CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.

2. Division 26 Section "Electrical Identification" for conductor and cable color-coding.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Qualification Data: For testing agency.
C. Field Quality-Control Test Reports: From a qualified testing and inspecting agency engaged by Contractor.

1.4 QUALITY ASSURANCE
A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency’s Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Manufacturers, Copper:

1. Aetna.
2. Cerro Wire.
3. Encore.
4. Prysmian.
5. Service Wire.
7. United Copper.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

D. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

E. Conductor Material: Copper complying with NEMA WC 70; stranded conductor.

F. Conductor Insulation Types: Type THHN-THWN, complying with NEMA WC 70.

G. Power Cable for Variable Frequency Controlled Motors: 600V and 2000V, three conductor, XLPE cable with three symmetrical positioned ground conductors and a continuous impervious corrugated aluminum armor and overall PVC jacket. Cable shield transfer impedance shall be less than 10 ohms per meter up to 30 MHZ when tested in accordance with NEMA WC 61.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Approved manufacturers for VFC power cables:

   a. Southwire Armor-x
   b. Draka USA

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.
6. T & B.
7. Burndy.
8. ILSCO.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

G. Underground Feeders and Branch Circuits: XHHW single conductors in conduit.


I. Fire Alarm Circuits: Type THHN-THWN, in raceway.

J. Class 1 Control Circuits: Type THHN-THWN, in raceway.

K. Connection between Variable Frequency Controllers and Motors: Use 600V rated VFC power cable for circuit lengths less than 50 feet and 2000V rated VFC power cable for circuit lengths 50 feet and greater. Support 5’ on center, minimum. Terminate according to cable manufacturer’s recommendations.

L. Isolated Power System Circuits: Use Type XLP in raceway.
3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."

G. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).

H. Identify and color-code conductors and cables according to Division 26 Section "Electrical Identification."

I. All wiring shall be installed in conduit or approved raceway. All raceways shall be provided with a ground conductor unless noted otherwise on the Contract Documents.

J. Use conductor not smaller than 12 AWG for power and lighting circuits. Unless indicated otherwise, all circuits shall be 2#12, 1#12G, ¾"C.

K. Use conductor not smaller than 14 AWG for control circuits, provided by Electrical Contractor.

L. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.

M. Use suitable cable fittings and connectors.

N. Neatly train and lace wiring inside boxes, equipment, and panelboards.

O. Clean conductor surfaces before installing lugs and connectors.

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

Q. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.

R. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.

S. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

T. Branch circuits may be combined up to 3 circuits in a homerun conduit.

U. Provide a separate neutral conductor for each circuit.
V. Electrical Contractor shall be responsible for derating of conductors as required by N.E.C.

W. AC/MC cable shall not be used.

X. Between support, hangers and termination no more than 3” deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
   2. Use compression type terminations for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”
   1. Description: Test all feeders rated 100 A and above.
   2. Visual and Mechanical Inspection
      a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
      b. Test cable mechanical connections with an infrared survey.
      c. Check cable color-coding against project Specifications and N.E.C. requirements.
   3. Electrical Tests
      a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
      b. Perform continuity test to insure proper cable connection.
   4. Test Values
      a. Minimum insulation resistance values shall be not less than fifty mega-ohms.

B. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
WIRE AND CABLE
MARCH 17, 2008

1. Material: Copper conductors of 98 percent conductivity shall be used unless use is restricted by Government Agencies.
   a. All medium voltage distribution cables shall be UL listed, 1/c, copper, mil Ethylene propylene rubber (EPR) insulated, 15 Kv, 133% rated, shielded, MV 105 degrees C. Feeders shall consist of three (3) primary cables and one (1) 3/0 neutral. Extension or modification of existing 4800 volt or 13,200 volt cables can only be done with prior written approval of the University Facilities Operations Principal Engineer or Electric Utilities Shop.

2. Secondary Conductors:
   a. Color Coding
      i. Color coding for 480/277V and 208Y/120V shall be as follows:

      | Phase          | Voltage (208Y/120) | Voltage (480Y/277) |
      |----------------|-------------------|-------------------|
      | Neutral        | White*            | Gray*             |
      | A              | Black             | Brown             |
      | B              | Red               | Orange            |
      | C              | Blue              | Yellow            |
      | Equipment Ground | Green            | Green             |
      | Isolated Ground | Green with Yellow Stripe | Green with Yellow Stripe |

      *Each with identifiable color stripe
   
   b. Solid and Stranded Wire: No. 14 AWG and smaller may be solid. No. 12 and larger shall be stranded.
   c. Minimum Size for Lighting and Power Branch Circuits: No. 12 AWG.
      i. Use No. 14 AWG stranded for control wiring and auxiliary system circuits.
   d. Field installed cords to portable equipment shall be Type ST or SO and field installed cords for normal equipment shall be Type SRDT or SPT-3 containing identified equipment.
   e. Circuit wiring through ballast channels of fluorescent fixtures shall be 600-volt, 90-1 degrees C insulation. Fixture must be approved for through wiring, if thus used.
   f. General Use Insulation: NEC, 600-volt type THHN/THWN or XHHW.
   g. Connections in No. 10 and smaller wire shall be made with threaded-on plastic or nylon insulated wire nuts. Crimp connectors, except butt connectors are prohibited. Joints in No. 8 and larger conductors shall be made with pre-insulated mechanical lugs.

**END OF SECTION**