

## **ITEM 10599.1304 - M SUBMARINE CABLES**

### **Description**

- (a) Under this item, the Contractor shall furnish all labor, materials, plant, and equipment; and he shall do all work necessary to install, test, and place in satisfactory operating condition submarine cables for carrying the power, control, lighting, and other circuits across the navigable channels, where indicated on the Plans.
- (b) The work shall include furnishing and installing new submarine cables under the channel, conduits in the rest piers, armor clamps, bell ends, cable terminators, brackets, supports, and other equipment required to complete the installation as well as the on-site services of the cable manufacturer's representative and Inspection Diver. The excavation of a cable trench in the river bottom shall be done under this item.
- (c) The Contractor shall warranty the in-service performance of the submarine cables for one year following final project acceptance.
- (d) The Contractor shall employ the services of an experienced Inspection Diver, who is also licensed Professional Engineer, to inspect the trench, inspect the cable installation, and determine the elevation and depth of the cables, in addition to personnel required to install the submarine cables. The Inspection Diver shall submit a report to the Engineer stating that the cables have been installed in accordance with the Plans. Plans of the as-built cable locations and depths shall be prepared by the Contractor's Engineer as well as a description of the in-place cable condition. This information shall be submitted to the Engineer as detailed herein these specifications.
- (e) The submarine cable shall be obtained from a manufacturer that is experienced in producing submarine cable of similar types to those described below.
- (f) The electrical work for the submarine cables shall be in accordance with item "Bridge Electrical Work."

### **MATERIALS**

#### **Conformance**

- (a) All electrical equipment and its installation shall conform to the requirements of the latest revision of the Standard Specifications for Movable Highway Bridges of the American Association of State Highway and Transportation Officials, except as may be otherwise provided herein.

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- (b) Materials and construction shall conform to the requirements of the current National Electrical Code and to any applicable local rules and ordinances. The Contractor shall obtain any required permits and approvals of all Departments or Agencies having jurisdiction. All work shall be in conformance with the requirements of the United States Coast Guard and the NYSDEC.

**Submarine Cables**

- (a) New submarine cables shall be provided under the navigation channel. The cables, cable supports, armor clamps, bell ends, cable terminators, brackets, and hardware shall be provided as needed for installation.

**(b) The construction and conductor counts shall be as specified on the Plans.**

- (c) Before cable orders are placed with any manufacturer, the Contractor shall determine the true length of each cable between the submarine cable terminal cabinets. Splicing or joining of conductors between these points will not be permitted. In addition, the Contractor shall verify the conductor count of each cable with the vendor of the bridge control system to insure the specified number of spare conductors are provided.

- (d) The Contractor shall be responsible for ascertaining and ordering the correct continuous length of submarine cables, including sufficient excess length to accommodate pulling eyes, adequate slack for submarine cable settling, cable clamping, connections, and for samples.

The Contractor shall be responsible for ascertaining and ordering the correct conductor counts based on his approved working drawings supplied by the control system vendor. In no case, shall the conductor counts be less than those hereinbefore specified.

- (f) Materials and construction of the submarine cables shall conform to referenced requirements of NEMA Publication No. WC7, latest revision. All conductors shall be soft annealed copper wire conforming to the requirements of NEMA Pub. No. WC7. All conductors shall have Class B concentric stranding. The insulation of each conductor shall be a moisture-resisting, cross-linked, polyethylene compound conforming to the requirements of NEMA WC7, Part 3.7. The thickness of insulation shall be as given under Column A of Table 3-1 for 2,000 volts rated circuit voltage. The insulation shall incorporate mineral fillers (not carbon) to inhibit treeing.

- (g) In each cable, the insulated conductors shall be cabled to a full circular section using non-hygroscopic fillers, where necessary, to fill out the section. Each layer of the conductors shall be covered with a single serving of binder tape. Conductors in each layer shall be identified by coloring or marking the outer surface of the insulation. Over the cabled conductors, there shall be applied one layer of binder tape followed by a homogeneous synthetic sheath conforming to the requirements of NEMA WC7, Part 4.4.2, Polyethylene,

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Black. The thickness of the sheath shall be in accordance with the requirements of Table 4-7. Over the sheath, there shall be applied cable armor consisting of a single layer of galvanized plow steel wire, each wire covered with a layer of polyethylene. A high-density polyethylene jacket shall be placed over the armor. The polyethylene jacket, jacket thickness, and armor jacket shall conform to NEMA WC7, Parts 4.4.2, 4.4.3, and 4.5.8 and be sunlight and weather resistant. Any variations in cable construction or materials shall be submitted to the Engineer for review and approval.

- (h) Approved moisture-resistant filler material suitable for submarine cable application shall be used in the interstices between and over the insulated conductors to give the complete cable a circular cross-section. Binder tape of approved, suitable, flame-resistant, and moisture-resistant fabric material with a thickness not less than 10 mils shall be applied over the multi conductor/filler assembly and overlapped not less than 10 percent of its width between turns.

### **CONSTRUCTION DETAILS**

#### **Submission of Proposed Method of Installation**

- (a) The Contractor shall submit, in detail, his proposed method for installing the submarine cables and shall obtain the approval of the Engineer before any work is started.

#### **Working Drawings**

- (a) The Contractor shall prepare and submit to the Engineer for approval the following working drawings executed in accordance with the provisions of the Contract:
  - (1) A drawing to scale showing the location, depth, and length of cables, together with the proposed method of installing the cables. This drawing shall be submitted and approved prior to placing a cable order with any manufacturer.
  - (2) Typical published test data showing physical and electrical characteristics of the proposed cable insulating compound.
  - (3) Manufacturer's construction drawings of all submarine cables showing the sizes of conductors, thickness of insulation, makeup of the cable layers, type and size of jackets, armor, jute serving and other components, and the outer diameters of the finished cables.

#### **Soundings**

- (a) Soundings shall be taken to determine the existing elevations of the river bed, the location in plan and elevation of the new submarine cables in the trench, and the elevations of the river bed after backfilling. The soundings shall be performed by a New York State licensed Land Surveyor. This information shall be submitted to the Engineer for his review and shall be shown on the as-built record drawings. The soundings shall also be submitted to the U.S.

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Coast Guard/Corps of Engineers. The surveying shall be included under the item "Survey and Stakeout."

- (b) The as-built record drawings shall attest to the actual location and depth and elevation to which the new submarine cables have been installed, and said drawings shall be certified by the licensed Land Surveyor. Depths shall be at 3.0 meter intervals.

### **Trenching and Backfilling**

- (a) The excavation of a cable trench in the channel bottom and the backfilling of said trench after installation of the cables shall be performed under this item.
- (b) The method of trenching shall be in conformance with the NYSDEC permit and approved by the Engineer. The existing river bottom shall be excavated and temporarily sidecast using the hydro/air transfer, or similar, method. All construction activities in the river shall meet the New York State Department of Environmental Conservation (NYSDEC) and Army Corps permit conditions. The existing river bottom consists of sand. The trench shall be excavated so that the cables can be installed at the required depth. The sides of the trench shall stand at their natural slope (1:2.5 as shown in the Plans). After the cables are laid and inspected the sidecast material shall be used to backfill the trench. Clean sand shall be used as additional backfill as required to restore the channel bottom to its original profile.
- (c) The Contractor shall furnish an experienced Inspection Diver and the necessary diving equipment to assure that the cable trench is properly excavated and that the cables are properly laid and spaced therein. The Inspection Diver shall perform the necessary inspections. In making these inspections, the Inspection Diver shall operate as directed by the Engineer and shall report directly to him. The Inspection Diver shall be provided in addition to any other Diver provided by the Contractor for his construction purposes.
- (d) The Inspection Diver shall be provided by the Contractor for the necessary number of days to perform the specified inspections of the trench and placement of the cables therein. The cost of supplying the Diver and necessary diving equipment shall be included in the unit prices bid for the submarine cables.

### **Submarine Cable Installation**

- (a) The cables shall cross the channel to the south of the movable span where shown on the Plans. Where the cables cross the navigable channel, they shall be buried below the bottom of the channel to a depth as shown on the Plans. The cables shall be laid side by side without twists or loops in a common trench at the locations shown on the Plans. No cable shall be permitted to cross the other. The route of the cables may have to be altered to avoid unforeseen obstructions.
- (b) The cable laying shall be performed without damaging the bridge structure, fenders, pile clusters, or any existing substructure and as directed by the Engineer.
- (c) During the installation of the cables, the Contractor shall arrange to have at the site a representative of the cable manufacturer. This representative shall be experienced in

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submarine cable handling and installation procedures, and he shall advise the Contractor and the Engineer in these matters.

- (d) The full cable length shall be lowered into position in the trench without loops or kinks and shall be continuously supported by approved means or devices until the cable is in correct position.
- (e) After installation of the cables, soundings shall be performed by the Contractor as specified under this item. The submarine cables shall be permitted to settle for 48 hours prior to final termination of cables. After such time and completion of specified field tests, the Contractor shall backfill the open trench such that the original channel profile is established. Backfill material shall be the original sidecast material. If required, additional material shall be provided as approved by the Engineer subject to the NYSDEC permit conditions.
- (f) The cables shall be allowed to settle for a period of a minimum of 48 hours after the last cable has been placed, before any rigid connections or attachments are made. The submarine cables shall be of sufficient length to allow for slack in settlement and to allow for making permanent connections.
- (g) The Contractor shall provide proper equipment for lifting or lowering the submarine cables at the piers. He shall exercise proper care so as not to over stress, score, or cut the conductors, insulation, outer jacket or armor, or otherwise damage the cable.
- (h) The Contractor shall determine the proper type of lifting or lowering device for the cables, subject to approval by the Engineer, and shall include considerations for the quantity and size of conductors in the submarine cable and distances involved.

### **Arrangement and Connections of Cables**

- (a) Slack shall be provided for the submarine cables and their conductors in the terminal cabinets.
- (b) After the submarine cables have been installed in place and are awaiting termination, the ends of the conductors shall be test-capped and the ends of the submarine cables sealed to prevent entry of moisture.
- (c) Conductors inside the terminal cabinets shall be neatly formed into cables and laced with approved cable ties, with the individual conductors leaving the cable at their respective terminal points. These conductors shall be looped to allow not less than 76 millimeters of free conductor when disconnected.
- (d) Both ends of every single length of conductor in the submarine cables shall be permanently and clearly tagged in accordance with the same numbers or designations appearing on the wiring diagrams provided under the item "Bridge Electrical Work." For conductors of Size No. 10 AWG and smaller, all wire ends shall be provided with compression-type, ring-tongue wire connectors suitable for connection to screw-type terminals.
- (e) Terminal blocks shall be marked to show the wire number or designation of each conductor connected thereto. The markings shall be placed on a material which will not be affected by

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age or moisture and shall be given two coats of clear lacquer after the markings are placed thereon.

### **Testing**

#### **Factory Tests of Submarine Cables**

- (a) All cable at the factory shall be tested in accordance with the latest test methods of ICEA/NEMA Standards for the types of cable and insulating materials specified and shall meet or exceed the minimum requirements and criteria for acceptance as set forth therein.
- (b) Prior to assembly and fabrication of the submarine cables, the individual insulated conductors to be incorporated in the cables shall be tested to demonstrate the quality of the production run. The conductors and insulating compounds shall meet the minimum physical and electrical requirements set forth in NEMA Publication No. WC-7. The test reports shall be submitted for approval prior to shipping any cable.
- (c) After each multi conductor cable is completely assembled and armored, it shall be subjected to tests for insulation resistance and high voltage. High-voltage tests shall be made at the same voltage used on the individual wires, and the insulation resistance shall not be less than 80 percent of the original values for the individual wires.
- (d) The Contractor shall submit to the Engineer seven (7) certified copies of all the factory test data for approval before accepting shipment of cable from the manufacturer. The test data shall include, in tabulated form, a description of the material undergoing test, a description of each test performed, the measured or observed results, and the value and limits required by the ICEA/NEMA Standard for acceptance.
- (e) In addition, the Contractor shall submit to the Engineer seven (7) copies of a statement certifying that the cable delivered for use under this Contract has passed the required factory inspections and tests and complies with all the requirements, including materials and construction, of the Standards and Specifications in the Contract.

#### **Tests on Samples of Submarine Cables**

- (a) The Contractor shall provide for sufficient additional length of cable on each reel so that a 5 meter sample of cable may be removed from each reel for test and inspection purposes. The sample shall be taken after installation of the cable from the leading portion of the cable that has been subjected to the pulling stresses and strains incurred in the raceway or conduit during installation.
- (b) In the presence of the Engineer, the Contractor shall cut a 5 meter sample from each reel and cut it into a 4.5 meter section and a 0.5 meter section. Each section of the sample cable shall be individually tagged and marked by the Contractor with the date the sample was taken, manufacturer's reel number, size and type of cable, and Contract number. The 0.5 meter section shall be given to the Engineer and shall become the property of NYSDOT. The Contractor, in the presence of the Engineer, shall test cap, deliver, and submit each 4.5 meter section to a testing laboratory designated by the Engineer.

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- (c) The testing laboratory need not be located locally within the New York Metropolitan area.
- (d) The Contractor shall provide that the Engineer receive notice at least 72 hours in advance when cable samples are to be taken.
- (e) The following inspections, measurements, and tests shall be performed, and the results recorded by the testing laboratory, on the section of cable sample taken from each reel, in accordance with test methods described in the applicable ICEA/NEMA Standards, for compliance with the Contract Specifications:
  - (1) Inspection of markings on cable for proper size, grade, type, and voltage rating.
  - (2) Inspection of cable for physical condition of all materials with respect to defects and damage.
  - (3) Quantity and measured size of each conductor, including quantity and size of its conductor strands, and the associated color code.
  - (4) D.C. resistance and material of each conductor.
  - (5) Measured wall thickness of insulation for each conductor, including minimum and average wall thickness per ICEA Standards.
  - (6) Measured wall thickness of overall non-metallic jacket.
  - (7) Visual inspection of condition of filler materials and identification of type of materials used.
  - (8) Measured thickness of tapes and binders and types of materials used.
  - (9) Measured diameter and quantity of individual wires used in wire armor and type and condition of protective finish.
  - (10) Measured and observed test results and computations for accelerated water absorption test on insulation.
  - (11) Measured and observed original and aged properties of insulation.
  - (12) Insulation resistance.
- (f) The laboratory shall submit seven (7) copies of certified test data results on the cable samples to the Engineer for approval. The Contractor shall pay the cost for testing the cable samples, including the costs of cable material, transportation of materials to the laboratory, and the submission of certified test data to the Engineer.
- (g) If, as a result of the laboratory tests, it is found that the cable does not comply with the approved certified factory test results or with the applicable ICEA/NEMA Standard, the Contractor will be ordered to remove all cable that came from the reel containing the defective cable sample and to remove the reel of defective cable from the work site, and he

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shall replace the defective cable with new cable, all without additional cost to NYSDOT. The Contractor will be held responsible for any delays in the execution of the work caused by the defective cable.

### **Field Tests of Submarine Cables**

- (a) After the submarine cables have been installed in the trench, clamped, secured, and terminal connectors attached, but prior to final connections, all conductors shall then be tested for insulation resistance by the Contractor in the presence of the Engineer and the test results recorded and submitted for approval.
- (b) The Contractor shall ensure that the Engineer receives at least 72 hours written notice in advance when field tests are to be made.
- (c) The Contractor shall submit the results of the test to the Engineer for approval before proceeding further with the work.
- (d) After approval of the insulation resistance test of the installed but unconnected submarine cables, the Contractor shall connect the submarine cables and test the energized installation as directed by the Engineer.
- (e) If a fault or defect is found to exist or a cable does not otherwise pass the tests, the Contractor shall identify and tag the faulty cable or conductor in question.
- (f) If a fault or defect is located in a cable, the Contractor shall remove all cable and shall furnish and install new cable, subject to all the aforementioned tests and acceptance requirements, all without additional cost to the State.
- (g) If it is definitely established that the fault or defect is due to a termination of the cable, the decision to correct or repair the cable or replace that section of cable shall rest with the Engineer.
- (h) The tests, including test equipment, test methods, and test data shall be as specified hereinafter.

### **Insulation Resistance Testing Procedures**

- (a) The test methods for measuring insulation resistance of cables installed in the field shall be in accordance with the specified NEMA Publications.
  - (a) The test equipment shall include a megohm meter, capable of generating a constant 1,000-volt D.C. source, calibrated in a range legible from 0 to 1,000 megohms and up to infinity, with heavy-duty, rubber-insulated, alligator-clip leads, carrying case, and a guard-circuit terminal available for use if required.
3. Polarity for connecting the megohm meter to the cable under test and the duration of time for electrifying the cable before taking the resistance reading shall be in accordance with

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the NEMA Publication.

4. The insulation resistance of each conductor in the installed wire-armored, multi-conductor submarine cables shall be measured between the conductor and all wires in the armor, all of which shall be bonded together and grounded.
5. The measured values of insulation resistance for each conductor in the submarine cables shall be recorded for comparison with the test values determined at the factory and shall be submitted as part of the approved copy of certified test data. The failure of any conductor in an installed submarine cable to demonstrate satisfactory insulation resistance will be cause for the rejection of the submarine cable. If this should occur, the Contractor shall promptly remove the rejected cable and replace it with a new cable, subject to all the aforementioned tests and acceptances, all without additional cost to the State.
6. The Contractor shall record the measured insulation resistance for each cable, the cable length installed, cable and reel identifications, date of test, ambient temperature, and weather conditions. The test results and data shall be submitted to the Engineer for approval. He shall also submit a certificate identifying the test equipment used and stating it is accurate within limits as rated by the manufacturer.

### **METHOD OF MEASUREMENT**

1. Payment for the Items "Submarine Cables" shall be made on a lump sum basis.

### **BASIS OF PAYMENT**

2. The lump sum bid for "Submarine Cables" shall include the cost of all labor, materials, and equipment necessary to complete the installation, ready for operation.

Progress payments for work satisfactorily completed will be made in accordance with the pre-established breakdown.