size, voltage rating, and manufacturer’s name.

B. All wires and cables shall be continuous and shall be delivered in reels or in coils. Reels and coils shall be plainly marked for complete identification, including the wire or cable size, the number of conductors, the type of wire of cable, length, weight, thickness and character of the insulation, and the name of the manufacturer.

C. All coils and reels of wires or cables shall carry original date for inspection labels of the Underwriter’s laboratories, Inc. showing the number of feet and type of wire contained.

2.02 MANUFACTURERS - BUILDING WIRE

A. Rome

B. Triangle

C. General Cable

D. American Insulated Wire Corporation

2.03 BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor: Annealed, uncoated copper. All conductors shall be stranded. ASTM designation B-3.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: ANSI/NFPA 70, Type THWN; high temperature polyvinyl chloride with nylon jacket.

E. Conductor Temperature Rating: 75 ^{0}C in wet locations; 90 ^{0}C in dry locations.

2.04 MANUFACTURERS - MULTICONDUCTOR UNDERGROUND FEEDER, BRANCH- CIRCUIT, AND CONTROL CABLE

A. Brand Rex Type XL-TC

B. American Insulated Wire Corporation

C. Rome

2.05 MULTICONDUCTOR UNDERGROUND FEEDER, BRANCH-CIRCUIT, AND CONTROL CABLE

A. Description: Multiple Conductor with PVC Jacket, ANSI/NFPA 70, Type TC.

B. Conductor: Annealed, uncoated, stranded copper; ASTM Designation: B-3.

C. Insulation voltage rating: 600 volts.

D. Conductor insulation: cross-linked polyethylene Type XHHW.

E. Conductor temperature rating: 75 ^{0}C in wet locations; 90 ^{0}C in dry locations.

F. Ground conductor: Each cable assembly shall contain a bare copper or green insulated copper ground conductor of 50% capacity (minimum) of the phase conductors.

G. All cables shall meet the requirements of Article 340 of the National Electrical Code.

2.06 MANUFACTURERS - INSTRUMENTATION CABLE

A. Single Pair Cable:

1. Belden No. 8760

2. American Insulated Wire Corporation

B. Multiple Pair Cable:

1. Belden No. 9773 through No. 9777

2. American Insulated Wire Corporation

C. Three-Conductor Cable:

1. Belden No. 8770.

2. American Insulated Wire Corporation

2.07 INSTRUMENTATION CABLE

A. Description, general:

1. Single pair cable shall be a single twisted pair, No. 18 gauge, stranded conductors with shield, drain wire, and overall jacket.

2. Multiple pair cable shall be two or more individual twisted pair, No. 18 gauge, stranded conductors, and each pair with shield and drain wire, and an overall jacket.

3. Three-conductor cable shall be three No. 18 gauge, stranded conductors with shield, drain wire, and overall jacket.

B. Underground and General Use Cables:

1. Conductors: Tinned copper.

2. Insulation voltage rating: 300 volts.

3. Insulation material:

   a. Single pair cable - polyethylene.
   b. Multiple pair cable - polyethylene or polypropylene.
   c. Three-conductor cable - polyethylene.

4. Shield material: 100% aluminum polyester.

5. Drain wire: Stranded, tinned copper.

6. Jacket: Chrome vinyl (PVC).

2.08 MANUFACTURERS - WIRING CONNECTORS AND ASSOCIATED MATERIALS

A. Substitutions: Under provisions of Section 01600.

B. Split bolt connectors:

1. Thomas & Betts

2. Burndy Model Servit Type KS

3. Anderson Model Type C

C. Solderless Pressure Connectors:

1. 3M Company Model Scotchlok

2. Thomas & Betts Model Sta-Kon

3. Burndy Model Insulug Type TN

D. Spring Wire Connectors:

1. 3M Company Model Scotchlok

2. Ideal Model Wing-Nut

E. Compression Connectors:

1. 3M Company Model Scotchlok

2. Thomas & Betts Model Color-Keyed

3. Burndy Model Hylug

F. Tap Connectors:

1. Thomas & Betts Model Color-Keyed

2. Burndy Model Crimpit

3. Anderson Model Crimptaps

G. Watertight, Twist-On Connectors:

1. 3M Company Direct Bury Splice Kits

3. Ideal Industries, Inc. Twister DB Plus

H. Watertight, Insulated Connector Blocks:

1. Utilco Type USPA-SS, Type PSA-SS, or Type PED-SS

2. Ilsco Type USPA-SS

I. Electrical Insulating Tape:

1. 3M Company ``Scotch" No. 33+

2. Plymouth ``Premium Black"

J. High Temperature Tape:

1. 3M Company "Scotch" No. 70

2. Plymouth No. 50

K. Fireproofing Tape:

1. 3M Company "Scotch" No. 77

2. Plymouth No. 50

L. Woven Fiberglass Tape:

1. 3M Company "Scotch" No. 69

2. Plymouth "Plyglas"

M. Color Coding Tape:

1. 3M Company "Scotch" No. 35

2. Plymouth "Slipknot" No. 45

N. Insulating and Watertight Sealing Materials:

1. 3M Company "Scotchcast" kits

2. Raychem WCS Series heat shrinkable sleeves

3. 3M Company 8400 Series cold shrink materials

O. Metal Clad Cable Fittings:

1. PLM Products JAG Series and TFA Series

P. Cable or Cord Strain Relief:

1. Hubbell-Kellems

2. Daniel Woodhead Co.

2.09 WIRING CONNECTORS AND ASSOCIATED MATERIALS

A. All wiring connectors shall be 90^0C rated and suitable for use on copper conductors.

B. Cable or cord strain reliefs shall consist of stainless steel wire mesh with support bale. Strain reliefs shall be of the split rod type where required or indicated on the Drawings.

C. Metal Clad Cable Fittings:

1. Fittings for terminating cables shall conform to NEMA Standards.

2. Individual items shall be the coordinate design of one manufacturer and shall be constructed from quality materials with smooth surfaces; clean, close-fitting threads; and free of sharp edges, burrs, or other defects.

Fittings shall be furnished complete with locknuts, bushings, or other required accessories.

3. When installed, the cable-clamping element shall provide secure mechanical strength against cable pullout or rotation and provide permanent electrical contact between fitting and metal armor without crushing or distorting either the armor or the cable insulation.

4. Fittings shall be made from steel, with a corrosion resistance coating.

5. The clamping element shall consist of a fixed base with an adjustable clamp containing a contoured lip for close engagement with the armor convolutions. Clamping fasteners shall be accessible from one side and shall be limited to slotted head for screwdriver installation. Clamp range shall not exceed 200 mils per fitting.

6. Gasketed fittings shall provide permanent, watertight seals, unless otherwise noted. All gaskets shall be neoprene. The gasket clamping surfaces shall be smooth and tapered to provide uniform pressure on the gasket.

7. Fittings for jacketed armor cable shall provide a closed neoprene gasket seal to the outer cable jacket, contain a stop to prevent the metal armor from passing through the fitting, and provide a permanent, secure method of grounding the metal armor to the fitting.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that mechanical work likely to damage wire and cable has been completed.

3.02 WIRING METHODS

A. Wire for general power, light, and control shall be building wire, Type THWN insulation, in raceway, where indicated.

B. Use wiring methods indicated on Drawings.

C. Color Coding:

1. The color schedule for the conductor insulation of wire and cable shall conform to the following:

   a. Three phase lighting and power, 208Y/120 VAC-Black, Red, Blue, White, and Green ground.
   b. Three phase power, 480 VAC, bare ground.
   c. Motor control, metering and relay circuits - 120 VAC - Red.
   d. Automatic pump control - 120 VAC - Yellow.
   e. Exciter - 250VDC - Black.
   f. Battery and control - 125VDC - Black and Red.
   g. Supervisory telemetering and alarm (if not shielded) - Orange.
   h. On wire sizes larger than Number 8 AWG and/or where authorized by the Engineer, coding may be identified by taping with the appropriate colored self-adhesive vinyl color-coding tape.
   i. Grounding conductors shall be continuous green or bare for all systems.
   j. Neutral conductors shall be continuous white for all systems.

D. The installation of intrinsically safe circuits shall meet all requirements of the NEC.

E. Wiring Connections:

1. Splices shall not be permitted unless approved by the Engineer.

2. Dry location tap connections shall consist of split bolt connectors, compression connectors, or tap connectors, taped to 150% of insulation rating of the conductors.

3. Final connections to equipment wire leads for No. 8 AWG and smaller wire in dry locations only, except 480-volt motor leads, may be made with spring wire connectors.

4. Wet and damp location tap connections shall consist of split bolt connectors, compression connectors, or tap connectors with insulating and watertight sealing materials; water tight, twist-on connectors for wire sizes up to three No. 10 AWG; or watertight, insulated connector blocks; providing watertight connections suitable for direct burial.

5. All conductor terminations at screw terminals shall consist of solderless pressure connectors, except where conductor terminations are included with the equipment being connected.

6. Insulation of connections in lighting fixture and high temperature equipment shall consist of silicone rubber type high-temperature tape with a woven fiberglass tape over-wrap.

7. Electrical insulting tape (plastic type) shall be used on all tap connections, unless wire manufacturer's recommendations require otherwise.

3.03 INSTALLATION

A. All wiring shall be run in 3\4” rigid metal raceway systems, unless noted otherwise.

B. Install products in accordance with manufacturers instructions.

C. The minimum size of conductors shall be No. 12 AWG, unless specifically approved and/or shown otherwise on the Drawings.

D. Use stranded conductors for control circuits, No. 14 AWG minimum, unless shown otherwise on the Drawings.

E. Multiconductor underground feeder, branch-circuit, and control cable shall meet the requirements of Article 340 of the National Electrical Code.

F. Use No. 10 AWG conductors for 20 ampere, 120-volt branch circuits longer than 60 feet.

G. Use No. 8 AWG conductors for 20 ampere, 120-volt branch circuits longer than 100 feet.

H. Use No. 6 AWG conductors for 20 ampere, 120-volt branch circuits longer than 170 feet.

I. Use No. 4 AWG conductors for 20 ampere, 120-volt branch circuits longer than 270 feet.

J. Use No. 3 AWG conductors for 20 ampere, 120-volt branch circuits longer than 420 feet.

K. Pull all conductors into raceway at same time. Cable pulling tensions shall not exceed manufacturer’s recommended values.

L. Use approved wire pulling lubricant for wire, No. 4 AWG and larger, and for all cables. No soap flakes, vegetable oils, clays, or grease shall be permitted in raceways.

M. Use suitable cable fittings and connectors.

N. Neatly train and lace wiring inside boxes, equipment, and panelboards. Wires and cables shall be bundled and laced as specified in Section 16190.

O. Clean conductor surfaces before installing lugs and connectors.

P. Make taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

Q. Wire and cable shall be supported in vertical runs by insulated clamps so that wire or

cable weight will not be unduly supported from conductor terminations.

R. Spade or fork tongue lugs shall not be used, except where approved by the Engineer.

S. Wires and cables shall be installed in raceways, as indicated on the Drawings or required, and shall provide a complete and operating system.

T Motor control center feeder circuits and distribution panelboard branch circuits shall each be run in individual raceways from source to motor or other load.

U. Vertical lengths of wire and cable shall be supported as required by Article 300-19 of the National Electrical Code. Cable weight shall not be unduly supported from conductor terminations.

V. Vertical lengths of exposed cable or cord runs over ten feet shall be supported with a strain relief.

W. All 120 VAC, single-phase loads shall be connected to provide a balanced load on the lighting transformers. All 480 VAC, single-phase loads shall be connected to provide a balanced load on the 480 VAC, three phase system.

X. Make conductor length for parallel feeders identical on each phase leg.

Y. Feeders shall be connected for correct phase rotation. Where possible, busses shall be connected to result in the ``A" or ``X" phase being in the north, east, or

top position with the other phases following in sequence. The terminals H1, H2, and H3 of transformers shall be connected to A, B, and C; 1, 2, and 3; or X, Y, and Z conductors, respectively, of incoming feeders.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 16195.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.05 FIELD QUALITY CONTROL

A. Inspect wire and cable for physical damage and proper connection.

B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

C. Verify continuity of each branch circuit conductor.

D. Verify continuity of each feeder conductor.

END OF SECTION 16123