



**SPECIAL PROVISIONS  
FOR  
MEDIUM VOLTAGE CABLE**

**Woodbury County  
IM-NHS-029-7(46)149--03-97**

**Effective Date  
December 15, 2015**

**THE ENGLISH STANDARD SPECIFICATIONS, SERIES OF 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS. THESE ARE SPECIAL PROVISIONS AND SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.**

**150028.01 GENERAL.**

**A. Section Includes.**

1. Medium voltage cable.
2. Medium voltage cable terminations.
3. 600V conductor for ground.

**B. References.**

1. ANSI/IEEE C2 - National Electrical Safety Code.
2. ANSI/NFPA 70 - National Electrical Code (NEC-326).
3. IEEE 48 - Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations.
4. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
5. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
6. NEMA WC 7 - Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
7. NEMA WC 8 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

8. UL-1072 (Type MV-105).

**C. Submittals.**

1. See appropriate sections of Iowa DOT Standard Specifications for submittal procedures.
2. Product Data: Provide for cable, terminations, and accessories.
3. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
4. Maintenance Data: Include instructions for testing, cleaning, and terminating cable and accessories.
5. **Production Tests.**

All testing required will be on samples from cable-run of product to be used on project. Test data and actual cable sample showing identifying legend above will be submitted to the Engineer as part of the shop drawing submittal.

  - a. Conductors shall meet electrical resistance requirements of ICEA S-639 and S-682.
  - b. Insulation Resistance test shall be performed in accordance with the requirements of ICEA S-639 and S-682. Each cable shall have an insulation resistance not less than that corresponding to the insulation resistance constant of at least 50,000 megohms - 1000 feet at 15.6C.
  - c. Shield resistance is measured and recorded from end to end on completed cable.
6. Test Reports: See Field Quality Control in this Special Provision for information on Test Reports submittals.
7. Project Record Documents: Record actual sizes and locations of cables. Record reel number used for each cable pull.

**D. Quality Assurance.**

1. Manufacturer: Company specializing in manufacturing Products specified in this Special Provision with minimum 3 years documented experience and with service facilities within 100 miles of Project.
2. Installer Qualifications: See Field Quality Control in this Special Provision.
3. Conform to requirements of ANSI/NFPA 70.
4. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

**E. Delivery, Storage, and Handling.**

1. Accept cable and accessories on site in manufacturer's packaging. Inspect for damage.
2. Store and protect in accordance with manufacturer's instructions.
3. Protect from weather. Provide adequate ventilation to prevent condensation.

**F. Project / Site Conditions.**

1. Verify that field measurements are as shown on plans.

2. Verify routing and termination locations of cable bank prior to rough-in.
3. Cable routing is shown on plans in approximate locations unless dimensioned. Route as required to complete wiring system.

**G. Warranty.**

Manufacturer shall warrant specified equipment to be free from defects in materials and workmanship for 2 years from date the equipment is energized and the Contracting Authority begins receiving useful benefit from equipment. Verify date with Engineer.

**150028.02 MATERIALS.**

**A. Medium Voltage Cable.**

1. Description: Jacketed Concentric Neutral Cable, Type MV-105, UL-1072 listed, ethylene-propylene rubber (EPR) insulated wire and cable for the transmission and distribution of electrical energy. Cables shall be rated for direct burial and installation in ducts. Cables shall meet ICEA S-94-649.
2. Voltage Rating: 15 kV.
3. Size: As indicated on plans.
4. Conductor: Stranded aluminum filled with a semi-conducting compound to prevent possible water migration along the conductor.
5. Conductor Screen: Extruded semiconducting EPR.
6. Insulation: EPR, 133% insulation level.
7. Insulation Screen: Extruded semiconducting ethylene-propylene rubber.
8. Concentric Conductor: Bare copper strands, 1/3 neutral rating.
9. Jacket: Extruded polyethylene or PVC, black with red ID stripe.
10. Temperature Rating: 105°C continuous operating temperature.
11. Cable end seals:
  - a. Provide and install 3M cable end seal kits at medium voltage cable open ends.
  - b. Install in accordance with manufacturer installation instructions.
12. Manufacturers.
  - a. Okonite.
  - b. Superior Essex.
  - c. General Cable.
  - d. Pirelli.
  - e. Engineer approved equivalent.

**B. Cable Termination.**

1. Dead Front Terminations: 200A modular cable terminators, IEEE 48, Class 1, molded-rubber cable termination in kit form with stress cone, ground clamp, non-tracking rubber skirts, load break connector, rubber cap, and aerial lug. Size terminator per conductor size and cable diameter.

2. Live Front Terminations: 200A cable terminator IEEE 48, Class 1 silicone rubber insulator cable terminator in kit form.

**3. Cable Lugs.**

- a. Lugs shall be circumferential compression type. No indent compression.
  - b. Lugs shall be rated for the cable size and capacity being used.
  - c. Cable lugs shall be high conductivity copper with corrosion resistant plating suitable for terminating copper or aluminum conductors.
4. Termination Kits appropriate for voltage and location (indoor/outdoor) as indicated on plans.
    - a. Cable terminations shall be a factory engineered kit suitable for cable being terminated.
    - b. Termination kit shall contain the following:
      - 1) Installation instructions.
      - 2) All necessary components required for the splice kit being used.

**5. Splice Kits.**

- a. Splice kits shall be for jacketed, single concentric neutral cable with a minimum voltage rating as the cables being spliced.
- b. Splice kits shall be compatible with the conductor sizes, insulation and outer jacket type/diameter.
- c. Center conductor splice shall be a crimp-type butt connector.
- d. Splices shall be listed for direct burial and for installations in underground raceway applications.

**6. Manufacturers.**

- a. Raychem.
- b. 3M.
- c. Elastimold.
- d. Engineer approved equivalent.

**C. Pulling Lubricants.**

Pulling lubricant shall be listed by manufacturer as compatible with cable being pulled. Pulling lubricant shall contain no waxes, greases, silicones, or glycol oil or waxes. Pulling lubricant shall be rated for the air temperature for which the installation is being performed. Pulling lubricant shall be water-based.

**D. 600 Volt Conductor.**

600V Conductor used for circuit ground: Stranded aluminum, Type RHW insulation black in color, size as indicated on plans. Mark conductor with colored phasing tape at all splices, junctions, and terminations.

**150028.03 CONSTRUCTION.**

**A. Examination.**

1. Verify that conduit or duct is ready to receive cable.
2. Verify that field measurements are as indicated.
3. Verify routing and termination locations of cable bank prior to rough-in.
4. Cable routing is shown in approximate locations unless dimensioned. Route as required to complete wiring system.

**B. Preparation.**

Use swab to clean conduits and ducts before pulling cables.

**C. Installation.**

1. Install cable and accessories in accordance with manufacturer's instructions.
2. Avoid abrasion and other damage to cables during installation.
3. Use suitable lubricants and pulling equipment.
4. Sustain cable pulling tensions and bending radii below recommended limits.
5. Ground cable shield at each termination and splice.
6. **Medium Voltage Cables:**
  - a. All reference to size in these specifications or on plans is for aluminum conductors. Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Except as otherwise indicated, provide aluminum conductors with conductivity of not less than 98% at 68°F.
  - b. The type of installation, sizes, and number of cables shall be as indicated. Manufacturer's written recommendations shall be furnished for each type of splice and medium-voltage cable joint and termination and shall be approved before any work is done. Medium-voltage cable splices and terminations shall be the standard product of a manufacturer and shall be of the factory preformed type. Medium-voltage cable splices shall be made by qualified cable splicers. Compounds and tapes shall be electrical grade suitable for the cable insulation provided and shall use design materials and techniques recommended by the manufacturer.
  - c. Maximum length of cable pull and cable pulling tensions shall not exceed the cable manufacturer's recommendations. Contractor shall use a dynamometer on all cable pulls to ensure that the manufacturer maximum recommended pulling tension is not exceeded. Contractor shall tabulate the actual pulling tensions of the power cables pulled with a copy of all results submitted to the Engineer.
  - d. Cable pulling rate shall not exceed 50 feet per minute maximum.
  - e. Cable shall be properly guided into and out of duct lines to prevent the cable from dragging across the edge of the duct mouth.
  - f. Cable ends subject to pulling stresses shall be cut off a minimum of 3 feet or more from the end.
  - g. Cable bending radius shall not be less than recommended by the cable manufacturer or 12 times cable O.D. (whichever is greater) during or after installation.
  - h. Use pulling means including cable, rope, and basket weave wire/cable grips which will not damage cables or raceway.
  - i. In cold weather, Contractor shall preheat the cable by means of a heated warming shed to a minimum of 60°F before pulling cable. Cable shall not be allowed to cool below 40°F before being pulled. No direct heating of cables shall be allowed.
  - j. Contractor shall notify Engineer 24 hours in advance of all medium voltage cable pulls so they may observe installation.
  - k. Where required in manholes and elsewhere, Contractor shall use large diameter pulleys for pulling to minimize cable side wall pressure when pulling. All pulling and cable training schemes shall be approved by Engineer prior to pulling cables.
  - l. Medium-voltage cables shall be rated for the circuit voltage indicated. Other parts of the cable system such as joints and terminations shall have ratings not less than the rating of the cables on which they are installed. Size shall be as shown on plans.
  - m. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields shall be grounded at each joint.

- n. The phase conductors shall be color code tagged at each splice and termination in accordance with Engineer approved method. Phase identification shall remain the same throughout the circuit.
- o. Cable ends shall be protected from water entry with heat shrink end seals at all times except when splicing or terminating.

**7. Cable Terminations.**

- a. Termination kits shall be installed in accordance with manufacturer's instructions by installers familiar with medium voltage cable termination installation.
- b. Terminations shall be installed in dry and dust free conditions.
- c. No solvents shall be used to clean cables prior to termination that are not approved by the cable manufacturer.
- d. All cable lug compressions shall be made using tools approved for the conductor/cable size, and the lug being used. Tool shall be designed to ensure complete connector compression before tool removal.
- e. All cable is to be pulled without splices.

**D. Field Quality Control.**

- 1. Inspect exposed cable sections for physical damage.
- 2. Inspect cable for proper connections as indicated.
- 3. Inspect shield grounding, cable supports, and terminations for proper installation.
- 4. **Qualifications of Cable Terminators.**
  - a. Before assigning any cable terminators to work covered by this Section, the Contractor shall submit to the Engineer the names of the cable terminators to be employed and satisfactory proof that each cable terminator has had at least 3 years' experience in splicing and terminating high-voltage cables, and is experienced with the type and rating of cables to be terminated.
  - b. In addition, each cable terminator may be required to make an approved dummy termination or splice in the presence of the Engineer in accordance with the cable manufacturer's instructions before the termination is approved. All materials for the dummy splices or terminations shall be furnished by the Contractor.

**5. Test Reports.**

Each length of cable delivered to the job site shall have a certified test report from the factory, stating that the cable meets the minimum cable standards for cables of the type as established by ICEA. The test report shall also not exceed 12 months prior to the delivery to the job site. Copies of this report shall be submitted to the Engineer prior to the cable is installed.

**6. Field Acceptance Testing.**

**a. Performed by the Contractor.**

- 1) Electrical tests shall include: All cable shall be insulation resistance tested after cable is installed and all terminations and splices are made, and before cables are terminated on switchgear, and before the DC high-pot test is performed. All cables shall be protected from moisture accumulation and shall be wiped clean prior to testing. Test shall be performed in accordance with the following:
  - a) Megger test to be run at 2500 VDC for minimum of five minutes or until reading stabilizes.
  - b) Cables to be tested between the conductor and the conductor sheath for each cable.
  - c) Tested cable shall pass the requirements of ICEA S-639 and S-682 latest version. Any failed cable shall be replaced and all cable retested without extra

- cost to the Contracting Authority.
- 2) All cable shall be DC high potential tested after passing the required insulation resistance test as outlined above. High-pot tests shall be in accordance with the following:
    - a) Each conductor individually tested with all other conductors grounded. All shields grounded.
    - b) Terminations properly corona suppressed.
    - c) A DC high potential applied slowly in 7 to 10 equal increments to the manufacturer's specified test voltage is reached (IECA standard for the cable). DC leakage current recorded at each step after a constant stabilization time (minimum of two minutes) consistent with the system charging current decay.
    - d) A graphic plot made of leakage current versus voltage shall be recorded at the end of each step. High potential test shall continue for specified time after test voltage level is reached. Leakage current shall be recorded every 15 seconds for the first minute and at one minute intervals for the duration of the test time.
    - e) The test conductor raised to a maximum test voltage and held for a total of 10 minutes. Reading of leakage versus time recorded and plotted.
    - f) Following current versus time test, the test set voltage control reduced to zero and the time voltage decay to 20% of the applied voltage recorded.
    - g) The applied conductor test potential reduced to zero and grounds applied for a period adequate to drain all insulation stored potential.
    - h) Maximum test voltages in accordance with applicable ICEA and manufacturer's recommended levels.
    - i) Any failed cable shall be replaced and all cables retested without any additional cost to Contracting Authority.
  - b. Electrical Contractor shall provide competent High Voltage Electricians experienced in medium voltage operation, startup and safety procedures for initial energization and phase checking of all cables and equipment. The following is a list of items to be completed during initial energization:
    - 1) Verify the phase rotation and phase angles upon initial energization of electrical equipment.
    - 2) De-terminate cables from electrical equipment, rotate phases, reterminate cables, and re-check phase rotation and phase angles as required until correct values are recorded.
    - 3) Megger for grounds and shorts prior to initial energization or re-energization of any cable and/or equipment.
    - 4) Provide medium voltage safety equipment for use during initial energization procedures for the purpose of protecting the testing personnel and other onsite personnel.
    - 5) All equipment to have test reports available to Engineer detailing latest high voltage testing by a certified testing laboratory.

**E. Protection.**

Protect installed cables from entrance of moisture.

**150028.04 METHOD OF MEASUREMENT.**

**A. Medium Voltage Cable.**

Method of measurement shall be by each linear foot of each size/type of cable installed.

**B. 600V Wire.**

Method of measurement shall be by each linear foot of each size/type of wire installed.

**150028.05 BASIS OF PAYMENT.**

**A. Medium Voltage Cable.**

Payment is full compensation for furnishing all labor, equipment, and materials required to provide and install the cable in the conduit, including all terminations, splices, supports, energization, testing, and startup.

**B. 600V Wire.**

Payment is full compensation for furnishing all labor, equipment, and materials required to provide and install the wire in the conduit, including all terminations, splices, supports, energization, testing, and startup.