

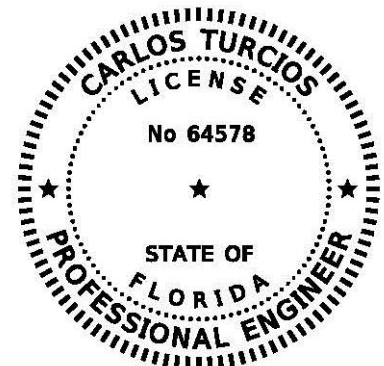
TECHNICAL SPECIAL PROVISION  
FOR  
T508 ELECTRICAL CONSTRUCTION FOR MOVABLE BRIDGES

FINANCIAL PROJECT ID: 437966-1-52-01

*The official record of this Technical Special Provision has been electronically signed and sealed using a Digital Signature as required by Rule 61G 15-23.004, F.A.C.*

This item has been digitally signed and sealed by Carlos Turcios, P.E. on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

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**SECTION T508**  
**ELECTRICAL CONSTRUCTION FOR MOVABLE BRIDGES**

**T508-1 BASIC ELECTRICAL REQUIREMENTS**

**T508-1.1 General Requirements**

**T508-1.2 References**

- A. AASHTO Standard Specifications for Movable Highway Bridges.
- B. NFPA 70, National Electrical Code (NEC), latest edition.
- C. NFPA 79, Electrical Standard for Industrial Machinery.
- D. Movable Bridge Preventative Maintenance Manual, Florida Department of Transportation; Maps and Publications, 605 Suwannee Street, Mail Station 12, Tallahassee, Florida, 32399-0450.

**T508-1.3 Description of Work**

The work to be done under this Technical Special Provision includes the furnishing of all labor and materials required to complete and leave ready for operation the installation of all items of electrical work in accordance with this Technical Special Provision and the accompanying Plans. It is the intention of this Technical Special Provision and Plans to call for finished work, tested and ready for operation. Furnish, deliver and install any apparatus, appliance, materials, or work not shown on the Plans but mentioned in this Technical Special Provisions or vice versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation without additional expense to the Department. Items of electrical work include but are not limited to the following:

- A. Remove, dispose, furnish and install replacement of existing south east and south west traffic barriers motor and motor brake assembly.
- B. Remove, dispose, replacement of existing submarine cable including termination cabinet and associated stainless steel supports.
- C. Remove, dispose, furnish and install replacement of existing power and control conduit and conductors for span locks originating from the electrical room in the tender house to the location of the span lock motors.
- D. Remove, dispose, furnish and install replacement of existing span drive machinery speed reducer gear box lube pumps (total of 2) and associated head discharge pressure switch.

**T508-1.4 Existing Incoming Services**

System Characteristics: 480/277 volts, three phase, four-wire, 60 Hertz to remain.

**T508-1.5 Protection of Electrical Equipment**

- A. Protect electrical equipment from water damage, especially from rain, condensation, and water dripping or splashing on equipment and wiring, at all times during shipment, storage and construction (prior to final acceptance). Provide climate-controlled environment for the storage of control equipment/assemblies during construction.
- B. Protect equipment from damage from mishandling, dropping, or impact.
- C. Damaged equipment shall not be installed.
- D. All spare parts shall be made available at time of Functional Checkout. Replace all spare parts used during the Functional Checkout.

**T508-1.6 Coordination of Electrical Work**

A. Given that the work involved requires the fabrication and installation of new components into an existing installation under complex requirements recognize that the Contract Documents will not contain all necessary requirements and procedures required to obtain a successful installation. The provisions of the Contract Documents were developed with the intent that experienced personnel in the type of work required will, through the process of field surveys, shop drawing, and procedure submittals, refine and supplement to complete the requirements in such a manner to provide a complete and satisfactory fitting and fully operational installation at no

additional cost to the Department. It is not the intent of this Technical Special Provision and the Contract Plans that the fabrication and installation of the work of this Technical Special Provision be performed relying solely on the provisions of this Technical Special Provision and the Contract Plans.

B. The Contract Documents are diagrammatic in showing certain physical relationships which must be arranged within the electrical work, and which must interface with other work including utilities and mechanical work. Coordinate as necessary between trades to allow for proper installation of all electrical work.

C. Schedule and arrange electrical work in a neat, well organized manner.

D. The existing submarine cable shall remain operational to the extent possible while the new submarine cable is installed. Coordinate all phases of cable replacement with bridge operators and allow for 7-days in advance notice for any scheduled bridge shut down due to submarine cable replacement.

E. Coordinate electrical work with the work of other trades to eliminate conflicts. Advise other trades of openings required in their work for the subsequent move-in of large units of electrical equipment. Electrical work must be considered in critical path scheduling.

#### **T508-1.7 Electrical Journeymen**

A. Designation of Electrical Journeymen: Designate and submit a listing of pre-qualified electrical journeymen to perform the electrical work in accordance with this Technical Special Provision. Perform all such work either by, or under the immediate supervision of an electrical journeyman. For this project, under the immediate supervision means that the journeyman is in the immediate vicinity and physically involved in performing the electrical work. It is the intention of this Technical Special Provision that the journeyman's knowledge, talents, and skills in performing certain critical work will be judged and approved by the Engineer and then that the journeyman will do the actual work utilizing those talents and skills. Helpers are expected to aid the journeyman in the performance of the work and not to act as non-credentialed surrogates of a remote journeyman. Non-approved helpers may only perform tasks of a support nature that do not directly involve responsibility for the installation, connection, or adjustment of electrical materials. (e.g. field bending and threading of conduit)

B. Qualification of Electrical Journeymen: Each electrical journeyman must hold, at a minimum, an active journeyman electrician's license, by examination, in the State of Florida. The journeyman must also have knowledge and experience on emergency power systems and other electrical devices required to operate movable bridges. Each journeyman must be pre-approved by the Engineer based on submitted documentation of licensing, training and experience history. The Engineer might also require a demonstration of knowledge of the tool and technique requirements of specialty electrical work to be performed including, but not limited to: conductor pulling, termination, testing, conduit and device mounting before the journeyman will be permitted to perform such specialty work. See FDOT Specification 105-8.10.5.1 for additional information.

#### **T508-1.8 Control System Engineer**

A. Designate an individual to act as the Project's Control System Engineer and to serve as the Contractor's representative as a single point of contact prior to, during, and after construction, and be available for consultation during all phases of the project, including shop drawing submittal and review.

B. Ensure that the Control System Engineer supervises and coordinates replacement of components in the control consoles, programming, and the hydraulic control system.

C. Ensure that the Control System Engineer reviews all shop drawings and submittals for electrical equipment, controls, and electrically operated machinery to assure coordination of voltages, currents, physical size, and specific compliance with the intent of the plans and that the Control System Engineer stamps all shop drawings to indicate that the shop drawings and that the items in

submittal are coordinated with bridge operating system, as a whole.

D. Process any approved changes associated with the bridge electrical system through the Control System Engineer so that he maintains responsibility for coordination of the work.

E. Ensure that the Control System Engineer is on site to direct all testing and commissioning of the bridge operating equipment and systems. To minimize interruptions during witness testing, coordinate all testing activities with other construction activities through the Control System Engineer.

F. Pre-qualify the Control System Engineer with the Engineer before preparing detailed shop drawings and Documents. The pre-qualification submittal must include preliminary details of the proposed control system for review of conformance with the intent of this Technical Special Provision. Include with the pre-qualification submittal documents that substantiate the following requirements:

1. Experience as detailed in FDOT Specification 105-8.10.5.2, knowledge of commonly used bridge leaf motion control techniques, and familiarity with drawbridge mechanical and hydraulic equipment and arrangements as used on this project.

2. Supervision including commissioning of one similar drawbridge system during the last three years.

3. Engineering design ability evidenced by registration as a Professional Engineer licensed to perform this type of work in the State of Florida.

4. Certification or completed certified training in installation, application and operation of the proposed PLC and span drive make and model.

G. The Engineer will review the pre-qualification submittal of the Control System Engineer and will be the sole judge of the adequacy of the information submitted. Inadequate proof of this ability and experience, or insufficient details, may be cause for disqualification. See FDOT Specification 105-8.10.5.2 for additional information.

## **T508-1.9 Tools and Procedures**

### **T508-1.9.1 Tooling and Procedure Requirements**

A. Manufacturer Requirements: Install, apply, or adjust all electrical equipment and materials in accordance with the manufacturer's recommendations including the usage of the manufacturer specified tooling. When such materials are UL, or other third party, listed or recognized, the tooling used for field installation must be the same as, or the manufacturer's approved equivalent to, the tooling utilized in the approval testing.

B. Quality Assurance:

1. Tooling Identification: When applicable, the approved tooling will provide a suitable identification to the work to allow verification that the appropriate tool was used to perform the work. For example, crimping dies shall contain identification marks that emboss the crimps made with them with an identification embossment.

2. Quality Isolation: Where possible, the requirement to provide a level of workmanship quality will be transferred to the tooling rather than the skills of the workman. As examples, but not limited to:

a. Conductor Stripping: Use approved non-nicking strippers rather than the operator's skill with knife edged stripping tools.

b. Crimp Tightness: Use, exclusively, controlled cycle crimping tools that require the proper degree of compression before releasing the work rather than upon the operator's judgment of how hard the tool handle is being squeezed.

c. Tie Tightness: Use the manufacturer's specified calibrated tensioning tool rather than the operator's judgment of what is tight enough.

d. Fastener Torque: Where the proper tightness is important to the performance of the function (which includes all electrical terminals), use a calibrated torque

(limiting) screwdriver or other torque indicating tool.

#### **T508-1.9.2 Tool Verification**

A. Where submittals are specified in this Technical Special Provision and tooling is associated therewith, submit the manufacturer's tooling requirements and procedures, including catalog and calibration information on the tooling that is proposed.

B. Document all tooling that is used as to the method of use and the calibration requirements and procedures. Calibrations shall be traceable to the National Institute of Standards and Technology (NIST) or other recognized standards laboratory. Equipment that requires repetitive calibration (e.g. terminal crimpers often require daily verification by pull testing sample crimps) must be supported, on site, by the required calibration verification instruments. Ensure that operating manuals for all specialized tooling is available on the site for reference by the Engineer at any time.

#### **T508-1.9.3 Tool Application**

The journeyman electrician intending to operate such specialized tool must demonstrate his knowledge of, and skill in using, the tool including the knowledge and ability to judge the results produced by the tool and to recognize failure of the tool to perform satisfactorily.

#### **T508-1.10 Verification Testing**

##### **T508-1.10.1 General**

Whenever verification testing is required in the performance of the work of other Technical Special Provisions, perform the tests and measurements in accordance with these requirements.

##### **T508-1.10.2 Test Equipment**

A. Provide test and measurement instruments suitable to perform the required tests including ratings and measurement accuracy as specified by the manufacturer. Clearly indicate the exact make and model of instrument to be used and include manufacturer's specification data indicating the suitability of the instrument's application in all procedure submittals.

B. No test instrument may be used unless it has been calibrated and certified by an independent certification laboratory to the required accuracy and in accordance with the instrument manufacturer's requirements; provided that all instruments have been calibrated within a maximum interval of the preceding 12 months. Certify all calibrations as traceable to the NIST or other recognized standardization authority.

C. Test instrument operating manuals and certification certificates must be available on the project site for reference by the Engineer whenever the instrument is being used or evaluated.

##### **T508-1.10.3 Test Result Reporting**

A. Where test or inspection data submittal is required by the provisions of other sections of this Technical Special Provision ensure the form(s) to be used for recording and submitting the data are approved prior to performing the tests. Record the test results directly upon the approved forms as the tests are performed, recopying the data onto the forms from informal field notes is not acceptable. Record all data with ballpoint pen or other non-erasable writing media; strike-thru and initial errors or corrections in such a manner that the original is still readable.

B. Identify each measurement item or group of items with the measurement date and approximate measurement time to the nearest quarter hour.

C. Record, where the environment influences the measurements, such as insulation measurements, the weather including approximate temperature, rain or fair, and approximate relative humidity, on the form at appropriate intervals as determined by the changing meteorological conditions. Record wind, velocity and direction for balancing measurements or other leaf related tests where the wind loading is a factor in the performance or results.

D. Identify each measurement item or group of items with the signature or initials of

the approved measurement technician performing the tests. A separate sheet cross-referencing the signatures or initials to the printed name of the technician will accompany the submittal of the test results to identify the technician. The use of manuscript initials will be treated the same as the full signature and will constitute the technician's certification that the tests were performed in accordance with the submitted and approved procedures, utilizing approved test instruments, and that the results recorded are a true and accurate representation of the test conditions and results.

E. Record test instrument identification, including traceable serial number, for each measurement group. The data submittal will include a copy of the Certificate of Calibration for the particular instrument.

F. All test data submittals shall be reviewed and approved by the Control System Engineer prior to submittal to the Engineer.

#### **T508-1.10.4 Test Performance**

The journeyman electrician, or other proposed test equipment operator, must demonstrate knowledge of the test equipment operating and testing procedures to the Engineer's satisfaction before performing tests. Only test results signed by such approved testing technician will be acceptable under the requirements of this Technical Special Provision.

#### **T508-1.11 Submittals**

- A. Submit qualification information for Control System Engineer.
- B. Submit qualification information for Electrical Journeymen.
- C. Submit Certificates of Calibration for test instruments.

## **T508-2 WORKING PLANS AND SHOP DRAWINGS**

### **T508-2.1 General Requirements**

A. Submit working plans and shop drawings as prescribed in the January 2020 edition of the FDOT Specifications, Section 5 as amended and in this Technical Special Provision. Clearly mark manufacturer's standard drawings which indicate dimensions and options for more than one piece of equipment to clearly indicate what data applies.

B. Provide a separate submittal package for each pay item unless otherwise indicated in this Technical Special Provision. Label each submittal package to indicate the Project Name, Pay Item number, Section number and Technical Special Provision number as listed in this Technical Special Provision. Label data sheets for individual components such as motors, limit switches, etc. with the identification numbers shown in the Plans and this Technical Special Provision.

C. Submit all electrical submittal items in an individual separate three-ring loose-leaf binder or binders suitable for letter size sheets with opening and closing mechanism. Provide a separate individual ring binder or binders for each set of submittal items. Include binder title sheet as first page having names of job and contractor with second page as table of contents listing each submittal item in same sequence as specified.

D. Piece-by-piece submission of individual components will not be acceptable. Submit all components of a pay item at the same time. Include shop drawings drawn to scale and certified by the manufacturer for all submittals for major electrical equipment. Where one-line diagrams, wiring diagrams, schematic diagrams, interconnection diagrams, etc. are called for, they are to be site specific. Submittal approval shall be on an "all or none" basis.

E. Provide complete resubmittals even if some items on the original submittals may not have been marked deficient. Provide sufficient time in project schedule to allow for the possibility of repetitious submittals without creating delays to the project. The Department shall not bear any responsibilities for delays caused by repetitious submittals.

F. Conduit layout drawings for conduit and wiring, including details of all conduit routing and penetrations through structural elements, and each type of conduit and fitting. Include details of reinforcement in the penetration area on conduit penetration shop drawings. Coordinate

structural block outs and embedded conduits with concrete drawings. Show all conduit runs between all pieces of equipment in the drawings. **Do not install any conduit until these drawings are approved.**

G. For fused disconnect switches include outline drawings with dimensions, equipment ratings for voltage, capacity, horsepower, and short-circuit. Provide manufacturers fuse and circuit breaker curves (time/current on log/log graph) for each rating of fuse and circuit breaker supplied.

H. For disconnect switches, provide catalog data, installation instructions, and replacement parts list for each type switch including voltage and ampere ratings, construction material, NEMA classification, dimensioned outline drawing. Include a replacement parts list.

I. Provide catalog data sheets for conduit and fittings, supporting devices, terminal blocks, wire, wiring devices, outlet boxes, fasteners, terminal blocks, mounting hardware, junction and pull boxes, termination cabinets, grounding, and safety switches.

J. Provide catalog data sheets including voltage, ampere, and kva ratings, materials, and weight; dimensional data and outline drawings; and electrical connection diagrams.

K. Provide catalog data sheets for each type of wiring device. Catalog data shall include voltage and ampere ratings, dimensions and outline drawing or photograph.

L. For motors, include plan and elevation drawings with dimensional data, nameplate data, performance data including torque-speed and current graphs, and schematic diagrams for each type of motor. Provide certified motor drawings to the machinery fabricator for coordination. Include a motor data sheet indicating horsepower, voltage, FLA and LRA current, motor speed, NEMA frame size, insulation class, temperature rise, service factor, and any optional equipment or attachments such as tach-generator, encoder, thermal switch, or space heater in the motor submittals. Provide a motor torque-speed performance graph. Provide dimensioned outline, plan/elevation and wiring interconnect drawings. Include installation instructions, operation, and maintenance data with instructions for storage, handling, protection and starting of motors. Include assembly drawings, bearing data with replacement sizes, and lubrication instructions.

M. For the Submarine Cable assembly, and prior to obtaining the cable, submit data to the Engineer showing the length of submarine cable needed, minimum bending radius, confirmation that the duct lengths are adequate for the actual needs of this bridge, and certification that all products to be furnished satisfy this Technical Special Provision. Utilize the contract drawings for length measurements and field verify measurements accordingly. Include details of protective sleeves, support clamps, adapters, strain relief, and sealing fittings. Submit drawings showing configuration of conduits and cables entering the submarine the termination cabinet, details and layout of terminal strips within submarine cable termination cabinet and details of the submarine cable entering the tender house including supports. Submit details of termination cabinets, showing dimensions and mounting arrangement, include calculation for space heaters

#### **T508-2.2 Movable Bridge Electrical Materials**

##### **A. General Requirements**

1. Manufacturer's standard descriptive leaflets or catalog sheets are acceptable for "off the shelf" items which require no modification for application on this project unless noted otherwise. "Off the shelf" items include, but are not limited to, control house and pier items such as lighting fixtures, smoke detectors, heat detectors panel and wiring devices.

2. Provide catalog data sheets for conduit, fittings, and wire.

##### **B. Refer to Individual Sections for additional submittal requirements**

#### **T508-3 MATERIALS AND EQUIPMENT**

Furnish only new materials that conform to the standards of the Underwriters' Laboratories, Inc., in every case where such a standard has been established for the particular type of material and its intended application. Prior to purchase of any materials or equipment required to be furnished and



installed, a complete list of all such materials and equipment including manufacturer's catalog numbers, catalog data sheets, illustrations, and shop drawings shall be submitted to the Engineer for approval.

Ensure that all electrical equipment used outside of the conditioned space of the tender house is suitable for use in a marine (salt atmosphere) environment.

### **T508-3.1 Wire and Cable**

#### **T508-3.1.1 Description**

Verify that field measurements are as shown in the Plans. Wire and cable routing shown is approximate unless dimensioned. Route wire and cable as required to meet project conditions. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

##### **T508-3.1.1.1 Definitions**

A. Power Conductor: Any wire that feeds power to an electrically operated device such as gate motors, span lock motors, traffic lights, etc.

B. Control Circuit Conductor: Any wire routed to pilot devices including but not limited to limit switches, pressure switches, and push buttons.

C. Field Wire: Any wire that leaves the Control House. Consider the machinery platforms to be outside the tender house.

D. Flexible Cable: Type SOOW, Multi conductor cable with extra flexible cable for use where flexing occurs in normal operation. Application for motor and control circuits between fixed and movable elements of the bridge.

##### **T508-3.1.1.2 Submittals**

Submit catalog data for each type of conductor.

#### **T508-3.1.2 Materials**

A. For single conductor insulated wire, use type XHHW-2 rated 600 V<sub>AC</sub> unless otherwise noted.

B. Provide insulation rated 90°C for all field wiring. Furnish insulated conductors of 7 or 19 strand copper, minimum 98% conductivity and connector accessories for copper insufficient quantities for a complete installation. Do not use aluminum or solid copper conductors.

C. Use no wire smaller than No. 12 AWG for power and lighting circuits and no smaller than No. 14 AWG for control wiring, except that control wiring within a cabinet may be No. 16 AWG. Minimum field wire size shall be No. 12 AWG for control wires and No. 10 AWG for motor loads. Where field device terminals are too small for No. 12 AWG, No.14 AWG pigtails, no longer than 12 inches may be used.

D. Use No. 10 AWG for 20 A, 120 VAC, branch circuit home runs longer than 75 feet, and for 20 A, 277 VAC, branch circuit home runs longer than 200 feet.

#### **T508-3.1.3 Construction Requirements**

A. Installation includes placement, splicing, terminating, identification, testing, and verification, of each circuit and conductor.

B. Do not install power and control conductors in the same conduits.

C. If more than three current carrying conductors are in a conduit, derate the conductors per Table 310.15(B)(2)(a) of the N.E.C. For derating purposes consider all power conductors, other than the ground conductors, as current carrying. This requirement does not apply to control wires.

D. No splicing is permitted, except for lighting circuits. Where No. 14 AWG pigtails are used, provide a small enclosure and terminal blocks to connect the pigtails to the No. 12 AWG wire.

E. Provide properly sized connectors. Trimming of strands to fit an undersized connector is not acceptable.

F. Use solderless pressure connectors with insulating covers for wire splices and taps, No. 8 AWG and smaller, for lighting circuits. Use split bolt connectors for wire splices and taps, No. 6 AWG and larger, and all motor connections or other approved method. Make waterproof, splices and taps to carry full ampacity of conductors without perceptible temperature rise.

G. For lug connections use high pressure indent connector tools as recommended by the lug manufacturer. Tighten all connections to manufacturer's recommendations. Identify each conductor with its circuit number or other designation indicated in the Plans.

H. Tape uninsulated conductors and connectors with electrical tape to 150% of the insulation value of conductor. Neatly train and lace wiring inside boxes, equipment, and panelboards. Place an equal number of conductors for each phase (three phase system) of a circuit in same raceway or cable. Make conductor lengths for parallel circuits equal. Pull all conductors into a raceway at the same time.

I. Install two spare conductors, minimum, for long field runs to critical devices such as traffic gates, traffic signals, and all movable span mounted devices.

J. Provide a dedicated ground conductor, with green insulation in each conduit in which voltage of the current carrying conductors exceeds 50 volts.

K. Test each circuit for continuity and short-circuits for its complete length before connecting it to its load. Verify identification numbers for the entire length of the circuit. Inspect wire and cable for physical damage and proper connection.

L. Test insulation resistance at 1,000 VDC for one-half minute for 480V systems. Minimum acceptable insulation resistance for new cable will be 100 mega-ohms or greater. When insulation resistance must be determined with all motor control centers, panelboards, switches, and over current devices in place at 120V, test the insulation resistance at 500 V<sub>DC</sub> and accept no less than 50 mega-ohms. The Engineer may witness the test. Submit test results to the Engineer for review prior to energizing the circuit. Include a table of the test results with the "As-built" drawings with additional columns left blank for future readings to be recorded.

### **T508-3.2 Supporting Devices**

#### **T508-3.2.1 Description**

Provide hangers and supporting devices as required by the National Electrical Code and this Technical Special Provision.

##### **T508-3.2.1.1 References**

- A. NECA - National Electrical Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

##### **T508-3.2.1.2 Submittals**

- A. Provide catalog data for each type of strut, clamp, insert, and associated hardware.
- B. Provide dimensional data for struts.
- C. Provide pullout data for anchors.

##### **T508-3.2.2 Materials**

A. Provide mounting bolts, nuts, washers, and other hardware used for fastening boxes, disconnect switches, devices, lighting outlet boxes, conduit clamps, and similar devices using 316 stainless steel. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown. Provide adequate corrosion resistance. Ensure that the material selected for the hardware is compatible with the material of the device being supported.

C. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products. Minimum safety factor is 2.0. Framework for supporting boxes, switches, and other externally mounted electrical devices shall be stainless steel as shown in the plans.

D. For U-Channel strut systems utilizing bolted construction, all components shall be of the same manufacturer, and shall be 316 stainless steel, 12 gage and 1-1/2-inch width minimum.

### **T508-3.2.3 Construction Requirements**

A. Do not fasten supports to piping, ductwork, mechanical equipment, or other conduit. In addition, do not allow piping, or other trades to fasten to electrical conduits and supports.

B. Bolt heads and nuts shall be hexagonal with spring lock washers under all nuts. Bolts smaller than 3/8 inch in diameter shall not be used except as may be necessary to fit the mounting holes in small devices, outlet boxes, and similar standard equipment. Fasten hanger rods, conduit clamps, and outlet and junction boxes to structure using proper fasteners.

C. All cut offs shall be cut square, ground smooth and de-burred.

D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

E. Do not use powder-actuated anchors. Do not drill or weld structural steel members.

F. Space conduit supports at no more than 6-foot intervals.

## **T508-3.3 Conduit and Raceways**

### **T508-3.3.1 Description**

Furnish and install conduit and raceways in the quantities and sizes required to complete the work as shown in the Plans. Where conduit size is not shown in the plans, determine the size as required by the NEC. Furnish products listed and classified by UL for purpose specified and shown. Unless noted in plans, do not use non-metallic flexible conduit, aluminum conduit, or electrical metallic tubing (EMT). Conduit and circuits indicated in the Plans, diagrams, and schedules may be recombined in the field where appropriate and as approved by the Engineer.

#### **T508-3.3.1.1 References**

- A. NEMA/ANSI C80.1 - Rigid Steel Conduit - Zinc Coated (GCR).
- B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- C. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- D. NEMA TC 2 - Electrical Polyvinyl-Chloride (PVC) Tubing and Conduit.
- E. NEMA TC 3 - PVC Fittings for use with Rigid PVC Conduit and Tubing.
- F. UL 651 - Schedule 40 and 80 Rigid PVC Conduit.
- G. NCEA 101 - Standard Practice for Good Workmanship in Electrical Construction.
- H. UL 514B - Fittings for Cable and Conduit.
- I. UL 360 - Liquid-Tight Flexible Steel Conduit.
- J. UL 6 - Rigid Metal Conduit.

#### **T508-3.3.1.2 Submittals**

- A. Provide catalog data for each type of conduit and fitting.
- B. Provide conduit layout drawings, showing routing and penetrations. Coordinate structural block outs and embedded conduits with concrete drawings.

### **T508-3.3.2 Materials**

#### **T508-3.3.2.1 PVC Coated Metal Conduit**

A. Furnish and install hot dipped galvanized rigid steel conduit (ANSI C80.1) with internal and external PVC coating 40 mils thick; meeting the requirements of NEMA RN 1 and Fittings and Conduit Bodies meeting the requirements of NEMA FB 1 with steel fittings with internal and external PVC coatings to match conduit.

B. Provide 40 mils thick PVC coating on the outside of couplings and a series of

raised longitudinal ribs to protect the coating from tool damage during installation.

C. Ensure the bond between the PVC coating and the conduit surface is greater than the tensile strength of the coating. Verify this bond by testing described in NEMA Standard RN-1, Section 3.8.

D. Uniformly and consistently apply a nominal 2-mil thick urethane coating to the interior of all conduit and fittings. Conduit or fittings having pinholes or areas with thin or no coating are unacceptable.

E. Protect all factory cut threads on conduit, elbows, nipples, and fittings by application of a urethane coating. The PVC exterior and urethane interior coatings applied to the conduit must afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F.

F. Furnish right angle beam clamps and U bolts specially formed and sized to snugly fit the outside diameter of the PVC coated conduit. All U bolts shall be supplied with encapsulated nuts that cover the exposed portions of the threads.

G. Ensure that only tools designed and approved by the conduit manufacturer for use on PVC coated materials are used and the workmen performing the installation are trained and skilled in the installation and use of PVC conduit and fittings by the manufacturer.

H. All PVC coated conduit, fittings, and accessories must be supplied by the same manufacturer.

#### **T508-3.3.2.2 Liquid-Tight Flexible Metal Conduit**

Furnish and install liquid-tight flexible metal conduit (UL 360) Interlocked galvanized steel construction with integral ground continuity and PVC jacket. Use only PVC coated fittings, meeting the requirements of NEMA FB.

#### **T508-3.3.2.3 Nonmetallic Conduit**

Furnish and install Non-metallic Schedule 80 PVC conduit meeting the requirements of NEMA TC 2 and Fittings and Conduit Bodies meeting the requirements of NEMA TC 3.

#### **T508-3.3.3 Construction Requirements**

A. Use one inch minimum size Schedule 80 PVC for:

1. Underground Installations
2. In Slab Above Grade (Embedded)

B. Use 3/4 inch minimum rigid galvanized steel (PVC coated) for:

1. Outdoor Locations, Above Grade, exposed (spans)
2. Dry Locations: Exposed (in Pier)

C. Use 3/4 inch minimum size Schedule 80 PVC for:

1. Wet and Damp Locations (Fender)

D. Install conduit in accordance with NECA Standard Practice and in accordance with manufacturer's instructions.

E. Plastic straps or plastic hangers shall not be used. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary support.

F. Group related conduits; support using conduit rack. Construct rack using stainless steel channel; provide space on each for 25% additional conduits. Fasten conduit supports to building structure and surfaces as described in this Technical Special Provision.

G. Use pull-boxes wherever necessary to facilitate the installation of the conductors. Use conduit hubs to fasten conduit to sheet metal boxes. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system. Install all conduits so that they will drain properly and drainage tees shall be provided at low points where required.

H. Do not pull more than ten conductors into condulets, use pull boxes. At any point where a conduit crosses an expansion joint, or where movement between adjacent sections of conduit

can be expected, install bronze or alloy expansion fittings.

I. Arrange conduit to maintain headroom and present neat appearance. Route exposed conduit parallel and perpendicular to walls. Maintain adequate clearance between conduit and piping. Maintain minimum 6 inches crossing and 12 inches paralleling clearance between conduit and surfaces with temperatures exceeding 40°C.

J. Use of flexible conduit is allowed only for the connection of motors, limit switches, and other devices that must be periodically adjusted in position. Make all connections between the rigid conduit system and all movable motors, and movable limit switches with flexible conduit with couplings and threaded terminal fittings. Use only flexible conduit that is fully interlocked with internal grounding and only in lengths not exceeding 2 feet. Install flexible conduit to drain away from the device it serves.

K. At both ends of each conduit run and on each side of each wall or floor penetration, install a brass tag having the conduit number stamped thereon in accordance with the conduit diagrams. Use bare copper wire to securely and permanently fasten the tags to the conduits.

L. Where conduits pass through the floors or walls of the control room, install Schedule 80 PVC conduit sleeves for free passage of the conduits. After the conduits are installed, seal the openings with a UL listed fire stop material for airtight fits. Provide escutcheon plates on the interior walls, ceilings, and floors.

M. Use threaded couplings for all connecting conduit sections. Install conduits to be continuous and watertight between boxes or equipment. Protect conduits at all times from the entrance of water and other foreign matter by capping or plugging overnight and when the work is temporarily suspended.

N. Where exterior conduit is mounted on parts of the steel work, provide conduit support so that conduit is not less than 1-1/2 inch clear from the supporting structure to prevent accumulation of dirt. Install parallel horizontal conduit spaced one inch apart and securely clamp conduits to the steel work to prevent rattling and wear. Space conduit supports and clamps at 5 feet intervals, maximum, and no more than 12 inches from a box or fixture.

O. Cut conduit square using saw or pipe cutter; de-burr cut ends. Clean and swab conduit after threading and coat threads with a conductive anticorrosive coating. Bring conduit to shoulder of fittings; fasten securely. Long running threads are not permitted. Tighten PVC coated conduits until all threads are concealed by the cuff of the PVC coated fitting or coupling.

P. Do not stub concrete embedded PVC conduits out of walls and at floor locations where stub outs may be broken. Install threaded 316 stainless steel couplings, flush with concrete, at stub-outs, for connection to threaded metallic conduit.

Q. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inches. All field bends shall be long sweep, radius shall be 12 times the diameter, and free of kinks to facilitate the drawing in of conductors without injury to the conductors. Make conduit runs with as few couplings as standard lengths will permit.

R. Upon completion of the conduit installation and prior to pulling in conductors, clear each conduit with a tube cleaner equipped with a mandrel of a diameter not less than 80% of the nominal inside diameter of the conduit and a swab. Provide caps and plugs to prevent entry of debris and moisture into conduits. Provide suitable pull string in each empty conduit except sleeves and nipples.

S. Do not fill control wire conduits more than 25% full.

### **T508-3.4 Boxes**

#### **T508-3.4.1 Description**

Provide pull boxes and junction boxes as shown in the plans and at locations where more than 8 conductors are gathered.

#### **T508-3.4.1.1 Submittal Requirements**

Provide catalog data sheets, including dimensioned drawings, materials, and approvals.

#### **T508-3.4.1.2 References**

- A. UL 50, File No. E27567: Type 3R, 4, 4X, and 12
- B. UL T508, T508, File No. E61997: Type 3R, 4, 4X and 12 C.

NEMA/EEMA

- C. Type 3R, 4, 4X, 12, and 13
- D. JIC standard EGP-1-1967
- E. CSA File No. 42184: Type 4, 4X, and 12
- F. IEC 60529, IP66

#### **T508-3.4.2 Materials**

- A. Provide PVC coated cast metal boxes for wall mounted wiring devices (toggle switches, duplex receptacle, GFCI).
- B. Ensure that all pull boxes, junction boxes, and all other miscellaneous housings used for pulling wires, terminating wires, or otherwise used to install electrical equipment, are NEMA 4X 316 stainless steel. Provide enclosures with drip proof rolled edge openings and a cover held closed with clamps.
- C. Provide enclosures, larger than 12 inches in any dimension, with a continuous stainless steel hinged cover with a glued in neoprene gasket.
- D. Provide sheet metal enclosures with O-ring sealing hub connectors, drain fittings, and not less than four mounting lugs.

#### **T508-3.4.3 Construction Requirements**

- A. Install insulated bushings on threaded hub ends projecting into all boxes.
- B. No box or enclosure shall be drilled for more conduits than actually enter it.
- C. In locations exposed to weather, make conduit entries on sides or bottom of boxes, only.
- D. Size boxes per NEC requirements for the size and number of conduits. Additionally, size junction boxes to include provisions for terminal block wiring clearance. Minimum size shall be 8" x 8" x 4".
- E. Exterior boxes shall be provided with ½-inch combination drain and breather fittings.

### **T508-3.5 Terminal Blocks**

#### **T508-3.5.1 Description**

Provide terminal blocks for internal circuits, circuits crossing shipping splits, where equipment parts replacement and maintenance will be facilitated and to connect the temporary systems to the permanent systems during phased construction. Provide disconnect type terminal blocks for conductors requiring connection to circuits external to the control house.

#### **T508-3.5.1.1 Submittal Requirements**

Provide catalog data sheets for each type and rating of terminal blocks, including voltage and ampere ratings, materials, and dimensioned outline drawings.

#### **T508-3.5.2 Materials**

- A. Provide 600 volt rated terminal blocks with white marking strips.
- B. For No. 8 AWG and smaller conductors use channel mounted screw cage box clamp type, with vibration proof screw and plate to physically isolate the conductor from the screw. Provide terminal blocks in groups of 12 with interlocking "finger safe" type barriers and white marking strips.
- C. For No. 6 AWG and larger conductors, provide power distribution blocks, three-pole, suitable for copper conductors, and UL rated for amperage equal to the largest conductor it

accommodates.

D. Provide terminal blocks with corrosion resistant plating, on current carrying components, and nonferrous hardware.

E. Do not use terminal blocks that require special tools.

### **T508-3.5.3 Construction Requirements**

A. Group terminals for easy accessibility unrestricted by interference from structural members and instruments.

B. Provide 2 inch minimum space on each side of each terminal block and between terminals and wire duct to allow an orderly arrangement of all leads to be terminated on the block and to allow for wire labels.

C. Do not terminate more than two wires on any one terminal position.

D. Permanently label each terminal block and both ends of each conductor to coincide with the identification indicated on the schematic and wiring diagrams. Add plan identification numbers to terminals where equipment terminals are already numbered.

E. Terminal blocks shall be provided in each terminal box for connection of all conductors including spare conductors entering the box plus at least 25% spare terminals for any control conductors and 20% for any power conductors.

### **T508-3.6 Electrical Identification**

#### **T508-3.6.1 Description**

Provide identification for each electrical component including, but not limited to, conduit, wire, panels, junction boxes, pull boxes, motors, motor controllers, disconnect switches, and control devices.

##### **T508-3.6.1.1 Submittal Requirements**

Provide catalog data for each type of identification device. Provide an engraving schedule for all laminated name plates.

#### **T508-3.6.2 Materials**

##### **T508-3.6.2.1 Conduit Identification**

A. Provide adequate marking of primary conduits which are exposed, or concealed in accessible spaces, to distinguish each run as either a power or signal/communication conduit. Except as otherwise indicated, use orange banding with black lettering.

B. Provide snap-on type plastic markers. Indicate voltage ratings of conductors where 240 V or above. Locate markers at both ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduits pass through walls, floors or into non-accessible construction, and at spacings of not more than 50 feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than one inch.

C. Both ends of each marked conduit run and on each side of wall or floor penetrations shall be provided with a brass tag having a number stamped thereon in accordance with the conduit diagrams. These tags shall be securely and permanently fastened to the conduit ends with bare copper or stainless-steel wire.

##### **T508-3.6.2.2 Wire Identification**

A. Furnish wire and cable markers of vinyl cloth labels, split sleeve, or tubing type.

B. Number shall be as indicated in the Plans or the approved shop drawings, if not shown in the plans.

C. Provide wire labels on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection.

D. Provide wire markers on each conductor at terminal blocks.

### **T508-3.6.3 Construction Requirements**

Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring. Where equipment already has manufacturer's wire number, place plan wire number label adjacent to the manufacturer's number.

**T508-3.7 Wiring Devices**

**T508-3.7.1 Description**

**T508-3.7.1.1 References**

UL 943- Ground-Fault Interrupters

**T508-3.7.1.2 Submittal Requirements**

Provide catalog data sheets for each type of wiring device. Catalog data shall include voltage and ampere ratings, dimensions and outline drawing or photograph.

**T508-3.7.2 Materials**

**T508-3.7.2.1 Receptacles**

A. Provide receptacles rated for heavy-duty use, duplex grounding type rated 20 A and 125 VAC with bodies of thermosetting plastic composition, supported on a metal mounting strap. Ensure that wiring terminals are side-wired with binding-type terminals and the grounded pole is connected to the mounting strap. Back-wired, clamp-type terminals are not allowed.

B. Provide Ground Fault Circuit Interrupter (GFCI) receptacles that are duplex, feed-through type, convenience receptacle with integral ground fault current interrupter rated 125 VAC and 20 A capable of detecting a current leak of 5 mA. Connect receptacles to protect the local load without disruption of the rest of the circuits.

**T508-3.7.3 Construction Requirements**

A. Install switches and receptacles as shown in the plans. Install switches 42 inches above the finished floor and receptacles 14 inches above floor unless otherwise noted. Install switches with OFF position down.

B. Install surface mounted devices in Type FS or FD boxes. Inside the control house and other environmentally controlled rooms, install cover plates that are 1/16 -inch thick satin finished Type 302 stainless steel.

**T508-3.8 Method of Measurement**

A. Furnish and install conduit and conductor for power and control of the span locks.

B. Conduit and conductor shall originate from the Electrical Room in the Tender house, along the span leaf and end at the new span locks. Provide a 3-pole circuit breaker housed in a Nema-4X enclosure with fuses and conductors termination boards as indicated on contract plans.

**T508-3.9 Basis of Payment**

A. This Article identifies the Payment Item(s) for the listed work items defined in this Technical Special Provision and a method of measurement where required. The work described and specified in this Work Item shall be measured and paid for and such payment shall constitute the entire compensation for all the various items (i.e., labor, material and equipment, etc.) or services required per this Work Item.

Payment Item No. 508- 4 Movable Bridge Electrical Equipment,

Rehabilitation 43796615201 (F&I) ..... LS

**T508-4 Traffic Barrier Motor and Motor Brake**

**T508-4.1 General Requirements**

A. Furnish and install totally enclosed, Class F insulation motors specifically designed for barrier gate actuator capable of operating at full load when the voltage to the motor is  $\pm 10$  percent of rated voltage meeting the characteristics and frame size of the existing barrier motor. Use only motors having the voltage capacity as shown in the Plans.



B. Furnish and install barrier motor brake that matches the characteristics of the existing barrier motor brake. The brake shall be of the direct acting, electromagnetically released spring set with a rotating and stationary disc contact to supply positive braking action.

**T508-4.2 Method of Measurement**

A. Furnish and install 2 barrier motors and 2 motor brakes as indicated on plans.

**T508-4.3 Basis of Payment**

A. This Article identifies the Payment Item(s) for the listed work items defined in this Technical Special Provision and a method of measurement where required. The work described and specified in this Work Item shall be measured and paid for and such payment shall constitute the entire compensation for all the various items (i.e., labor, material and equipment, etc.) or services required per this Work Item.

Payment Item No. 508- 2- 5 Movable Bridge Gate, Adjust / Modify / Rehab  
(F&I) ..... AS

**T508-5 Submarine Cable and Termination Cabinet**

**T508-5.1 References:**

- A. ICEA Publication S-66-524
- B. NEMA WC-7

**T508-5.2 Application**

A. This Technical Special Provision covers multi-conductor, cross linked polyolefin insulated, polyethylene jacketed, polyethylene coated, helically served, steel armored, power and control, and ground cables for underwater installations.

**T508-5.3 Description**

A. General configuration consists of stranded copper conductors insulated with cross-linked polyethylene, cabled with fillers as necessary, binder tape, high density polyethylene inner jacket, high density polyethylene coated galvanized steel armor, and a high density polyethylene jacket overall.

**T508-5.4 Assembly**

**T508-5.4.1 Cabling**

A. The cable components shall be cabled in a tight and concentric configuration. Reverse the direction of lay for adjacent layers of cabled conductors. Maximum lay lengths and lay directions shall be in accordance with ICEA Publication #S-66-524 (2nd. Edition) Paragraph 5.2.

**T508-5.4.2 Fillers**

A. The various cable components shall be cabled together and filled if necessary to give the completed cable a substantially circular cross section.

B. Binder: Cover the cable assembly with a 20-mil corrugated polyester film separator applied helically with minimum of 25% overlap.

**T508-5.4.3 Cable Jacket**

**T508-5.4.3.1 Jacket Material**

A. Provide the cable with a high-density polyethylene jacket according to ICEA Publication #S- 66-524 (2nd. Edition) Paragraph 4.4.2.

**T508-5.4.3.2 Jacket Thickness**

B. The jacket thickness shall be in accordance with ICEA Publication #S-66-524 (2nd. Edition) Paragraph 4.4.3.

**T508-5.4.3.3 Steel Armor Material**

A. The cable armor shall consist of high-density polyethylene coated strands of galvanized plow steel wires. The size of wires and the amount of coating are as

follows:

Calculated Diameter of Cable	Nominal Size of Armor Wire	Nominal Thickness of Polyethylene
Inches	AWG	Mils
0.425	12	20
0.7	10	25

**T508-5.4.3.3.1 Armor Coverage and Angle**

A. The size and number of strands shall provide a percent coverage of 91% to 97%. Apply the coated armor wires in a left lay helix. Apply cable armor at a nominal lay angle of 18 degrees to 25 degrees in a preformed helix.

**T508-5.5 Insulated Conductors**

**T508-5.5.1 Conductors**

A. Conductors shall be annealed uncoated copper in accordance with ASTM B-3. Conductors shall be stranded in accordance with ASTM B-8, class "B" concentric stranding.

**T508-5.5.2 Insulation**

A. Conductor insulation shall be chemically cross-linked polyethylene (XLPE) compound, meeting the requirements of ICEA (Insulated Cable Engineers Association) Publication #S-66-524 (2nd edition), NEMA Publication WC7-1988. Thickness of the insulation shall be designated by Table 3-1 of ICEA S-66-524, NEMA WC7 selecting from the appropriate voltage. The insulation shall be concentrically applied over the copper.

**T508-5.5.3 Testing of Conductors**

A. The XLPE insulation shall meet the following accelerated water absorption requirements:

Electrical Method:	
Dielectric Constant after 1 day, max.	6.0
Increase in capacitance - percent, max.	
1 to 14 days	3.0
7 to 14 days	1.5

Stability Factor after 14 days, max. 1.0

or

Stability Factor Difference, 1 to 14 days, max. 0.5

**T508-5.5.4 Physical and Aging Requirements**

A. The XLPE insulation shall meet the following physical and thermal aging requirements:

Unaged:

Tensile strength - MPa, min.	12.41
Elongation - percent, min.	250

Aged:

Air oven (168 hours at 136 degrees C.)

Tensile strength and Elongation at rupture - percent of unaged, min. 80

#### **T508-5.5.5 Dimensional Tolerances**

A. The insulation thickness and wire overall diameter are nominal dimensions. The dimensional tolerances for the conductors shall meet the requirements of ICEA Publication #S-66-524 (2nd. Edition) Paragraph 3.1. The insulation thickness shall meet the requirements of ICEA Publication #S-66-524 (2nd. Edition) Paragraph 3.3.

#### **T508-5.5.6 Conductor Identification**

A. Conductor identification of insulated conductors shall be accomplished by surface printed legends consisting of consecutively numbering all conductors of each wire type in each cable. All numbering sequences shall start with the number 1 (one). The marking shall consist of the appropriate number followed by the corresponding spelled-out word or words. The Signal and Control cable shall have the #14 AWG twisted pairs color coded so that each conductor of each pair is easily distinguished from the other conductor of that pair, and each pair is easily distinguished from all other pairs. Color coding similar to standard telephone communication cable coding is acceptable.

B. Repeat coding sequence at intervals of not more than 2 feet. Code along the entire length of each conductor.

C. Begin sequence from the inner conductor layer and progress to the outer conductor layer.

D. Employ contrasting color print and be legible after normal handling during installation.

#### **T508-5.5.7 Strippability**

A. The insulation shall be readily removable from the conductor. A separator is required between the conductor and the insulation, to enhance the strippability. Color the separator black or opaque to make clearly distinguishable from the conductor once the insulation is removed.

#### **T508-5.6 Submarine Cable Termination Cabinet**

A. Submarine cable cabinets shall be NEMA Type 4X, Type 316 stainless steel, constructed of ample size per the National Electric Code, and arranged so that terminal strips, supports and other devices are readily accessible for maintenance, repair, and replacement. Furnish cabinet with hinged doors and stainless-steel hinges. The general arrangement and shape of the cabinet shall be such as to fit in with the scheme of installation, which shall be approved by the Engineer. Furnish space heaters, connect to receptacle branch circuit, with humidistat control; adjust to turn ON at 70 degrees F (temperature dropping) 80% relative humidity. Provide adequate grounding lugs or bus to accept the #4/0 AWG Ground cable and other bonding conductors as required.

#### **T508-5.7 Submarine Cable Support**

A. Provide submarine cable support assemblies for each power and control subcable. Each support assembly shall consist of a galvanized base, U-flange, and associated fasteners. The opening shall be of ample size for submarine cable to pass through (typically twice the cable diameter).

B. Fasten base to concrete wall, splay cable armor wire and attach flange. Fasten flange to base to clamp armor wire. The purpose of this assembly is to provide support for the vertical portion of the submarine cable above the channel bottom.

C. Submarine cables (less outer jacket material and armor wire) shall enter the termination cabinet through sealed fittings. Provide basket-weave type cable strain relief fittings.

#### **T508-5.8 Submarine Cable Construction Requirements**

### **T508-5.8.1 Installation**

A. The cable manufacturer shall have a company employee present during the installation procedure to ensure that the cable is installed in a manner that will not damage the cable, who can certify that the cable was installed in a manner approved by the manufacturer. A representative of a supplier will not be acceptable.

B. The cables shall cross the channel permanently buried in a trench. Power, control, and ground cables shall be installed in the same trench. Provide adequate equipment for installation of the cables. The bottom of the trench shall be 6 feet below the channel bottom between the fenders or at a depth as required by the Army Corps of Engineers whichever is greater.

C. All cable bends shall be of large easy curvature well within that recommended by its manufacturer (minimum radius of 12 cable diameters). The cables shall enter the termination box through sealing glands. Spare Conductors within the submarine cable shall be terminated on terminal strips and properly identified. Shields shall be grounded in the near side only. Arrange cable entry sleeves, base and support rings such that cables enter the bottom of the termination cabinet without substantial bending of cable.

D. Insulation resistance testing, wire-to-wire and wire-to-ground, shall be witnessed by the Engineer. A copy of the test results shall be furnished to the Engineer. An additional copy in tabular format shall be included in the O and M manuals to provide a baseline for future measurements.

E. Provide a turbidity barrier during trenching activity.

### **T508-5.9 Inspection Requirements**

#### **T508-5.9.1 Test on Completed Cable**

##### **T508-5.10.1.1 Voltage Test**

A. The cable shall withstand between each conductor and all other conductors (including armor), an RMS voltage in accordance with ICEA Publication #S-66-524, NEMA WC7, Table 3-1.

##### **T508-5.9.1.2 Insulation Resistance**

A. The insulation resistance shall be measured after the completed cable AC voltage test and the measured values shall be in accordance with the requirements of ASTM D 470 (200,000 MΩ).

### **T508-5.10 Packaging**

#### **T508-5.10. 1 Reels**

A. Packaging of the finished cable shall be on suitable non-returnable reels capable of supporting the weight during transportation and normal handling.

#### **T508-5.10.2 Cable Ends**

A. Cable ends shall be suitably sealed to prevent moisture from entering the conductor core area during shipment, storage and installation.

### **T508-5.11 Existing Submarine Cable Removal**

A. See Contract Plans.

### **T508-5.12 Method of Measurement**

A. The submarine cable assembly shall consist of three (3) types of cable; a power cable(s), a ground cable, and control cable(s).

B. Submarine cable termination cabinet(s), trenching, protective sleeves, etc., are also included in this Pay Item.

C. The quantity to be paid for existing submarine cable removal shall be the plan quantity completed and accepted.

**T508-5.13 Basis of Payment**

A. This Article identifies the Payment Item(s) for the listed work items defined in this Technical Special Provision and a method of measurement where required. The work described and specified in this Work Item shall be measured and paid for and such payment shall constitute the entire compensation for all the various items (i.e., labor, material and equipment, etc.) or services required per this Work Item.

Payment Item No. 508- 73- 1 Submarine Cable Assembly  
(Furnish & Install) ..... LS/LF

Payment Item No. 508- 73- 4 Submarine Cable Assembly  
(Remove) ..... LS/LF

**T508-6 Span Drive Machinery Speed Reducer Lube System Pump and Pressure Switch**

**T508-6.1 General Requirements**

A. Remove existing lube pumps as shown on plans. Furnish and install two NEMA C frame size motor, 460V, 3/4 hp motors with the electrical characteristics of the existing motors. Provide the required pump/motor coupling adapter. The contractor is required to field verify the existing motors electrical characteristics before shop drawing submittal. Provide new power liquid-tight flexible metal conduit and conductors between existing motor disconnect and new motors.

B. Remove existing lube pumps head discharge pressure switch. Furnish and install a new pressure switch. Pressure switch shall match the characteristics of the existing pressure switch. As a minimum, pressure switch shall be of the electromechanical pressure type, NC-NO, SPDT, silver nickel contacts, die cast aluminum enclosure, and zinc plated steel material contact. Reconnect existing control conductors to new pressure switch. Verify pressure switch operation at control system.

**T508-6.2 Method of Measurement**

A. Remove existing, furnish and install 2 lube oil pump motors and 1 head discharge pressure switch.

**T508-6.3 Basis of Payment**

A. This Article identifies the Payment Item(s) for the listed work items defined in this Technical Special Provision and a method of measurement where required. The work described and specified in this Work Item shall be measured and paid for and such payment shall constitute the entire compensation for all the various items (i.e., labor, material and equipment, etc.) or services required per this Work Item.

Payment Item No. 508- 4 Movable Bridge Electrical Equipment, Rehab  
43796615201 (F&I) ..... LS