

## SECTION 16120 - WIRES AND CABLES

### PART 1 - GENERAL

#### SUMMARY

Section includes the following:

1. Low-Voltage Wire and Cable.
2. Medium-Voltage Cable.
3. Instrument Cable.
4. Multiconductor Control Cable.
5. Telephone Cable.
6. Local Area Network Wiring (LAN).

#### SUBMITTALS

Shop Drawings: Submit shop drawings covering the items included under this Section. Include Shop Drawings of wires, cables, connectors, splice kits, and termination assemblies.

Reports of field tests.

#### QUALITY ASSURANCE

UL Compliance: Provide components which are listed and labeled by UL. For cables intended for use in air handling space comply with applicable requirements of UL Standard 710, "Test Method for Fire and Smoke characteristics of cables used in Air Handling Spaces."

NEMA/ICEA Compliance: Provide components which comply with following standards:

1. NEMA WC 70-1999/ICEA S-95-658-1999, Nonshielded Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
2. NEMA WC 71-1999/ICEA S-96-659-1999, Standard for Nonshielded Cables Rated 2,001-5,000 Volts for use in the Distribution of Electrical Energy.
3. NEMA WC 74-2000/ICEA S-93-639, 5-46 kV Shielded Power Cable for use in the Transmission and Distribution of Electrical Energy.

IEEE Compliance: Provide components which comply with the following standard.

1. Standard 82, Test procedures for Impulse Voltage Tests on Insulated Conductors.

Network Wiring Experience: CONTRACTOR must be able to prove to the satisfaction of OWNER that it has significant experience in the installation of Local Area Network cable systems. Installation must include installation of Network cable, cable termination, knowledge of interconnect equipment, and a thorough knowledge of testing procedures.

Labeling: Handwritten labels are not acceptable. All labels shall be machine printed on clear or opaque tape, stenciled onto adhesive labels, or typewritten onto adhesive labels. The font shall be at least 1/8 inch in height, block characters, and legible. The text shall be of a color contrasting with the label such that it may be easily read. If labeling tape is utilized, the font color shall contrast with the background. Patch panels shall exhibit workstation numbers or some type of location identifier, in sequential order, for all workstations or devices attached. Each Network cable segment shall be labeled at each end with its respective identifier.

Network Wiring Interconnect Equipment (Patch Panels): Interconnect equipment shall be used in all Local Area Network cable installations. Patch panels shall be mounted in the equipment racks or panel mounted. Interconnect equipment mounted in racks shall be affixed to the rack by at least 4 screws. All interconnect devices shall be assembled and installed in accordance with the manufacturer's instructions and recommendations.

Patch Cords: Patch cords shall be provided for each Local Area Network port on the patch panel. Patch cords shall meet or exceed technical specifications of all installed Local Area Network cable. Patch cord connectors shall be matched with patch panel connector type and network module connector type as required.

## PART 2 - PRODUCTS

### MANUFACTURERS

Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Low-Voltage Wire and Cable:
  - a. American Insulated Wire Corp.
  - b. General Cable.
  - c. The Okonite Co.
  - d. Southwire Co.
2. Connectors for Low-Voltage Wires and Cable Conductors:
  - a. AMP.
  - b. O-Z/Gedney Co.
  - c. Square D Company.
  - d. 3M Company.
3. Medium-Voltage Cable:
  - a. American Insulated Wire Corp.
  - b. General Cable.
  - c. Kerite Co.
  - d. The Okonite Co.
  - e. Prysmian Cables & Systems.
  - f. Southwire Co.
4. Medium-Voltage Cable Splicing and Terminating Products and Accessories:
  - a. Adelet-PLM.
  - b. Amerace Corp.
  - c. Electrical Products Division 3M.
  - d. G&W Electric Co.
  - e. M.P. Husky Corp.
  - f. Raychem Corp.
  - g. RTE Components.
5. Instrument Cable:
  - a. Belden (Trade Nos. 1120A and 1118A).
6. Local Area Network Cable:
  - a. Belden 7882A/7883A, or equal.

## LOW-VOLTAGE WIRES AND CABLES

Conductors: Provide stranded conductors conforming to ASTM Standards for concentric stranding, Class B. Construction of wire and cable shall be single conductor (1/c) unless multiconductor cable is shown by notation in form (x/c) where x indicates the number of separate insulated conductors per cable.

Conductor Material: Copper. Minimum size power wire shall be No. 12 AWG.

Insulation: Provide RHW/USE insulation for power conductors used in single- and 3-phase circuits with more than 120 volts to ground. Provide RHW/USE, XHHW, or THWN/THHN insulation for power conductors used in single- and 3-phase circuits with 120 volts or less to ground

1. Provide RHW, THHN/THWN, or XHHW insulation for grounding conductors installed in raceways.
2. Provide THHN/THWN insulation for control conductors.

## CONNECTORS FOR LOW-VOLTAGE WIRES AND CABLES

Provide UL listed factory fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types, and classes for applications and services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

## MEDIUM-VOLTAGE CABLE

Cable shall be single-conductor type, size as indicated, and conforming to UL Standard 1072, "Medium Voltage Power Cables."

Cable shall be cross-linked-polyethylene (XLP) insulated and shall conform to NEMA Standard WC 74-2000 (ICEA S-93-639), "5-46 kV Shielded Power Cable for use in the Transmission and Distribution of Electrical Energy."

OR

Cable shall be ethylene propylene rubber (EPR) insulated and shall conform to NEMA Standard WC 74-2000 (ICEA S-93-639) "5-46 kV Shielded Power Cable for use in the Transmission and Distribution of Electrical Energy."

Conductors: Class B stranded, annealed copper.

Conductor Shield: Extruded, semiconducting.

Insulation Shield: Extruded, semiconducting.

Concentric Neutral: Evenly spaced, annealed, coated, solid copper wires applied concentrically over semiconducting insulation shield. Individual wires shall be No. 14 AWG minimum. Concentric neutral ampacity shall be not less than 1/3 the ampacity of central conductor.

Metallic Shielding: Copper shielding tape, helically applied over semiconducting insulation shield or evenly spaced solid copper wires applied concentrically over semiconducting insulation shield.

Cable Jacket: Sunlight-resistant PVC, cross-linked polyolefin, or chlorosulfonated polyethylene (hypalon).

Cable Voltage Rating: 5 kV phase to phase.

Cable Voltage Rating: 8 kV phase to phase.

Cable Voltage Rating: 15 kV phase to phase.

Cable Voltage Rating: 25 kV phase to phase.

Cable Voltage Rating: 28 kV phase to phase.

Cable Voltage Rating: 35 kV phase to phase.

Cable Voltage Rating: 46 kV phase to phase.

#### MEDIUM-VOLTAGE SPLICING AND TERMINATING PRODUCTS

Types: Compatible with cable materials and shall be suitable for indoor or outdoor environments as required.

Connectors: Compression type as recommended by cable or splicing kit manufacturer for application.

Splicing and Terminating Kits: As recommended by manufacturer in writing for specific sizes, ratings, and configurations of cable conductor, splices, and terminations specified. Kits shall contain components required for a complete splice or termination including detailed instructions and shall be the product of a single manufacturer. Completed splices and terminations shall provide insulation equivalent to the insulation class of cable it connects and maintain current carrying capacity and mechanical strength of cable.

#### INSTRUMENT CABLE

Instrument Cable: 600 volt minimum insulated shielded cable with two or more twisted No. 16 or No. 18AWG stranded copper conductors; PVC, nylon, or polyethylene outer jacket; and 100 percent foil shielding.

#### MULTICONDUCTOR CONTROL CABLE

Multiconductor Control Cable: Concentrically cabled No. 14 AWG stranded copper conductors with saturated interstitial fillers; overall binder of nylon or similar material; and PVC jacket. Quantity of conductors shall be as indicated on Drawings. Provide Type 2010 individual conductor insulation unless otherwise indicated on Drawings as one of the following:

3. Type ISS: 15 mils polyethylene with 5 mils nylon.
1. Type 2010: 20 mils polyethylene with 10 mils PVC.
2. Type 3015: 30 mils polyethylene with 15 mils PVC.

#### TELEPHONE CABLE

Telephone Cable: Insulated and paired solid soft copper conductors with color coding per Telephone Industry Standards and IPCEA 5-56-454-1 and insulation thickness per IPCEA 61-402. Telephone cable installed in underground ducts shall be shielded with a 3 mil copper tape and shall be provided with an overall high molecular weight polyethylene jacket. Telephone cable installed by direct burial shall be shielded with a 10 mil copper tape or two five mil tapes of opposite lay and shall be provided with an overall high molecular weight polyethylene jacket.

## LOCAL AREA NETWORK CABLE

### Category 6 (Ethernet) Data and Patch Cable:

1. Paired, 4-pair, 24 AWG, solid bare copper conductors with polyethylene insulation, overall aluminum foil-polyester tape shield with 24 AWG stranded tinned copper drain wire, 100 percent shield coverage, PVC jacket.
2. UL verified to Category 6.
3. Provide plenum rated cable where installed exposed.

## PART 3 - EXECUTION

### FIELD QUALITY CONTROL

Prior to energizing, check installed 480 volt, 3-phase power circuits and higher wires and cables with a 1,000-volt megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Minimum acceptable megohm meter reading is 100 megohms held at a constant value for 15 seconds. A certified copy of megohm meter tests shall be submitted to ENGINEER. Test reports shall include ambient temperature and humidity at time of testing. Notify ENGINEER 48 hours prior to test with schedule.

Medium-Voltage Cable Tests shall include high-potential test of cable and accessories and such tests and examinations required to achieve specified objectives. Where new cables are spliced to existing cables, high-potential test shall be performed on the new cable prior to splicing. After test results for new cables are approved and splice is made, an insulation resistance test and continuity test on the length of cable including the splice with existing cables being tested to the nearest disconnect point.

Local Area Network (LAN) Cable Tests: Testing of all cable segments shall be completed in compliance with EIA/TIA-568-B.1 Standards. Testing shall be done by CONTRACTOR with at least 5 years of experience in testing Network cabling systems.

1. **TESTING:** CONTRACTOR shall test each network cable segment. **OWNER reserves the right to have representation present during all or a portion of the testing process. CONTRACTOR must notify OWNER 5 days prior to commencement of testing.** If OWNER elects to be present during testing, test results will only be acceptable when conducted in the presence of OWNER.
2. **DOCUMENTATION (Network Cable):** CONTRACTOR shall provide documentation to include test results and as-built Drawings. Network Cable Results: Handwritten results are acceptable provided the test is neat and legible. Copies of test results are not acceptable. Only original signed copies will be acceptable.
  - a. Each cable installed shall undergo complete testing in accordance with TIA/EIA-568-B.1 to guarantee performance to this Standard.
  - b. All required documentation shall be submitted within 30 days at conclusion of the project to OWNER.
  - c. Test Criteria: Pass rate to conform to latest TIA/EIA-568-B.1 Standards that incorporate link performance testing through entire path, including cable, couplers, and jumpers.
3. **ACCEPTANCE:** Acceptance of the Data Communications System, by OWNER, shall be based on the results of testing, functionality, and receipt of documentation.

Reports (non-LAN cable): Testing organization shall maintain a written record of observations and tests, report defective materials and workmanship, and retest corrected defective items. Testing organization shall submit written reports to ENGINEER.

END OF SECTION 16120