MICHIGAN

DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

FOR

**TRAFFIC BARRIER GATE REPLACEMENT**

BRG:MGB 1 of 14 APPR:KCK:REL:06-03-24

**a. Description.** The work consists of removal of the existing bridge barrier gates and furnishing new bridge barrier gates.

**b. Applicable Standards.** Comply with the following standards and specifications as applicable.

• Standard Specifications for Construction

• National Fire Protection Association (NFPA) 70 – National Electrical Code (NEC)

• AASHTO LRFD Movable Highway Bridge Design Specifications

• International Electrical Testing Association, (NETA) Acceptance Testing Specifications

• American Society for Testing and Materials (ASTM)

• American National Standards Institute (ANSI)

• American Welding Society (AWS)

• American Iron and Steel Institute (AISI)

• American Institute of Steel Construction (AISC)

• American Concrete Institute (ACI)

**c. General Requirements.**

1. Character of Work and Quality Control. Perform the work to not pose any unusual and/or unreasonable danger to persons and/or property, and, in the judgment of the Engineer, to not expose persons and/or property to any unusual and/or unreasonable danger as a result of normal service, including normal wear and tear.

Coordinate all features, ratings, etc., of products as required to provide complete, operational, reliable and safe system(s) and sub-system(s) in accordance with the requirements of the contract.

Perform all coordination necessary, including, but not limited to, coordination with and/or between suppliers, vendors, sub-contractors, trades, and utility companies. Ensure proper interfacing between electrical systems and sub-systems, and the bridge operating machinery, the bridge structure, and miscellaneous equipment.

Fully determine the nature and location of the work, the character, quality, and quantity of the materials that are required, the nature of equipment and facilities needed preliminary to and during the performance of the work, the general and local conditions, and of all other matters which can in any way affect the work for this project. Failure to comply with these requirements does not relieve the Contractor from responsibility for completion of all specified work and is not considered cause for delay or additional payment.

All products and work, including fabrication, erection, and/or installation procedures, will be subject to inspection and testing by the Engineer. If any products and/or installations are found to be defective, coordinate repair or replacement at no additional cost. Under no circumstances will any inspection and/or test by the Engineer or their duly authorized representative, or any approval granted as a result thereof, relieve the Contractor from responsibility for full compliance with the requirements of the contract.

2. Field Measurements and Verification. Before ordering any materials or fabricating any items, verify all relevant dimensions at the job site and ensure their accuracy.

Verify all dimensions and details at the site before proceeding with any work, purchasing any items, or fabrication of any custom components. The Contractor bears all costs and/or damages that may result from the ordering or fabrication of any items or materials prior to such verifications.

Verify field point-to-point wiring for connections of new installation and modifications. Verify all field measurements that are critical to the fabrication of new items, and clearly indicate to differentiate from other dimensions on working drawings that are submitted for review and approval.

3. Submittal Requirements. Submit shop drawings for the required work and product to include, but to not be limited to, the following requirements applicable to all electrical work for this project.

Ensure all equipment and/or materials is approved by the Engineer prior to their use/installation on this project.

Do not perform any work without approved shop drawings.

Submit calculations verifying design, including drive machinery sizing calculations, and anchor bolt capacity calculations.

Submit brochures, catalog cut, certified prints with certified ratings and dimensions, and specification sheets, and other product literature for all products.

Submit certified drawings for products when requested by the Engineer or as otherwise required by the contract. Certified drawings must clearly depict all critical dimensions, as well as all electrical and mechanical ratings. Manufacturer's standard catalog drawings are not acceptable in place of certified drawings.

Submit material test certificates for raw materials when requested by the Engineer, or as otherwise required by the contract.

Submit assembly drawings for fabricated items and assemblies.

Submit shop drawings to include, the following:

• Barrier gate schematic wiring diagram(s) depicting all required power and control wiring, limit switch trip schedule, and connections to existing wiring and equipment.

• Complete bill of materials for all components. Present bill of materials in tabular format. Clearly identify all components by designation and/or description, along with manufacturer's name and complete model or catalog number.

• A complete listing of proposed spare parts to be furnished, in accordance with the requirements given elsewhere herein, submitted for approval prior to delivery of the spare parts.

• The required component descriptive data and system shop drawings submitted together.

• Installation drawings clearly illustrating the physical relationship between new and existing components and features, including mounting methods and critical dimensions. Field verify all pertinent information regarding existing features, dimensions, etc., prior to preparation of the drawings. Ensure dimensions obtained by field measurement are clearly indicated as such on the drawings.

• Final acceptance test, perform additional electrical testing, and provide results per section e.11 of this special provision.

Submit complete descriptive data (catalog cut sheets, etc.) for all components.

On multi-line schematic wiring diagrams, show all circuit phase, neutral, and grounding conductors. Identify all conductors on the diagrams by wire numbers that match the same respective conductors or connections shown on other diagrams, shop drawings, and existing wiring. Clearly indicate the size and type of all conductors on wiring diagrams. Wiring diagrams are not intended to be to scale, but must show all equipment, terminals, splices, etc. Show items in their approximate geographic orientation to each other to the extent practical.

Prepare and submit new as-built drawings of the barrier gate installation drawing(s) and barrier gate schematic wiring diagrams. As applicable, provide marked-up revisions (red-lined) to the existing as-built control system schematic wiring diagrams.

4. Warranties. Warrant the product against defects in materials or manufacturer workmanship for a period of 1 year from the date of final acceptance of the project. Provide a manufacturer’s warranty on products furnished and installed for the project to the Engineer in writing as a part of the shop drawing submittal process. Perform at no additional cost all required corrections or adjustments to the electrical work during this period. Assign manufacturer’s warranties on products furnished and installed for the project to the Engineer in writing.

5. Execution. Employ electricians licensed in the State of Michigan who are experienced in the installation and maintenance of movable bridge control systems, with at least three prior movable bridge projects. Submit a summary of projects to the Engineer within 10 days of award. Ensure all electrical work is supervised by properly qualified supervisory personnel.

Complete all work in a professional and safe manner. Verify all relevant dimensions prior to performing any work and ensure compliance with NEC required clearances (i.e. "Working Space", "Dedicated Equipment Space", etc.). Immediately inform the Engineer of any conflict between equipment locations shown on the plans and NEC required clearances. In the case of any such conflict, ensure the equipment in question is relocated or similar remedial action taken, as directed by the Engineer and at no additional cost to the contract.

Physically install all products in a secure manner as shown and as required to provide a reliable installation. Inspect and test all installed products for correct installation, performance, and workmanship. Torque all terminals and other current carrying connections per the manufacturer's recommendations using calibrated tools. Furnish nameplates and necessary warning labels for all equipment, cabinets, and boxes.

6. Delivery, Storage, and Handling. Properly store and protect all materials and products until installation, including during shipment and storage. Securely mount and store all large, bulky and/or heavy items on skids or pallets of ample size and strength. Box all small parts in sturdy wood or heavy corrugated paperboard boxes. Perform skid/pallet mounting and boxing in a manner that will prevent damage to the equipment during loading, unloading, storage and any associated and/or subsequent handling. Furnish weatherproof covers to protect materials from weather, when stored outdoors.

Store products to permit easy access for inspection and identification, and furnish pallets, platforms or other means to support from the ground. Do not store products in a manner that would cause distortion or damage. Furnish lifting eye bolts or lifting holes properly sized for safe working loads and located to provide a balanced lift for all large units.

7. Protection and Maintenance of Facilities and Work. Protect and preserve at all times all materials and work. Repair any damage to materials or work during construction to the satisfaction of the Engineer, at no additional cost to the contract. Maintain all work, and the project site in a safe manner. Always keep the project site free of excess material, debris, and rubbish caused by the Contractor's operations.

If the Contractor causes any damage to the existing facility, repair all damage to the satisfaction of the Engineer, at no additional cost to the contract. Contractor will assume all penalties that may be assessed due to the damage caused by construction operations.

8. As-Built Documentation. Turn over all as-built documentation to the Engineer at the completion of the project. The Engineer will review the submitted, as-built documentation for thoroughness, accuracy, and general acceptability. After the completion of the drawing corrections and final approval by the Engineer, submit one complete set of as-built-drawings to the Department for approval before final distribution. Include electronic files of all submitted as-built drawings with the submission.

The project will not be granted final acceptance until all required as-built documentation is furnished to and acceptable to the Engineer.

**d. Materials.** Furnish materials in accordance with the following:

1. Traffic Barrier Gates. Furnish traffic barrier gates to include the following minimum requirements:

A. Furnish crashworthy, positive protection traffic barrier gates, as customized for movable bridge applications, designed to prevent intrusion of vehicles into areas where occasional restriction is required, with dimensions and characteristics as shown on the plans and described herein. Deploy the barrier arm using a vertical pivot action and utilize a positive locking device at each side of the roadway to secure the barrier during an impact.

B. Design and test the barrier gate to meet *Test Level 2 (TL-2)* conditions as specified in the AASHTO MASH, second edition. Furnish barriers capable of stopping a vehicle as defined in the above specification, and impacting the barrier arm at ninety degrees (perpendicular to vertical face of barrier arm), and the gate arm must withstand a wind pressure in its normal up position defined by Section 3.8 of *AASHTO’s “Load and Resistance Factor Design (LRFD) Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals”, first edition, 2015* with a gust effect factor of 1.14 and a 10 year mean recurrence interval *(MRI)*. Furnish at no additional cost any modification to the details as indicated in the contract, including the addition of features or provisions, required in order to comply with this requirement. A Professional Engineer licensed in the State of Michigan must review the barrier gate design for compliance with the above requirements, including sizing of the barrier mounting and cable anchorage provisions, and all project specific conditions, and ice and wind loading conditions. The reviewing Professional Engineer will furnish the barrier manufacturer with a letter certifying that the barrier is properly designed in accordance with the above requirements, along with signed and sealed back-up calculations. Submit the letter along with the barrier working drawings. Submit barrier gate calculations to the Engineer for review.

C. Select anchor bolt system from the MDOT Qualified Products List found in the Material Source Guide. Submit calculations to the Engineer for review which demonstrate adequacy of the anchor bolt system to restrain the barrier gate and associated components against the design loads.

D. Fabricate the housing from 0.375-inch steel plate, hot dip galvanized after fabrication, and coat with aluminum paint. Utilize corrosion resistant external fasteners and furnish O-ring seals for gate arm shaft openings. Furnish holes in the base of the housing for mounting the barrier gate with spacing as shown on the plans.

E. Hang the front and rear access doors on slip-off type hinges. Seal doors with neoprene strip gaskets. Equip door with a mechanism with provision for attaching a padlock.

F. Seal openings for arm shafts with O-ring seals. Use corrosion-resistant external fasteners. Fabricate the arm from aluminum tube. Cover the arm on both sides with vertical 16 inch alternating red and white engineering grade reflective sheeting. Furnish two end-of-roadway markers (18 inch by 18-inch diamond panel, consisting of 9 3-inch diameter red retro-reflectors on a 0.08 inch red aluminum background) in accordance with the *Manual on Uniform Traffic Control Devices* (*MUTCD),* and *OM4-1*.

G. Furnish stainless steel truss cables, with stainless steel hardware, to stabilize the arm. Furnish one or more, as determined by the barrier manufacturer, spring loaded bumper rods on the arm to help stop the arm travel when the arm is in the horizontal position.

H. Equip the barrier gate arm with a system of three 0.5-inch (minimum) diameter annealed stainless steel cables, one in each gate arm tube and one along the center of the arm. Anchor the cables at the housing end of the barrier gate arm with a galvanized steel receiver. Each barrier gate arm must also latch into the arm of the barrier opposite it by means of a male-female type latch. Design the anchoring system to withstand three design impacts without requiring replacement. Design the end lock to automatically engage the cable assembly when the arm is lowered to the horizontal position. Neither mechanical linkages, nor actuators will be required for alignment and engagement of the cable assembly.

I. Equip one barrier of each mating pair with a proximity switch installed on the tip of its arm and properly arranged to detect proper mating with the arm of the opposite barrier.

J. Furnish hot-dip galvanized steel arm mounting tubes. Connect the tubes rigidly to the arm operating shaft in such a manner as to prevent horizontal migration of the tubes on the shaft during normal operation, such as by through bolting or similar means.

K. Equip each barrier with galvanized steel counterweights of the sectional, bolt-on type. Counterweight offset will be determined by manufacturer to balance the arm in both the raised and lowered position.

L. Mount the main arm shaft in heavy-duty ball bearings to be lubricated from the inside. Ensure the main arm shaft is a minimum 2½ inches in diameter, and the shaft material compliant with *AISI 4140* high strength, alloy steel.

M. The barrier arm must pivot in the vertical plane via a mechanical linkage that furnishes field adjustable arm travel. The linkage must utilize cranks keyed to the main arm shaft and transmission shaft and an adjustable connecting rod between a pair of self-aligning spherical rod ends. Construct the connecting rod from *AISI 4140* alloy steel or approved equal. Use an auxiliary crank paired with the transmission crank. Mount the auxiliary crank in a permanently lubricated bearing. Furnish a fully enclosed transmission that drives the linkage mechanism.

N. Furnish a heavy-duty torque limiter to limit torque transmitted to the operating mechanism in the event of a physical obstruction to the arm that could damage the mechanism during operation. Set the torque limiter anywhere within a range of 10,000 to 75,000 inch-pounds of torque. Ensure each torque limiter is factory set for the load recommended by the manufacturer, based on installation requirements. Adjust and test each torque limiter at the factory, under over-load condition, for a minimum of 5 minutes to verify the setting. Ensure the gate limit switch assembly is driven from the output side of the torque limiter so that slippage of the torque limiter will have no effect upon the limit settings.

O. During the opening and closing cycles, the arm must begin with zero velocity and accelerate smoothly reaching maximum velocity at mid-stroke (45 degrees). The arm must then decelerate smoothly to zero velocity at full stroke (90 degrees) preventing bounce or whip of the arm.

P. Size the barrier drive motor to properly operate the gate arm in accordance with the criteria required for the barrier gate, and for operations under 50 mph wind and ice conditions of 2½ psf per *AASHTO Standard Specifications for Highway Movable Bridges*. Furnish a 480-VAC, three-phase, 60 hertz motor. Install a solenoid-actuated, automatic brake on top of the motor. Furnish a brake that allows for manual operation of the barrier with a release lever.

Q. Include a hand crank and drill crank with each barrier to permit manual operation during installation or an emergency.

R. Anchor the energy absorption cables at both ends of the span in the closed to traffic position. At the housing, mechanically link heavy duty side arm locks to the operating mechanism to automatically engage and lock the side arm tubes into a rigid configuration when the arm is lowered, to assist in transferring the load into the housing in the event of an impact.

S. Furnish an enclosed rotary cam limit switch assembly with eight individual switches having one set of normally open and one set of normally closed contacts each. Furnsih environmentally sealed contacts having *UL* rating of not less than 15 amperes at 480 VAC. Use limit switches readily accessible and easily replaced with normal hand tools. Control each individual switch by an independent, adjustable cam. Furnish limit switch bodies, shafts, and cams with corrosion resistant non-ferrous materials. Cover the limit switch assembly drive with a corrosion-resistant cover.

T. Furnish each gate with a manual disconnect, a hand-crank safety switch, and door safety switches. Prewire all devices at the factory to protect personnel during installation or service. The manual disconnect switch must break the main motor leads. The hand-crank safety switch must prevent powered actuation of the gate during manual operation. Furnish automatic safety interlock switches consisting of one switch per door with rotating arms and arranged to break the control circuit when either door is opened. Furnish pressure type *NEMA* rated terminal blocks and install inside the housing. Terminate all control wires on these blocks. Clearly label each terminal and color-code or number all conductors. Reflect such colors or numbers on the wiring diagram(s). Furnish a thermostatically controlled heater within the barrier gate housing. All control circuits must operate at 120 VAC. House electrical components in a *NEMA* 4 compartment located within the gate housing.

U. Arm Light Flasher. Furnish a LED warning light flasher inside each gate assembly. Ensure the flasher is moisture and corrosion resistant, is capable of dissipating heat sufficiently for continuous duty, and is *Restriction of Hazardous Substances Directive (ROHS)* compliant. Furnish the flasher with two alternately flashing circuits and one steady burn circuit. Each flashing circuit must flash 0.50 seconds on and 0.50 seconds off.

V. Use factory supplied wiring, as follows:

(1) Power circuits: minimum #14 AWG, moisture, and sunlight resistant Type XHHW-two stranded copper.

(2) Control circuits: minimum #16 AWG, moisture, and sunlight resistant Type XHHW-two stranded copper.

(3) Wiring to the arm lights: At least #16 AWG, water, sunlight, and oil resistant, extra-flexible, stranded copper multi-conductor cable.

W. Furnish material with specifications as follows, unless specifically noted otherwise herein:

(1) Fabricate metalwork from either micaceous iron oxide finish MIO20 Merchant Quality steel or *ASTM A36/A36M* steel. Galvanize metal work after fabrication in accordance with *ASTM A123/A123M*. Ensure all welding is done by or under the direction of a certified welder.

(2) Assemble the system with hot dip galvanized and stainless-steel fasteners. Unless otherwise specified, furnish commercial quality *ANSI* bolts, nuts, and washers.

X. Arrange all components mounted within the barrier gate housing such that manual operation, and all normal maintenance, is from the rear of the barrier (away from the roadway).

Y. A representative of the barrier gate manufacturer must visit the project site to examine the site and directly supervise the surveying and gathering of all field data (characteristics of the site and existing features, critical dimensions, etc.) necessary for preparation of the barrier gate submittals, and fabrication. Ensure this representative is a properly qualified Engineer who is directly and regularly employed by the barrier gate manufacturer, and will assist the Contractor in the installation, adjustments, and testing of the traffic barrier gates as necessary.

2. Spare and Renewal Parts.

At a minimum, provide the following spare parts:

• Two arm light flasher modules.

• Two LED arm fixtures.

• One proximity switch.

• Two door limit switches.

• One hand crank.

• One drill crank.

• One heater.

**e. Construction.**

1. General Requirements. Furnish all miscellaneous products, tools, equipment, and labor necessary to properly complete all work in accordance with the requirements of the contract. Install all products in accordance with their manufacturers' recommendations and the requirements of the *NEC* and the contract. Physically install all products in a secure manner as indicated and as required to furnish a reliable installation. Inspect and test all installed products for correct installation, performance, and workmanship.

2. Removals. Before removing any existing electrical items for the installation of replacement equipment, which is to be reconnected to existing systems, identify, record, and document all existing circuits and wiring with identified wire labels.

Remove materials, equipment and devices required for replacement, as described herein and shown on the plans.

Remove intact all components of the existing barrier gates and receiver to be salvaged, and handle with care to avoid damage. Upon removal, carefully and suitably package all salvaged equipment in wooden or heavy cardboard boxes, neatly and accurately labeled as to contents, and deliver to a designated facility as directed by the Engineer. Contact Mike Wakley at 517-243-6866 for pick-up of the salvage components from 7:00 a.m. - 5:30 p.m., Monday through Thursday excluding state holidays. Reimburse the Department for any costs associated with repairing and/or replacing any removed equipment which is damaged by the Contractor's activities.

Unused or un-salvaged materials from the removal will become the properties of the Contractor who must dispose of them away from the construction site.

3. Documentation of Existing Wiring. Prior to removal of existing equipment, document and record wires to be detached from the existing equipment and re-attached to the new equipment. These documents are for reference and used along with the changes shown on the contract plans for the Contractor to install, modify and connect new and replacement equipment and devices to the existing bridge control system and power distribution system to ensure that after the installation all systems and equipment function properly as they are intended.

4. Installation*.* Prior to commencing installation:

Verify that all surfaces upon or in which enclosures are to be mounted, are properly prepared, and that all wire pulling required before enclosure mounting, has been completed and all wires are properly tagged. Take corrective action, if necessary.

Verify that enclosure mounting provisions are suitable for intended mounting. Make corrective adjustments, if necessary.

5. Wiring. Use conductors with green colored insulation only for grounding conductors. The re-identification of conductors with green colored insulation, such as with colored tape, is prohibited.

Ensure permanent labeling of all conductors, cables, and terminal blocks at every terminal or connection, splice, and tap. Ensure that all re-used conductors are terminated at the correct location in or at the barrier gate housing and with original or identical-to-original replacement conductor identification. As necessary, coordinate new conductor numbers and labels for consistency and accuracy with conductor numbers on the bridge as-built wiring diagrams and any other diagrams containing the same respective conductor or cable.

Label all conductors with machine printed sleeve-type labels. Use water and smudge resistant text. Coordinate label text with shop drawings and wiring diagrams. Hand-written labels are not acceptable.

Label all conductors and cables, both internal shop wiring and field wiring at both ends, and at any intermediate splices.

Use internal shop wiring with permanent "hot stamping" directly on the conductor insulation, machine printed heat-shrink labels, or sleeve type labels. Ensure machine printed heat-shrink labels are utilized for labeling communications cables.

6. Low Voltage Splices, Terminals, and Terminal Blocks. Splice and tap conductors only in equipment enclosures, cabinets, or junction boxes, and on terminal blocks or with insulated compression crimping-type connectors or as described herein. Do not terminate more than two conductors per terminal block. Splices and/or taps made at equipment or in locations which do not permit the use of terminal blocks may be made with crimp or mechanical type connectors with the Engineer’s permission.

Insulate all splices made with crimp or mechanical type connectors with rubber and vinyl tape, or an insulating cover specifically designed for use with the connector, after installation. The Engineer may require the use of special splices or splice kits to address specific application considerations.

For splices without integral insulating sleeves, tightly apply a minimum of one half-lapped layer of rubber tape, tacky side up, over entire splice and extending onto the conductor insulation at least one tape width on both sides of splice. Apply a minimum of 2 half-lapped layers of vinyl tape completely over rubber tape and extending onto conductor insulation past ends of rubber tape.

For splices which are provided with integral insulating sleeves, apply a minimum of 2 half-lapped layers of vinyl tape completely over splice and extending onto conductor insulation, past ends of splice.

Use 3M 33+, or Super 88 vinyl electrical tape, or Scotch electrical vinyl tape, or Engineer approved equal. Ensure rubber insulating tape is 3M 130C liner-less rubber splicing tape, or Scotch rubber liner-less tape, or Engineer approved equal.

7. Enclosures, Cabinets, Junction/Pull Boxes, Device/Outlet Boxes. Install boxes, cabinets, and equipment enclosures plumb and level. Anchor cabinets securely as shown, and as required to furnish a dependable installation. Neatly route, harness and support conductors in gutters, wiring spaces and compartments. Ensure conductor bending radii is not less than recommended by the conductor manufacturer.

Install at shown or approved locations, in accordance with the manufacturer's instructions. Verify that enclosure mounting provisions are suitable for intended mounting. Make corrective adjustments, if necessary.

Bond boxes, cabinets, and enclosures directly to each equipment grounding conductor, not just through the conduit and or connectors. This connection may be made by a jumper tapped to the main equipment grounding conductor.

8. Grounding and Bonding. Furnish grounding and bonding in compliance with the requirements of *NEC Article 250* for grounding and bonding.

Solidly connect all electrical equipment to the equipment grounding conductor serving that equipment.

9. Touch-up Painting. Touch-up paint all scratches and damage to factory-applied finishes on electrical equipment cabinets and enclosures, raceways, and boxes, as required to repair the damage to the factory finish. Use touch-up painting, at least, 1 coat of primer and 2 coats of finish paint. Ensure primer and paint is as supplied or recommended by the manufacturer of the item being painted.

10. Identification nameplates. Permanently mark the barrier gates utilizing identical nomenclature to the previously installed barrier gates. Unless otherwise specified, furnish identification nameplates made of laminated plastic with white outer layers and a black core, and with all edges chamfered. Fasten nameplates flat with round-head drive screws, or other approved non-adhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor must devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates.

In all instances, install the nameplate in a conspicuous location. At the option of the Contractor, and with prior approval from the Engineer, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic.

Permanently affix “danger high voltage” signs with red background and black lettering on all equipment operated at voltage higher than 120 VAC.

11. Electrical Testing and Measurements.

A. Submittals. Submit as specified to meet the following minimum requirements:

(1) Submit proposed testing procedures, including test instruments, up-to-date instrument calibration proof, and other equipment to be used for approval at least 21 calendar days prior to testing.

(2) Accurately record the results of all tests in a neat and orderly manner along with time and date of test(s), environmental conditions (temperature, humidity, general weather conditions, etc.), testing equipment used, conditions of test(s), and the name(s) of person(s) performing the test(s).

(3) Submit all test results with all text in typewritten format no later than 14 calendar days from date of test(s). The test results must be approved by the Engineer prior to acceptance of the work in question.

(4) Submit the following:

(a) Insulation resistance testing, including the continuity and resistance testing of all spliced wires and any wires affected by the work. Do not test insulation resistance (megger) of communications, data, and instrumentation circuit conductors.

(b) Voltage and current tests on the barrier gate motors while operating.

(c) Results of operational testing after installation of barrier gates.

B. General Requirements. Performing all testing, inspections, and any resulting corrective work to ensure that, after the installation of the new barrier gates, the entire bridge power and control systems function at least as well as prior to the installation and as recorded prior to the removals and as modified and required by the contract.

In addition to the specific tests described herein, perform all additional testing, and make any necessary repairs or adjustments, as required elsewhere in this special provision and as otherwise necessary to furnish a complete, functional, and reliable installation. All testing, inspections, and demonstrations, and any resulting remedial work, will be deemed solely the responsibility of the Contractor and will not be considered cause for delay or additional payment.

Use test procedures and equipment in accordance with manufacturer’s recommendations, *NETA* Acceptance Testing Standards, any other applicable industry standards, and be appropriate for the specific test being performed.

Use true rms type voltmeters and ammeters. Where recording instruments are required, use three phase, strip chart or computer-based type instruments. Maintain in proper calibrated condition and use all tools and instruments specifically designed for measuring the quantity in question.

C. Testing and Inspection after Installation.

(1) Visual Inspection. Visually inspect to verify the proper operation of the operating mechanism and mechanical interlocks, and the proper installation of all installed new equipment and devices.

(2) Testing. After all wires have been installed and prior to connections of any circuit, test to verify that all installed and spliced conductors are free of shorts, opens, or unintentional grounds, and properly terminated.

Disconnect, measure, and record the insulation resistance (megger) of the conductors installed or spliced for this contract with a megger set at the proper DC voltage test level as recommended by *NETA* Acceptance Testing Specifications, for a duration of 60 seconds. Measure, as appropriate, phase to phase, phase to neutral, and phase to ground. The minimum acceptable resistance of new conductors is 100 megohms for 600 VAC rated conductors and 25 megohms for 300 VAC rated conductors. Do not perform insulation resistance testing on data, and communications circuit conductors. Perform insulation resistance testing on instrumentation circuit conductors rated 300 volt only as directed by the Engineer.

Perform tests after energizing any circuit and prior to connections to equipment or motors to verify the following conditions:

(a) Correct no-load voltage for the equipment to be powered.

(b) Correct phase sequence.

(c) Correct polarities.

After all connections have been made to all equipment and devices, visually inspect all electrical connections, and verify that all lugs, connectors, and terminals are tightened and torqued to the levels recommended by the manufacturer.

D. Operational Tests and Demonstrations. Conduct operational tests on individual, group, or system of new equipment and of existing equipment and systems to remain in place and affected by the construction, including new traffic barrier gates and the existing bridge control system, to demonstrate that an acceptable and reliable operation can be assured. Prepare a format and record thereon all test results observed.

When the installation of all systems are complete and ready for testing, test-run the bridge. The barrier gates as operated in conjunction with the bridge control system must demonstrate a trouble-free operation, meeting all specified requirements with all interlocks properly functioning.

Perform additional miscellaneous operational tests as requested by the Engineer to demonstrate and establish the new barrier gates meet all specified requirements and operate in a reliable manner.

After the conclusion of all testing, turn over to the Engineer all test results including any recorded charts, voltage and current readings, insulation resistance test readings, and all other required test readings performed by the Contractor.

E. Final Acceptance Testing. The Contractor and other system Vendors must jointly prepare a detailed testing procedure for final acceptance testing of all newly installed and modified systems that affect the operations of the bridge, and as determined necessary for testing by the Engineer. Submit the Final Acceptance Test procedure 21 calendar days in advance for approval before beginning final acceptance testing.

Coordinate with the Engineer and schedule the test at a time agreeable to all parties involved. Determine the schedule at least 14 calendar days in advance of the proposed start date for the testing. Perform a complete interlock test and two complete (full open and close starting and ending with traffic signals green) bridge operations and ensure that all safety measures are in place to the traveling public.

Perform additional tests to demonstrate to the Engineer the installed new and modified systems satisfy the requirements of the contract.

Correct any deficiencies revealed during testing which are related to the barrier gates and repeat the test until such time as the Engineer is satisfied with all test results and the overall performance of the bridge traffic control system. For final acceptance by the Engineer, restore all existing systems and equipment, which are to remain and are affected by the construction, to their existing working conditions in accordance with the data recorded prior to the construction.

F. Corrective Actions. For any test failure, or for any test result which fails to meet the specified requirements or the stated acceptable values or conditions, or the Engineer finds unacceptable, the Contractor must investigate the cause of the failure, take appropriate corrective actions, and repeat the test(s). Repeat this procedure until such time as all test results are deemed acceptable by the Engineer.

**f. Measurement and Payment.** The completed work, as described, will be measured as a lump sum, and paid for at the contract price using the following pay item:

**Pay Item Pay Unit**

Traf Barrier Gate Replacement (Structure Identification) Lump Sum

**Traf Barrier Gate Replacement (Structure Identification)** includes, but is not limited to, the following work items:

Perform field verification of measurements and dimensions.

Replace barrier gates for bridge traffic control.

Furnish all miscellaneous materials and appurtenances to complete the work.

Dispose of removed materials that are un-salvaged, and deliver the existing materials salvaged for use as directed by the Department.

Test all newly installed and modified equipment and devices for their trouble-free operation with relation to existing bridge equipment and control systems.