EXHIBIT K
TECHNICAL SPECIAL PROVISIONS
REVISED ADDENDUM # 4

I hereby certify that these Technical Special Provisions have been properly prepared by me, or under my responsible charge:

Technical Special Provision Section(s): T465, T468, T508		
Signature:		
Date:		
Engineer of Record:		
Florida License No.:		
Firm Name:		
Firm Address:		
City, State, Zip Code:		
Cert. of Authorization No:		

TECHNICAL SPECIAL PROVISIONS – SUPPLEMENTAL TWO

FOR

SECTION T465 - MOVABLE BRIDGES CONSTRUCTION

COUNTY PROJECT NUMBER: CN-1414-218

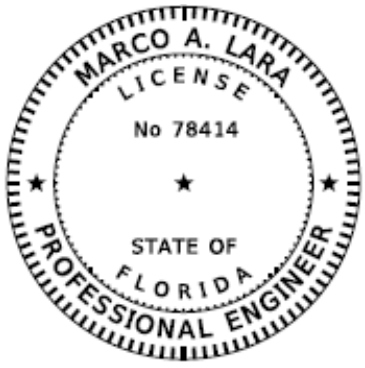
MATLACHA BASCULE BRIDGE EMERGENCY REPAIRS

BRIDGE NO. 124134

This Technical Special Provision has been digitally signed and sealed by Travis M. Kimmins, PE 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.

Engineer of Record: Travis M. Kimmins, PE
Date: 02/14/2025
Florida License No.: 87786
Firm Name: Hardesty & Hanover, LLC
Firm Address: 5110 Eisenhower Blvd, Suite 310
City, State, Zip Code: Tampa, Florida 33634
Pages: 1-11, 15-21

This Technical Special Provision has been digitally signed and sealed by Marco Lara, PE 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.



Engineer of Record: Marco Lara, PE
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Pages: 1-14, 17-21

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MOVABLE BRIDGES

T465-1. GENERAL

T465-1.1. Description

The work under this Technical Special Provision includes rehabilitation of movable bridge systems and components, bridge operators, and functional checkout of the movable bridge as required by the Contract Documents.

T465-1.2. Standards

Portions or all of certain recognized industry or association standards or specifications referred to as a requirement in these specifications are to be considered as binding as though reproduced in full unless supplemented and modified by more stringent requirements of the Contract Documents. Unless otherwise stated the reference standard or specification which is current at the time of the Contract Documents are issued will apply. The following abbreviations will be used throughout the Contract Documents to designate standard specifications for material and workmanship:

American Associate of State Highway and Transportation Officials	AASHTO
American Bearing Manufacturers Association	ABMA
American Iron and Steel Institute	AISI
American National Standards Institute	ANSI
American Society of Mechanical Engineers	ASME
American Welding Society	AWS
International Organization for Standardization	ISO
National Lubricating Grease Institute	NLGI
National Fluid Power Association	NFPA
Society of Automotive Engineers	SAE

T465-1.3. Existing Information

The dimensions and elevations shown are based on the Existing Bridge Plans and may not represent as-built conditions.

T465-1.4. Field Measurements and Surveys

Conduct field surveys to verify existing dimensions shown on the plans, prior to development of submittals. Clearly indicate field verified dimensions on all submittals. Conduct field measurements and surveys as required to supplement information provided in the plans and as necessary to provide a complete and satisfactory fitting and operational installation.

T465-1.5. Products

Provide materials and equipment meeting the requirements of this TSP. Where particular products are called for, provide said products unless otherwise approved by the Engineer.

T465-1.6. Bridge Operator, Preventive Maintenance, and Routine Repair

Assume responsibility for the operation and all maintenance of the movable bridge from the first chargeable workday through Final Acceptance, including all aspects of bridge equipment, administration, maintenance, troubleshooting, repairs, replacements, and operation as directed by the Engineer. Perform initial bridge facility walkthrough on the first chargeable workday to identify any deficiencies

For Maintenance Requirements refer to the established Maintenance Procedures.
Notify the County immediately of any failure or malfunction and document by describing the event and logging a “Preliminary Cause of Failure Report.” Submit this report to the Engineer within ten days of the event. Complete repairs immediately upon failure or malfunction to the satisfaction of the Engineer. If

immediate repair is not possible, provide a temporary solution. Upon Engineer approval of the proposed solution and timeframe thereof, implement the solution. Copy of maintenance and operations manual is available on site at the bridge, digital copy may be requested from the owner, Lee County for bidding purposes of required lubrication and other maintenance procedures.

T465-1.7. Coordination

Coordinate installation and testing of the machinery and electrical systems.

Coordination of Shop Drawings: Provide Shop Drawings meeting the requirements of FDOT Specification 5.

T465-1.8. Quality Control

Perform all work under this Technical Special Provision in accordance with an approved Quality Control Plan meeting the requirements of FDOT Specification 105.

T465-1.9. Observation of Work

Meet the requirements of FDOT Specification Section 105.

T465-1.10. Documentation of Tests

Meet the requirements of FDOT Specification Section 105.

T465-1.11. Equipment Start-Up

A. Verify that work is complete, and equipment is in operable condition.

B. Observe start-up and adjustment. Record date and time of start-up, and results.

C. Provide equipment demonstrations to the Engineer. Record times, valve adjustment and setting turns and additional information required for operation and maintenance manuals.

D. Provide the services of a factory authorized start-up representative at the time of energizing and for the Functional Checkout as required in this Technical Special Provision.

T465-1.12. Inspection and Acceptance of Equipment

Prior to Functional Checkout, verify that equipment is tested, operational, clean, and ready for operation.

Assist Engineer with review. Prepare list of items to be completed and corrected.

T465-1.13. Submittals

T465-1.13.1. General

Meet the requirements of FDOT Specification Section 5. As a minimum, but not limited to, include the following in the Shop Drawings:

A. Before preparation of shop drawings for new components that must mate with the existing structure, obtain all necessary field dimensions to provide proper fit of the new components. Where new components are to be attached to the existing structure where existing fasteners exist, take care that any fastener holes in the new components will mate with the bolts/holes in the existing material. If reaming larger holes in existing components, verify edge distances are acceptable.

B. Mark standard drawings showing more than one model or size or selection, to indicate the model, size or type proposed.

C. Submit shop drawings for new equipment as required by the specifications.

D. Submit shop drawings when installation and mounting details of components are different from Plans or not specifically detailed on the Contract Documents.

E. Submit copies of a full report documenting the results of the Dynamic Hydraulic Cylinder Pressure Testing as required in this Technical Special Provision.

T465-1.13.2. As-Built Drawings and Operations Manual

As a condition precedent to Final Acceptance under FDOT Specification 5-11, prepare and submit to the Engineer for review and approval complete as-built drawings and operations and maintenance instructions for all new components meeting the requirements of FDOT Specification 5-1.4.4. In addition, provide an electronic copy of all supplementary documents in a format acceptable to the Engineer.

Prepare as-built drawings from the marked up working drawings. Provide the working drawings for checking purposes.

Operations and maintenance instructions shall comprise a compilation of the manufacturers' catalog data, installation, and maintenance instructions of all new mechanical and electrical components. The County will add this information to the existing operations and maintenance manual.

Ensure that as-built drawings are essentially the same as the working plans and shop drawings submitted for approval but showing all the changes made during construction.

T465-1.13.3. Product Data

Submit products meeting the requirements of FDOT Specification 5-1.4.4.

T465-1.14. Training

Provide on-site training for operations and maintenance personnel, in addition to any factory training which is provided under Technical Special Provisions Section T468.

Train maintenance personnel during the last 15 days of the Operational Testing Period in the maintenance and operation of the bridge. All training shall be completed prior to final acceptance.

T465-1.15. Maintenance and Operations Training

Provide a minimum of 8 hours of on-site training for the new specified equipment for 3 persons.

Coordinate the time of the training with the County.

Include the following topics:

A. Lubrication for new machinery and hydraulic equipment.

B. New hydraulic equipment.

C. Preventive maintenance for all new machinery.

Perform maintenance training prior to the end of the Operational Testing period.

T465-2. BRIDGE OPERATION AND PREVENTATIVE MAINTENANCE

T465-2.1. Description

Provide bridge tending services for the bridge once it is operational through final acceptance. Provide adequate, responsible personnel trained as bridge tenders to operate the bridge(s).

Bridge administration, maintenance, repairs, storm preparation and operation will be the responsibility of the Contractor throughout the life of the Contract. During this period, make immediate repairs of any damage caused by the Contractor's use or operations at the Contractor's expense.

Adhere, at all times, to the Bridge Operations and Maintenance Manual and to the U.S. Coast Guard Code of Federal Regulations (CFR) 33.

Prepare a bridge storm preparation plan and submit to the County for review and approval prior to the start of field work. Execute approved plan as required to protect the bridges and associated equipment associated with this contract. Such plan is to include, but not be limited to, the following:

1. Removal, securing and reinstallation of the traffic gate arms upon closure and reopening of the movable spans to navigable traffic, prior to and after the storms, respectively.
2. Shutting down all power with the exception of that which is necessary to keep the movable spans safely open to roadway traffic.
3. Monthly load testing of the bridge back-up generator to ensure reliable operation in the event of a storm.
4. Keeping generator fuel tank full and with fuel stabilizer, if needed.
5. Secure the bridge before the storms make landfall, assess for any damage after the storms pass, perform any repairs as needed to its condition prior to the storm and return to proper operation as soon as possible.

T465-2.1.1. Bridge Tender

Employ bridge tenders that are at least 18 years of age with corrected vision of 20/40 or better and the ability to distinguish red, amber, and green colors. Bridge tenders must have normal

hearing and be able to climb bridge stairs and ladders. Subject bridge tenders to drug screening within 30 days of employment. Employees failing such screenings will be dismissed from work associated with this contract. Bridge tenders must be able to:

Read and comprehend FDOT and U.S. Coast Guard manuals, rules, regulations, and procedures.

Update and maintain logs and records in legible English according to the dictates of this Contract.

Effectively communicate in English on a V.H.F. marine radio.

Follow instructions and respond appropriately and professionally in various situations.

Bridge tending candidates will meet the training and testing requirements described in the FDOT's Bridge Operations and Maintenance Manual, Section III (C-2).

T465-2.1.2. Bridge Tender Supervisor

Provide a responsible Bridge Tender Supervisor. Provide the Bridge Tender Supervisor with a cellular telephone so that he or she will be available 24 hours a day, seven days a week, for immediate contact by the County or by members of the bridge tending staff. This individual to respond via telephone to efforts to contact him or her by the Engineer within 15 minutes. Bridge tender supervisors will be required, when necessary, to respond to a bridge site within one hour after notification. The bridge tender supervisor will spend much of his or her time in the field, ensuring that all bridge operations are safe and in accordance with the rules and regulations spelled out in CFR 33 and in the Bridge Operations and Maintenance Manual.

Provide Bridge Tender Supervisors with a picture identification card that will list the bridge he or she supervises. If an emergency situation arises where the supervisor must serve as a bridge tender, he or she must notify the Engineer or his designated representative immediately. Failure to notify the Engineer that the supervisor is serving as a bridge tender will result in a non-conformance assessment as detailed in the non-conformance section of this Contract. A Bridge Tender Supervisor, however, is not authorized to serve as a temporary bridge tender unless he or she has met all the requirements for bridge tender qualification and refresher training.

Bridge tender supervisors must have a minimum of one-year experience as a bridge tender and one year experience in a supervisory capacity.

Bridge tender supervisors must successfully complete the bridge tender training program to meet the qualifications of a trained bridge tender, as spelled out in the Bridge Operations and Maintenance Manual. After employment, they must be trained and tested on all bridge sites in their area of supervision.

T465-2.1.3. Mechanic

Provide one mechanic to perform preventative maintenance work and mechanical repairs on the bridges covered by this contract. At least one mechanic will be on call after normal office hours and on weekends and holidays at all times for emergency repairs. Provide a mechanic that will be capable to respond, via telephone, within 15 minutes if required.

Mechanics are required to respond to the bridge site within one hour following notification, should their services be needed, prepared with the necessary equipment, materials, and supplies to repair the bridge in a timely and efficient manner.

This mechanic will have at least four years hands-on maintenance or millwright experience, working with mechanical, electrical, and hydraulic equipment.

Vocational/technical training in mechanical, electrical, or hydraulic repair can substitute at the rate of 720 classroom hours for a maximum of one year of the required experience. Mechanical experience to include, but not be limited to: drive couplings, thrustor brakes, speed reducers, open gearing, bearings, linear actuators and control instrumentation limit switches.

All mechanics are to have working knowledge and experience on operating machinery and span lock machinery required to operate drawbridges and have the ability to perform maintenance as well as emergency repairs caused by equipment failure or accidents, should they be required.

T465-2.1.4. Electrician

Provide one electrician to perform preventative maintenance and emergency repairs on the bridges covered by this contract. At least one electrician will be on call after normal office hours and on weekends and holidays at all times for emergency repairs. Provide an electrician that will be capable to respond, via telephone, within 15 minutes if required.

Electricians are required to respond to the bridge site within one hour following notification, should their services be needed, prepared with the necessary equipment, materials, and supplies to repair the bridge in a timely and efficient manner.

Electricians must hold, at a minimum, a journeyman electrician's license in the county in which the bridge is located and have at least two years of experience in industrial electrical work.

Vocational training in industrial electricity can substitute at the rate of 720 classroom hours for each year of the required experience. Electrical experience to include, but not be limited to, frequency drives, switches, resistors, control circuits, and the repair and installation of electrical motors.

All electricians are to also have knowledge and experience on emergency power systems and other electrical devices required to operate drawbridges and have the ability to perform emergency repairs caused by equipment failure or accidents.

T465-2.1.5. Guarantees

Guarantee for ninety days the workmanship of a maintenance repair. In the event a repair fails within the guarantee period and such failure is the result of the parts provided by or the workmanship of, the Contractor, the correction to be made by the Contractor at no additional cost to the County.

T465-2.1.6. Documentation

Submit all appropriate forms for documenting preventative maintenance procedures to the County each month.

T465-2.1.7. Forms

The County will supply originals of the forms to be used in this contract at the Pre-Construction Meeting. Supply copies of all of these forms needed during the length of the contract. Submit all necessary forms monthly or as directed by the County:

1. Bridge Tender’s Report on Unnecessary Bridge Opening and/or Unauthorized Approach of Vessel: The bridge tender uses this form to document vessels requesting openings to accommodate outriggers or antennas, or to report vessels that are approaching the bridge in an unsafe manner (Under no circumstances are bridge tenders to engage in verbal altercations with boat captains).
2. Vehicle Traffic Accident on Bridge: This form serves to record all vehicular accidents on the bridge. Please note on the report the responding agency's case number. Include pedestrian and cycling accidents as well as trespasser activity.
3. Bridge Tender Supervisor Inspection Form: Used to monitor overall bridge conditions to ensure high standards are maintained.
4. Monthly Equipment Checklist: On a monthly basis, the bridge tender supervisor will inspect the bridge house to determine that all required equipment and supplies are in stock or are in working order and good condition.
5. Bridge Maintenance Log: Documents the date, time and assignment for any repair or maintenance crew serving the bridge. This will record for future reference when various repairs and maintenance work are performed.
6. Telephone Log: Documents all incoming and outgoing phone calls made to or from the bridge.

7. Bi-Annual Emergency Generator Checklist: Allows maintenance personnel to document maintenance procedures to the bridges' auxiliary emergency generators.

8. Bridge Tender's Comment Log: Allows bridge tenders on each shift to note problems, incidents, or malfunctions.

9. Drawbridge Malfunction Report: This form is filled out jointly by the bridge tender and the technician responding to the scene to make emergency bridge repairs. The bridge tender fills out the top half of the form, which asks for information regarding the problem the bridge tender is having and date and time the malfunction occurred. The bottom half of the form is filled out by the responding electrician or technician, who notes the repairs that were made. It is important for the bridge tender to keep track of the amount of time the bridge was down to either marine or vehicular traffic. Managers within the County use these reports to track the amount of down time for the bridge in a given period of time. It is imperative that this form be completely and accurately filled out each time the operation of the bridge is interrupted due to electrical or mechanical failure.

10. Report of Bridge Accident Caused by Water-Borne Traffic: This three-page report documents any mishaps or accidents involving the bridge structure and marine vessels.

11. Bridge Information: Each bridge needs to maintain its own list of emergency phone numbers for police, fire, and rescue agencies. As a matter of consideration, it is also recommended that other public service agencies, such as mass transit, be kept informed when the bridge is closed to vehicular traffic due to electrical/mechanical malfunctions.

12. Bridge Tender Shift-Change Checklist: When one bridge tender relieves another, this form is used to document the exchange of information regarding bridge problems, malfunctions, or deficiencies.

13. Bridge Tender Safety Equipment Checklist: Used by the bridge tender supervisor to maintain the appropriate safety equipment on each bridge and ensure that they are in good working order.

14. Report of Drawbridge Openings: The primary bridge documentation report, this form is used to log the date, time, direction, weather conditions and name of every vessel accommodated by the bridge.

15. Electrical Components: A checklist for electricians performing routine preventative maintenance procedures.

16. Mechanical Components: A checklist for mechanics performing routine preventative maintenance procedures.

17. Supervisors Report: Allows managers to schedule the various mandated inspections.

T465-2.2. Materials

T465-2.2.1. General

1. Furnish all miscellaneous equipment, tools, and supplies required for the maintenance and repair of the bridge, as described in the Bridge Operations and Maintenance Manual for the duration of the Contract.

2. Routine housekeeping supplies including but not limited to toilet paper, brooms, mops, buckets, towels, cleaning solutions, all light bulbs, and batteries (including generator batteries and battery charger) as required.

T465-2.2.2. Parts

Provide new parts. Rebuilt and/or repaired parts can never be used, unless approved in advance by the Engineer. Provide all parts of a brand or quality equal to or better than the ones being replaced and 100 percent compatible with the existing equipment.

T465-2.2.3. Uniforms

The bridge tender dress code to conform to the following criteria:

1. Short sleeved shirts clearly bearing the company logo.
2. Long pants or Bermuda type shorts with a length of no more than 6" above the knee.
3. Open-toed shoes are prohibited.

T465-2.2.4. Incidental Materials and Supplies

Assume responsibility for purchasing all fuel, fuel filter, oil filters, air filters, spark plugs, points, bolts, nuts, and hoses required to operate and maintain the emergency power generators. Assume responsibility for maintaining the specified fuel for each generator such that the fuel level does not fall below one half of a tank to ensure the bridge's power needs during any emergency. Damage caused by supplying the wrong kind of fuel will be the Contractor's liability. Top off all fuel tanks at the completion of the contract. Assume responsibility for maintaining the lighting and wiring systems on each bridge and supply and replace all light bulbs and lenses as needed.

At the beginning of the contract, meet with the County and/or County representative and perform a facility walkthrough, to take an inventory of all county-owned equipment on the bridge covered by this Contract. This inventory will be listed on the Monthly Equipment Checklist form. The Contractor is to then sign this form indicating that he/she has received it and will be responsible for this equipment.

At the first of each month for the duration of this contract, conduct a survey of this equipment, and submit a signed form to the Engineer. Replace any missing or damaged equipment at no cost to the County. If such discrepancies are not resolved within five days, and the County has to correct them, the Contractor to be billed for the entire cost incurred by the County.

T465-2.3. Construction Requirements

T465-2.3.1. General Requirements

General requirements include but are not limited to the following:

1. Bridge tenders are to make the safety of the following a priority:
    a. Personal
    b. Public
    c. Construction and Contractor
    d. Bridge structure
2. Do not schedule bridge tenders more than 16 hours of work in a 24-hour period or more than 56 hours in a seven-day work week.
3. Always keep the bridge house clean and orderly. Remove all trash or other types of debris found inside the traffic gate areas.
4. Bridge tenders are to always provide prompt and courteous service to the boating and motoring public.
5. Maintain a roster of qualified employees throughout the duration of the Contract.
6. Respond in writing to the Engineer to answer any complaints filed by the public, the U.S. Coast Guard, or the County concerning the conduct of employees or the operation of the bridge. Should complaints be made directly to the Contractor, make the County aware of such complaints by providing the Engineer with copies of all paperwork associated with these complaints along with details of how the matter was resolved.

T465-2.3.2. Conformance with Contract Documents

Specific tasks to which the Contractor must conform include but are not limited to the following:

1. Operate the bridge according to the Bridge Operations and Maintenance Manual.
2. Provide the Engineer with complete bridge tenders competency qualification form.
3. Provide proper supervisory personnel.
4. Inform the Engineer of mechanical, electrical, plumbing, air conditioning, and facility maintenance malfunctions and conduct the appropriate repair procedures for which the Contractor is responsible.
5. Inform the Engineer each day of malfunctioning navigation lights.
6. Inform the Engineer of events that may have jeopardized bridge structural integrity.
7. Respond within 15 minutes to any telephone call made to the Contractor by the Engineer.
8. Supervisors or other repair personnel must respond in person within one hour when requested.
9. Advise the Engineer when supervisory personnel serve as a bridge tender.
10. Inform the Engineer of any complaints from citizens or public agencies.
11. Notify the U.S. Coast Guard and the Engineer within 30 minutes of any event which causes lane closure or restriction of waterborne traffic.
12. Update and provide to the Engineer all completed forms as required by the County and the U.S. Coast Guard monthly or when requested.
13. Respond to any emergency repair of a malfunctioning bridge within the allotted time as specified by these specifications and the Engineer.
14. Conduct preventative maintenance as required.

T465-2.3.3. Bridge Tender Inspection

Weekly inspections of all shifts are to be conducted by the Bridge Tender Supervisors using the Bridge Tender Supervisor Inspection Form.

T465-2.3.4. Preventative Maintenance Inspection

Immediately and appropriately address any preventative maintenance deficiencies discovered because of these inspections under this item.

Any deficiencies discovered because of these inspections which fall outside the scope of preventative maintenance and require County involvement are to be communicated immediately to the County so that the County can take corrective action or authorize the Contractor to take corrective action. When the County decides to utilize the Contractor's services to rectify any non-preventative maintenance deficiencies, work required to correct such deficiencies are to be considered unforeseen work as defined in Article 4-4 of the General Provisions. Give the County no less than 48 hours advance notice of all preventative maintenance inspections. Perform all work to the satisfaction of the Engineer. The Engineer may elect to inspect all work performed at any time.

The results of all inspections are to be recorded and reported to the County using appropriate forms. All monthly, quarterly, semi-annual, and annual inspections as required by the Bridge Operations and Maintenance Manual will be scheduled in advance of the actual inspections. Submit a monthly schedule of all inspections to the County in advance. The Engineer may elect to be present during the scheduled inspection.

If any problem precludes a scheduled inspection, notify the Engineer as soon as possible. Reports from these inspections are to be submitted to the Engineer's office at the first of each month.

T465-2.3.5. Preventative Maintenance during Construction

Assume the responsibility for all maintenance on the movable bridge from the first chargeable workday through final acceptance, including all aspects of bridge administration, maintenance, repairs, and operation. Maintenance requirements are described below. During this period, make immediate repairs of any damage occasioned by use or operation at Contractor expense. If the construction activities or operations result in damage to a bridge requiring repairs, such repairs have a priority right to any equipment, material, or labor at the Contractor's disposal. Provide proper maintenance of all components of the mechanical and electrical systems involved in the operation of the bridge covered by this contract.

Assume responsibility for performing all preventative maintenance inspections and services to all mechanical, electrical, hydraulic, and other related systems. Perform all preventative maintenance in accordance with all applicable specifications established for proper maintenance of these bridges. These specifications include the County's Bridge Operations and Maintenance Manual, as well as all manufacturer's manuals for each system's constituent components.

As a minimum, perform at least one inspection per month on each and every component of the bridge system for all bridge systems for all bridges covered under this contract. These monthly inspections will be documented on the electrical and mechanical inspection forms provided by the Engineer. Any item graded poor, or fair is to require timely corrective action. Where County or manufacturer's specifications require inspections and/or preventative maintenance service intervals more frequent than once a month, schedule and report the completion of these services to the Engineer.

Perform all work to the satisfaction of the Engineer. The Engineer may elect to inspect all work done by the Contractor at any time.

T465-2.3.6. Plumbing

Assume responsibility for making all repairs to maintain water and sewer service to the bridge house. Those repairs will include, but not be limited to, fixing stopped-up toilets, leaking faucets, broken water and sewer lines and any other repairs that would otherwise be the responsibility of the County. Provide a portable toilet on the bridge in the event water or sewer service is going to be interrupted for more than 24 hours.

T465-2.3.7. Air-Conditioning and Heating

Assume responsibility for maintaining the air conditioning and heating units on the bridge, including the monthly cleaning of all air conditioning filters. Notify the Engineer of an air conditioning breakdown. Provide parts and repair services.

T465-2.3.8. Bypass Utilization

The bridge tender will NOT, under any circumstances, utilize the bypass switches without proper authorization. Contract personnel are to gain such authorization on each and every occasion from the Bridge Tender Supervisor and the Engineer. Bridge tenders may gain such authorization over the telephone, but an electrician will be expected to follow-up such authorization with an on-site service call to the bridge within one (1) hour of the time that authorization is provided.

T465-2.3.9. Equipment Failures

In the event the bridge becomes inoperable due to an equipment failure, whether the specific item which failed is under contract or not, respond within 30 minutes by notifying the County via the Engineer and initiate corrective action to remedy the situation using the same design configuration. Document any equipment failure by completing a Preliminary Cause of Failure Report, which must include a description of the event. Submit this report to the Engineer within ten days. If repair is not possible within a reasonable time, document temporary resolutions for review and approval by the Engineer.

T465-3. TRAFFIC AND SIDEWALK GATE ASSEMBLIES

T465-3.1. Description

T465-3.1.1. General

Furnish and install traffic gate and sidewalk gate assemblies as indicated in the Plans, MUTCD, AASHTO Standard Specifications for Movable Highway Bridges, and this Technical Special Provision.

T465-3.1.2. References

Florida Department of Transportation Design Standard Index Drawing 508-T01 "Traffic Control Devices for Movable Span Bridge Signals".

T465-3.1.3. Shop Drawings

1. Include Manufacturer's data sheet for each new gate assembly, including arms, gongs, and lights. Include drawing for dimension and interconnect wiring for each gate.
2. Installation instructions and operation and maintenance data.
3. Anchor bolt sizing calculations, signed and sealed by a Florida Registered Professional.

T465-3.2. Materials

T465-3.2.1. Traffic Gates

A. Furnish and install gate arms equipped with steel hot-dip galvanized, sectional bolt-on type counterweights with at least 10% adjustment and lights in accordance with the Design Standards Index No. 508-T01.

B. Ensure that during the opening and closing cycles, the gate arm will begin with zero velocity and accelerate smoothly, reaching maximum velocity at mid stroke (45 degrees) then decelerate smoothly to zero velocity at full stroke (90 degrees) without whip or bounce, all within a maximum of 13 seconds for a full opening or closing cycle. Ensure the electrically operated gate will operate the arm with a wind speed of 80 mph.

C. Furnish and install main arm shafts with a minimum of 2 inch diameter, AISI 4150 with a minimum tensile strength of 140,000 psi, mounted in heavy duty ball bearings and lubricated from inside the housing. Furnish and install a fully enclosed, all gear, direct drive unit running in oil bath and ductile iron gear case. Non-metallic gears, belts, cams, pulleys, linkages, chains or connecting rods are not acceptable in drive train.

D. Furnish and install totally enclosed, Class F insulation motors, operating on 480 V, 3 phase, and specifically designed for gate actuator, capable of operating at full load when the voltage to the motor is plus or minus 10% of rated voltage. Ensure the motor has the capacity to perform all necessary functions to the satisfaction of the Engineer based on torque required for gate arm and accessories. Ensure the braking mechanism is equipped with a solenoid release, automatic motor brake that automatically releases when hand crank is inserted. Provide a hand crank to manually raise or lower gate arm in event of power failure. Provide a limit switch that interrupts the control power circuit whenever the hand crank is engaged.

E. Fabricate the operator housing from 1/4 inch thick welded plate aluminum. Paint housing inside and outside with an industrial wash primer followed by a quick dry enamel. Equip housing with 4-1 inch holes and provide anchor bolts and template for installation. Provide front and rear access doors hung on bronze, slip-off type full cross hinges with stainless steel hinge pins. Provide held in place doors with pad lockable door locks and sealed with neoprene strip gaskets. Provide limit switches on both doors. Provide door limit switches that interrupt the control circuit, but can be defeated (circuit closed) by pulling the plunger out and automatically reset when the door is closed.

F. Furnish and install limit switch unit assemblies consisting of eight individual switches with one set of normally open and one set of normally closed contacts each. Furnish and install contacts with a UL rating of not less than 10 A at 120 VAC. Use corrosion resistant non-ferrous materials for limit switch body, shafts and cams. Ensure that gear limit switches to the drive mechanism are in step with the actual gate position at all times, whether operation is by power or manual mode. Do not use cams or screws to set the limit switches or designs requiring battery backup methods to ensure position control in the event of power failure.

G. Equip gate with a manual disconnect switch.

H. Install screw clamp, pressure plate type terminal blocks inside the housing on the roadway side and terminate all control wires on terminal blocks and clearly label all circuits. Number conductors to match wiring diagram. Complete all electrical connections required to provide proper operation of the traffic gates, lights, gongs, etc.

I. Gate Arm. Furnish and install gate arms to the length specified in the Contract Documents constructed of 6061-T6 rectangular aluminum tubing and fiberglass with ultra-violet resistive treatment. Ensure that the gate arm is covered on both sides with alternating 16 inch reflective red and white 3M "High Intensity Prismatic" reflective sheeting. Provide a retained pivot shear pin base for each gate arm so that when excessive force is applied to arm, a spring loaded latch pin engages, once the arm has rotated, to prevent the arm from rotating back into traffic. Design shear pin base and lightweight arm assembly for easy, rapid reinstallation or replacement by one person.

J. Furnish and install warning lights with the housing constructed of molded plastic, which are moisture and corrosion proof equipped with 2-way visibility, 4 inch diameter red lens with a 100,000 hour LED lamp. Ensure the light circuit is equipped with a heavy duty, solid state, fully factory wired flasher, with two alternately flashing circuits with a flash rate of 0.50 seconds ON, 0.50 seconds OFF and one steady burn circuit. Mount the strobes on the gate arms as shown in the Plans. Provide all mounting hardware, solid state flashing circuitry, clearly labeled terminal block, heat sink, and transformer when required.

K. Furnish and Install, on On-Coming gates, a heavy-duty, 120 VAC motor driven, industrial quality gong of cast aluminum construction; machined for proper fit with gasketed rear door hinged with stainless steel hinge pins and equipped with a swing bolt with provisions for a pad lock. Ensure the gear train is journaled in oil-impregnated, bronze bearings and driving a cam and hammer to strike gong shell approximately 100 times per minute. Ensure the gong shell is 8 inch in diameter, constructed of spun silicon bronze held in place with tamper resistant, stainless steel stud and protected by a cast aluminum weather guard.

T465-3.2.2. Sidewalk Gates

A. Furnish and install horizontal, swing type, sidewalk gates. Provide electrically operated operating machinery with manual cranking ability at locations shown in the Plans.

B. Size anchorages for new gate installations on gate pilasters per Manufacturer's recommendations and make by drilled anchor bolts, set with epoxy adequately sized to support all attachments.

C. During the opening and closing cycles, the gate arm begins with zero velocity and accelerates smoothly, reaching maximum velocity at mid stroke (45 degrees) then decelerating smoothly to zero velocity at full stroke (provide range of operation adjustable from 90 to 180 degrees) without whip or bounce. Standard operating time is 13 seconds for full opening or closing cycle. Sized to handle the weight of the arm used and be able to operate against a wind speed of 50 mph.

D. Furnish and install a fully enclosed, all gear, direct drive unit running in oil bath and ductile iron gear case. Non-metallic gears, belts, cams, pulleys, linkages, chains or connecting rods are not acceptable in drive train.

E. Furnish and install totally enclosed, Class F insulation motors, operating on 480 V, 3 phase, and specifically designed for gate actuator, capable of operating at full load when the voltage to the motor is plus or minus 10% of rated voltage. Ensure the motor has the capacity to perform all necessary functions to the satisfaction of the Engineer based on torque required for gate arm and accessories. Ensure the braking mechanism is equipped with a solenoid release, automatic motor brake that automatically releases when hand crank is inserted. Provide a hand crank to manually open or close gate arm in event of power failure. Provide a limit switch that interrupts the control power circuit whenever the hand crank is engaged.

F. Fabricate the operator housing from 1/4 inch thick welded plate aluminum. Paint housing inside and outside with an industrial wash primer followed by a quick dry enamel. Equip housing with 4-1 inch holes and provide anchor bolts and template for installation. Provide front and rear access doors hung on bronze, slip-off type full cross hinges with stainless steel hinge pins. Provide doors held in place with pad lockable door locks and sealed with neoprene strip gaskets. Provide limit switches on both doors. Provide door limit switches that interrupt the control circuit, but can be defeated (circuit closed) by pulling the plunger out. Provide limit switches that automatically reset when the door is closed.

G. Equip gate with a manual disconnect switch.

H. Install screw clamp, pressure plate type terminal blocks inside the housing on the roadway side and terminate all control wires on terminal blocks and clearly label all circuits. Ensure that the color code or number conductors to match wiring diagram. Complete all electrical connections required to provide proper operation of the sidewalk gates, lights, etc.

I. Furnish and install gates to lengths in the Contract Documents constructed of 6061-T6 aluminum tubing.

J. Furnish and install one warning light on each gate with the housing constructed of molded plastic; moisture and corrosion proof with 2 way visibility, 4 inch diameter red lens with a 100,000 hour LED lamp. Equip the light circuit with a heavy duty, solid state, fully factory wired, flasher. Provide all mounting hardware, solid state flashing circuitry, a clearly labeled terminal block, a heat sink, and a transformer when required.

K. Furnish and install “No Pedestrians” sign on each gate as shown in the Contract Documents.

L. Furnish and install limit switch unit assemblies consisting of eight individual switches

M. with one set of normally open and one set of normally closed contacts each. Furnish and install contacts with a UL rating of not less than 10 A at 120 VAC. Use corrosion resistant non-ferrous materials for limit switch body, shafts and cams. Ensure that gear limit switches to the drive mechanism are in step with the actual gate position at all times, whether operation is by power or manual mode. Do not use cams or screws to set the limit switches or designs requiring battery backup methods to ensure position control in the event of power failure.

T465-3.2.3. Barrier Gate

A. Furnish and install replacement components of the barrier gate enclosure including main crank arm shaft, connecting rod and associated components as shown on the Plans.

B. Cover both sides of the arm with alternating 16 inch reflective red and white engineering grade sheeting.

C. During the opening and closing cycles, the gate arm shall begin with zero velocity and accelerate smoothly, reaching maximum velocity at mid stroke (45 degrees) then decelerating smoothly to zero velocity at full stroke (90 degrees) without whip or bounce. Standard operating time is 16 seconds for full opening or closing cycle. Sized to handle the weight of the arm used and be able to operate against a wind speed of 50 mph.

T465-3.2.4. Construction Requirements

T465-3.2.4.1. General

Verify system voltage matches gate requirements, install in accordance with manufacturer's instructions. Make connections to control system, manually test hand crank, and power test all gates to ensure proper operation of gate operator, gate arm lights and gate interlock.

Adjust gate arm lengths and mounting heights to match existing conditions and as shown in the Plans. Field verify.

Size anchorages for gate installations on gate pilasters per manufacturer's recommendations and make by drilled anchor bolts, set with epoxy.

T465-4. COUNTERWEIGHT AND BRIDGE BALANCING

T465-4.1. Description

T465-4.1.1. Terminology

The terms "balance state" and "balance condition" are used interchangeably.

T465-4.1.2. Requirements for Balance States

T465-4.1.3. General Scope of Work

General: The work specified in this Section is required for the single leaf bascule span.

A. Hire a Specialty Engineer to perform the dynamic hydraulic cylinder pressure measurements and recording for Balance Testing.

B. Perform a balance test to determine the unbalance of the bridge prior to Functional Checkout.

T465-4.1.4. Work Restriction and Requirements

A. Meet the requirements of FDOT Specification 7 and 103.

T465-4.1.5. Quality Assurance

Provide signed and sealed span balance report by a Professional Engineer registered in the State of Florida.

Provide Specialty Engineer for performing dynamic hydraulic cylinder pressure measurements and recording data for Balance Testing. Specialty Engineer shall have a minimum of three years' experience in dynamic hydraulic cylinder pressure recording and data interpreting of at least three movable bridges and hydraulic systems of similar size and type. Submit the experience record of the Specialty Engineer per FDOT Specification 105 for approval by Engineer.

T465-4.1.6. Leaf Balance Test Report

Submit description of proposed equipment to be utilized, proposed balancing procedures, and proposed reporting forms for review and approval. Submit final balance state prior to the Functional Checkout. As a minimum, the balance state report must contain the following: hydraulic cylinder pressures with associated leaf positions, magnitude of span unbalanced moment (WL), centroid angle alpha relative to the horizontal line trunnion (alpha), average trunnion friction (AVTF), imbalance plots, accompanying weather, wind, and temperature measurements, quantification of the location of the center of gravity of the leaf, summary and conclusions, and Signed and Sealed by Professional Engineer registered in the State of Florida.

T465-4.2. Construction Requirements

T465-4.2.1. Notifications

Notify the Engineer a minimum of 14 days prior to the date that is anticipated that the Specialty Engineer's Balance Testing is going to be performed.

T465-4.2.2. Span Balancing - General

A. Obtain, as a minimum, pressure measurements as follows: At leaf angular positions of every 5 degrees from Fully Closed to Fully Open. For a minimum of three cycles of the leaf; the intent is to obtain three measurements at each angular position, the second and third measurement being made after the leaf is cycled back to the closed position.

B. Given the numerous variables that may have an effect on the values of the pressure measurements, schedule testing generally as follows in order that measurements taken on one day may be better correlated with measurements taken on another day:

1. In the morning at sunrise so as to minimize the differential in ambient temperature.

2. At a time with no wind; if wind exists, preferably the wind should not be in a direction along centerline of the bridge (perpendicular to the bridge deck surface).

T465-4.2.3. Shop Drawings

As a minimum, submit the following for review and approval:

A. Span Balance Tests:

1. Submit the results of the span balance test to the Engineer for approval.

T465-4.2.4. Balance Testing

Perform dynamic hydraulic cylinder pressure testing which includes, at minimum, the following items:

A. Formulate a detailed test procedure to ascertain the final balance of the leaf. The test procedure will be based on obtaining and analyzing pressure readings from the hydraulic system. Submit the proposed test procedure to the Engineer for approval.

B. Furnish and install the required transducers, all cabling and transmission equipment, data acquisition equipment and strip chart recorders and produce fully documented reports detailing the results of the measurements.

C. Submit the following items to the Engineer for approval.

D. Description of the procedure including type and method of installation of hydraulic pressure transducers, method of transmission of low-level signals, data acquisition equipment and/or strip chart recorders.

E. Layout of span drive machinery showing proposed location of transducers, power supplies, cable or radio links, data acquisition equipment and all associated cabling.

F. Provide elementary wiring diagrams of interconnection of pressure transducers, power supplies, data acquisition equipment and strip chart recorders and sample computations of:

G. Hydraulic pressures to forces.

H. Span imbalance.

I. Curve fitting and basis for friction correction.

J. Connect 5000 pounds per square inch hydraulic pressure transducers to the blind and rod end test ports of both main hydraulic cylinders for a total of four transducers, per leaf. Use transducers with accuracies not less than 0.5 percent full-scale output. Use output voltage/current compatible with the data acquisition/strip chart recorder utilized. Use transducer power supply as recommended by the manufacturer.

K. Connect output leads from each transducer to either the computer-based data logger streaming the data to disk at a minimum 1000 hertz sample rate or a five channel minimum strip chart recorder with at least 10 inch wide chart paper. Provide an inclinometer to record continuous leaf angle to either the data logging equipment or the strip chart recorder. Use an adjustable chart speed with a setting of at least 10 inches per minute. Use a recorder capable of recording data from at least four channels if it is equipped with a dedicated event marker or five channels if a channel is used to record events.

L. Record simultaneously the blind and rod end pressures of both main hydraulic cylinders versus span opening angle to a suitable scale. Use the same scale and the chart speed for all transducers, if a strip chart recorder is used. Make at least three opening/closing runs, when the wind speed is less than five miles per hour and the bridge deck is visibly dry. Prior to taking measurements ensure that all air is bled from the system.

M. Convert cylinder pressures to force by applying fundamental hydraulic system relationship calculations for each plot for both opening and closing. Use the constant velocity region. Process the data to give leaf imbalance (kip-feet) versus opening angle, corrected for friction, about the center of roll. Prepare plots of total span imbalance.

T465-4.2.5. Balance Testing Access

Provide safe access to the bridge for the Specialty Engineer to conduct Balance Tests.

T465-5. MOVABLE BRIDGE FUNCTIONAL CHECKOUT

T465-5.1. General Requirements

Develop written procedures for and perform functional acceptance testing of the movable bridge operation as defined herein to determine compliance with the requirements for construction, safety, maintenance, and operation of the facility as required in the Contract Documents. Include in the tests verification of all functions related to leaf operation, maintenance, and safety whether specifically defined herein or required of the Contract.

Working drawings must be available at the time of the functional checkout and that unavailability of the working drawings is cause to cancel functional checkout, start-up, and commissioning.

Collect and assemble full documentation of the test requirements and provide in booklet form meeting the requirements of FDOT Specification 5-1.4.4.2.

Detail and submit in shop drawing format for approval, test procedures for specific tests to be performed and the acceptance criteria for each test. Each procedure will be reviewed before and after testing by the Engineer.

Ensure this testing demonstrates the functionality of the bridge components as well as the complete operation of the constructed facility. Shop test individual systems prior to this procedure as required herein or under individual item specification.

Verify all mechanical, electrical and structural systems integration requirements.

T465-5.2. Material Requirements

Functional Acceptance Test Books: Integrate and assemble information required for Functional Test into a book (approximately 8 1/2 in. x 11 in.). Neatly label the book with a descriptive title, the name of the project, bridge number, the location, year of the test, the Owner, the Contractor and the Engineer. Provide black on white background, easily legible, copies of drawings, figures, and data. Bind the information into each instruction (test procedure) section between rigid plastic or cloth binding covers. Submit four bound copies for review to the Engineer. Submit a PDF electronic version of the book with searchable text and table of content links to each section.

T465-5.3. Construction Requirements

T465-5.3.1. General

A. The Functional Acceptance Tests consists of three stages:

1. Preliminary Checkout.
2. Functional Tests (Phase C).
3. Operational Testing Period.

B. Engineer Notification: Provide adequate notice (ten working days minimum) prior to all tests so that the Engineer can witness and accept the method and result of the testing.

C. Manufacturer Representatives: Arrange to have at the site, for each test, appropriate representatives of the bridge drive and electrical control equipment. These representatives must be prepared to make adjustments to the equipment, locate faults or defects and correct them, and obtain from the manufacturer without delay new parts or replacements of apparatus which, in the opinion of the Engineer, do not perform satisfactorily.

D. Field Tests: Arrange for and provide all necessary field tests, as indicated herein and as directed by the Engineer, to demonstrate that the entire modified or reworked area is in proper working order and is in accordance with the Contract Documents.

E. Phasing of Tests:

1. Functions which have been completed to the extent required of the testing may be accepted in part, provided the deficiencies have been documented, an approved plan of corrective action has been submitted, and an approved method of providing a safe substitute function has been implemented (example, gate functions may be provided by temporary flagmen).

2. Completion of Final Testing (also known as "Phase C") will be accepted only when the entire integrated system has been tested and accepted, all temporary functions have been removed, and all required records and documentation have been provided.

T465-5.3.2. Tests

The Functional Acceptance Tests: Present specific, step-by-step procedures to demonstrate and provide data for evaluation of each function of the movable bridge. Include for each test quantitative measurements including torque, amperage, watts, pressure, temperature, speed, RPM, and other parameters required by the Engineer to evaluate functionality. Include method of measurement, and their method of recording. Refer to the testing requirements of TSP Sections T468 and T508.

Acceptance Criteria: Present Functional Acceptance criteria that is concise and void of ambiguities. State specific performance of each component or function with regards to the requirements of the design and each unique condition of performance. Include all normal and emergency operating conditions as defined in the Contract Documents and design specifications and all maintenance modes of operation.

T465-5.4. Start-up Requirements

T465-5.4.1. General

Implement start-up procedures that protect the equipment from damage and ensure safe working conditions during bridge operations throughout construction. This section identifies specific requirements related to movable bridge start-up operations.

T465-5.4.2. Machinery Operation

A. Movable leaf shall not be operated by the drive machinery until all of the following conditions have been met:

1. Hydraulic Cylinder connections have been completed including installation of shims and tensioning of fasteners. Any temporary measures shall first be approved by the Engineer. Cylinder and cylinder clevis bearings shall have been installed and lubricated.

2. Hydraulic System shall have completed the Hydraulic Static Field Test and the test results have been reviewed and approved by the Engineer.

3. Pressure relief and all new valve settings have been tested and approved.

B. The bascule leaf shall not be operated at greater than the specified creep speed until all of the following conditions have been met:

1. All conditions listed above for operation of movable span by the drive machinery.

2. Hydraulic Systems shall have completed the Hydraulic Unit Dynamic Field Test and the test results have been reviewed and approved by the Engineer.

T465-5.5. Preliminary Checkout

Prior to scheduling the Functional or Acceptance Test, perform preliminary checks and make adjustments on the new work, such that the system is in general working order. Ensure that all control wiring has been completely and properly labeled. Coordinate this work with the maintenance of traffic plan such that any failure of the system being tested would not interfere with the scheduled use of the bridge. Perform shop tests prior to this phase as specified in the applicable Articles.

A. The Preliminary Checkout shall include testing of the following systems and sub-systems and check-out in the following order:

1. Functionally test the control and hydraulic system. Record data as required.

B. During the Preliminary Checkout, record the following data (each record shall have "time" as the base measurement):

1. Chart recorded pressure and flow readings for the hydraulic power unit for a full cycle of operation.

2. Chart recorded ammeter readings for each main drive motor throughout a full cycle of operation.

3. Chart record the Timing Sequences of electrical inputs to each Hydraulic Power Unit. Include all limit switches.

C. Record times and additional information required for operation and maintenance manuals.

During the Preliminary Checkout perform and record Functional Tests results. The Preliminary Checkout shall be used to troubleshoot the entire facility, such that the proper function can be demonstrated during the Functional Checkout without extensive modifications. Extreme caution shall be observed when operating systems for the first operations. Refer to Section T465-4.4 for start-up requirements. Submit Preliminary Checkout records to the Engineer in duplicate a minimum of one week prior to scheduled Functional Testing.

T465-5.6. Functional Tests

Arrange for and provide all necessary field tests, as indicated herein and as directed by the Engineer. Demonstrate the correct operation of the entire modified or reworked area in accordance with the Contract Documents during this phase of functional checkout. Test both manual and automatic operations. Upon approval of the Engineer to proceed, conduct the Functional Tests. The tests shall include but are not limited to the following:

A. Bridge Sequence: Demonstrate sequenced operation of the bridge in normal mode on utility power and emergency power.

B. Emergency Stop: Demonstrate the emergency stops of the Bascule Leaf during each phase (i.e., accelerating and decelerating, full speed, creep speed) of opening and closing the bridge and during each direction of span lock and gate operation. Demonstrate recovery to resume sequence of operation from point of interruption.

C. Bridge Machinery:

1. Demonstrate operation of all lubrication systems.

2. Demonstrate live load shoe contact and alignment of the bascule rear and rest pier joints.

D. Hydraulic Functions

1. Main Drive Power Unit: Operate the Main Drive Power Units under the following conditions and record pressure, operation time, timing sequences, and motor current draws.

a. Operation with pump group 1 or 2 only and both cylinders on-line.

2. Drive System Hydraulic Cylinder Assemblies.

a. Demonstrate emergency (total loss of electrical power) lowering of the leaf from the fully open position using the needle valves located on the hydraulic cylinder assemblies.

b. Demonstrate cylinder cushion performance driving bridge into load shoe and lowering bridge via hydraulic cylinder needle valves.

c. Demonstrate emergency lowering of bascule leaf using the manual needle valves on the hydraulic cylinder manifolds.

E. Bumper Blocks: Demonstrate bumper block contact points relative to leaf position and contact face parallelism. Record clearances between bumper blocks with leaf open to normal full open position.

F. Lubrication Systems: Demonstrate all lubrication systems associated with the new machinery subcomponents are fully operational. Demonstrate delivery of the lubricating agents to intended interfaces per subcomponent manufacturers recommendations.

T465-5.7. Operational Testing Period

Following successful completion of the Functional Tests, a 60 day Operational Testing Period will start and this testing period shall end on the last contract work day.

Repair or replace mechanical or electrical components of the bridge, agreed upon by the County and the Contractor before the Pre-Construction meeting that becomes inoperative during the 60 day period at no cost to the County. Test any repaired or replaced components in accordance with the Contract Documents. The 60-calendar day testing period for repaired or replaced individual components shall begin immediately after that individual work is completed.

During this period, operate the leaf a minimum of four times per day, under the observation of the Engineer.

Replace any spare parts used during the operational testing period.

Repair or replace, at no cost to the County, any bridge equipment that becomes inoperative during the 60 day period. Maintenance other than specified in the established Maintenance Procedures will be accomplished by County forces during the 60 day period.

If correction of inoperative or defective equipment requires installation of components from a different manufacturer, or reconfiguration of components, the changes will be subject to approval by the Engineer. Additional functional testing of the corrected systems may be required and the 60-day Operational Testing Period may be increased or restarted at the sole discretion of the Engineer. Perform the tests at no additional compensation. The Operational Testing Period is in addition to the Construction Period.

T465-6. METHOD OF MEASUREMENT

A. Counterweight Adjustment (Balancing), Furnishing of CW Blocks and CW Pocket Cleaning: The work of maintaining the bascule leaf in an acceptable balanced condition and safe stable condition including adjusting the Counterweight as described in this Section will be measured as one Counterweight associated with one Bascule Leaf. All labor, materials, and equipment for counterweight adjustments including verification of existing balance block configurations, preparation of balance procedures, balance calculations, pressure gauge testing, furnishing of counterweight blocks, and cleaning of the counterweight pockets will be paid for by each Counterweight assembly.

B. Movable Bridge Preventive Maintenance: The quantity will be paid at the Contract unit price of lump sum for the duration of days that the Movable Bridge Operator is maintaining the bridge.

C. Operating Instructions: No separate measurement will be made toward furnishing operating instruction books, and providing bridge operations and maintenance training.

D. Movable Bridge Functional Checkout will be paid at the Contract lump sum price completed and accepted. No separate measurement will be made toward furnishing operating instruction books and providing bridge operations and maintenance training. No separate measurement will be made for work associated with pre-test, preliminary checkout, functional testing, and operational testing.

T465-7. BASIS OF PAYMENT

Price and payment will be full compensation for all work specified in this Technical Special Provision, including furnishing and installing all equipment and materials.

Payment will be made under:

Pay Item No. 465-3-17	Movable Bridge - Counterweight, Adjust	EA
Pay Item No. 465-20	Movable Bridge - Preventive Maintenance	LS
Pay Item No. 465-21	Movable Bridge - Bridge Operator	LS

Pay Item No. 465-71-3 Movable Bridge - Functional Checkout, Phase C, Complete LS

For Traffic Gates and Sidewalk (Pedestrian) Gates: Pay Item No. 508-2-1 - Movable Bridge Gate, Furnish and Install – AS

For Barrier Gate: Pay Item No. 508-2-5 - Movable Bridge Gate, Adjust/Modify/Rehab – AS

For Traffic Gates and Sidewalk (Pedestrian) Gates: Pay Item No. 508-2-6 - Movable Bridge Gate, Remove and Dispose- AS

TECHNICAL SPECIAL PROVISIONS – SUPPLEMENTAL TWO

FOR

SECTION T468 - MECHANICAL CONSTRUCTION FOR MOVABLE BRIDGES

COUNTY PROJECT NUMBER : CN-1414-218

MATLACHA BASCULE BRIDGE EMERGENCY REPAIRS

BRIDGE NO. 124134

This Technical Special Provision has been digitally signed and sealed by Travis M. Kimmins, PE 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.

Engineer of Record: Travis M. Kimmins, PE
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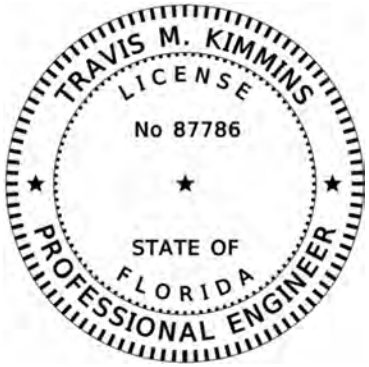

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MECHANICAL CONSTRUCTION FOR MOVABLE BRIDGES

T468-1. BASIC MECHANICAL REQUIREMENTS

T468-1.1. General

The work under this Technical Special Provision includes rehabilitation of movable bridge systems and components of the movable bridge as required by the Contract Documents.

Dimensions given in the Contract Documents are nominal and intended for guidance. Note any variations from nominal dimensions on the Shop Drawings.

T468-1.2. Definitions

A. Bascule Span: All structural, mechanical, and electrical elements of the movable span, including the Bascule Leaf, and all associated trunnion bearings, machinery, power and control systems.

B. Bascule Leaf: The movable portion of the roadway and sidewalk deck and its supporting elements, including the Bascule Girders, floor beams, brackets, barriers, handrails, roadway deck, sidewalk deck, counterweight, trunnions, and appurtenances which rotate about the trunnion axis during operation.

C. Bascule Girder or Main Girder: The main longitudinal load carrying members of the Bascule Leaf (steel girders).

D. Counterweight: The weight provided to balance the leaf including the counterweight concrete and associated reinforcing steel.

E. AASHTO Movable Specifications: AASHTO LRFD Movable Highway Bridge Design Standard Specifications.

F. Blend: A smooth transition between surfaces with a slope less than or equal to 1:3.

G. Centerline Trunnion (Trunnion Centerline): The theoretical axis of rotation of the Bascule Leaf.

H. Tight Integration (Well Integrated): The methods, practices, techniques, standards, and procedures by which a seamless hardware, software, electrical, mechanical and structural interfacing of electrical sub-systems, hydraulic sub-systems, mechanical sub-systems and structural components is provided. Tight integration is determined (in part) by the Engineer through submittals, shop testing of complete systems and sub-systems, shop drawings, and incidental items as required by the Engineer. Provide a rehabbed movable bridge system that is reliable, repeatable and free of anomalies and intermittent operation.

T468-1.3. Integration

Coordinate hydraulic, electrical, and mechanical equipment, systems and sub-systems integration with structural components and disciplines.

T468-1.4. Supervisory and Technical Personnel

Provide the following supervisory and technical personnel at a minimum and submit qualifications according to the requirements of FDOT Specification Section 105.

A. Certified Hydraulic Technician:

1. Provide a Certified Hydraulic Technicians or Certified Industrial Hydraulic Mechanics certified by the International Fluid Power Society. Use Certified Technician/Mechanics having prior experience on similar sized systems for installation, start-up, piping and flushing of hydraulic systems. Use Certified Technicians/Mechanics with at least five years of experience in the design, fabrication, and installation of hydraulic systems of the size, type and scope described within contract documents for this specific project.

2. Use only personnel with demonstrated skill in this type of work for installation and adjustment of hydraulic components.

B. Millwrights:

1. General:

For field installation and alignment of machinery/hydraulic components and other designated components required under the provisions of the Contract Documents, utilize millwright(s), with a minimum of ten years of experience in the assembly and alignment of hydraulic cylinders of similar size, type and character. Millwright(s) shall be present for the full duration of all field installations.

2. Supervisory Millwright:

Provide the services of an approved supervisory millwright who is a millwright by trade. Responsibilities include but are not limited to the supervision of field alignment and installation of the machinery and other designated work.

3. Millwright:

Utilize approved millwright(s) for field alignment and installation of the machinery and other designated work to be provided under the provisions of these Technical Special Provisions and the Contract Documents. For alignment and installation procedures for machinery components, have Supervisory Millwright initial all submittals.

T468-1.5. Working Contract Documents and Shop Drawings

Provide Shop Drawings in accordance with FDOT Specification Section 105 and as follows, including but not limited to:

A. Detail and accurately dimension all parts, indicate limits of accuracy and tolerances required for machining, surface finishes and allowances for fits. Unless otherwise called for, provide the fits and finishes in accordance with ANSI B46.1 and ANSI B4.1.

B. Provide an outline drawing (master assembly drawing) depicting general layout of the machinery including location and orientation relative to the larger bridge structure. Provide sub-assembly and subsequent detail drawings depicting all operating machinery and parts relevant to the scope of work to be performed on this contract. Ensure the drawing contains all information necessary for computing the strength of the machinery parts. Provide sufficiently detailed drawings to permit the duplication of the machinery parts by others, including assembly and disassembly instructions.

C. Any deviation from what's contained in the Contract Plans and in these Technical Special Provisions should be submitted to the Engineer for approval with an explanation why the change was made and how this new change affects the design.

D. Assembly drawings must be provided in order for detailed components to be approved.

E. Show the estimated weights of individual parts and total weights of all parts in the details for machinery and castings.

F. Include in submittals for each manufactured item manufacturer's descriptive literature, drawings, diagrams, performance and characteristic curves, and catalog cuts, and include the manufacturer's name, trade name, catalog model or number, nameplate data, size, certified layout dimensions, capacity, specification reference, including ASTM, ANSI, and any other applicable references, and all other information necessary to establish Contract compliance.

G. Provide complete shop bills of materials for all machinery parts. If the bills are not shown on the shop drawings, furnish prints of the bills in the same manner as specified for the drawings.

H. State the material and material specifications for each part. Where ASTM Specifications or any of the Standard Specifications are used, give the designating numbers of such specification.

I. Furnish complete assembly and erection drawings. Indicate identifying marks, match marks and essential dimensions for locating each part or assembled unit with respect to the bridge or equipment foundation. Cross-reference every part to the drawing sheet on which it is detailed. Clearly show and detail marks or indentations of any type on the drawings. In general, avoid die stamping or scoring unless otherwise called for on the Contract Documents.

J. Detail all components and assemblies separately to assure correct fabrication, assembly, and erection.

K. Submit assembly drawings of machinery prior to submission of the corresponding individual parts.

L. Do not use mirror image or opposite hand drawings.

M. Give each shop drawing a suitable title to describe the parts detailed therein.

N. Where equipment or materials are specified to conform to requirements of the standards of an organization such as American Society of Mechanical Engineers (ASME), Underwriters Laboratories (UL), American Gas Association (AGA), and American Refrigeration Institute (ARI), which use a label or listing as method of indicating compliance, submit proof of such conformance for review. The label or listing of the specified organization will be acceptable evidence. In lieu of the label or listing, submit a certificate from an independent testing organization adequately equipped and competent to perform such services and approved by the Engineer, stating that the item was tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard or code.

O. Provide detailed written installation procedure for all machinery components. The procedure shall include sequence of installation, alignment methods, bolt tightening methods and torque values for all bolts.

P. Provide manufacturer's lubrication literature for every new machinery component that requires lubrication.

Q. Provide machinery painting procedures and materials.

R. Indicate procedures for field structural welding with inspection requirements.

S. Provide attachment methods and details where new components are connected to the existing structure, including bolt holes and edge dimensions. Dimension fastener locations to the centerlines of machinery components.

T. Clearly indicate and accurately detail minimum and maximum tolerances for all dimensions requiring a fit. Verify the maximum and minimum clearance and interference between mating components for all fits do not exceed the specified standard limits.

U. Clearly differentiate any dimensions that are prior to machining from final dimensions. Provide a final dimension for any dimension that is prior to machining.

V. As used herein, certified test reports refer to reports of tests conducted on previously manufactured materials, or equipment identical to that proposed for use.

W. As used herein, factory tests refer to tests performed on the actual materials or equipment proposed for use. Submit results of the test in accordance with provisions of the Contract Documents for laboratory test results.

T468-1.6. Construction Requirements

Construct in accordance with the Contract Documents and the applicable provisions of the AASHTO Movable Bridge Specifications.

Ensure that, unless specified in the Contract Documents or herein, dimensions between machined surfaces have a tolerance of 0.010-inch and machined surfaces have a flatness tolerance of 0.030-inch.

Design and construct temporary members in accordance with the provisions of FDOT Specification Section 5.

T468-1.6.1. Notification of Shop Work

Comply with FDOT Specification Sections 5 and 105.

T468-2. MATERIALS AND EQUIPMENT

T468-2.1. Materials

T468-2.1.1. General

Provide products that are compatible with other products of the mechanical work, and with other work that requires interface with the mechanical work, including mechanical and electrical connections and control devices.

Provide each piece of new mechanical equipment and apparatus with a permanent, corrosion-resisting metal nameplate stamped with the name of the manufacturer, the catalog or model number, and the rating or capacity of the equipment or apparatus.

Shop Inspection and Testing: Comply with the requirements of FDOT Specification Sections 5, 6, and 105.

Use materials that conform to the current ASTM specifications. An alternative material may be requested in writing; the request must provide complete data justifying suitability of the alternate materials and must be approved by the Engineer prior to initiating fabrication or construction.

Furnish materials and equipment that are the standard catalogued products of manufacturers regularly engaged in production of such materials or equipment and be the manufacturer's latest standard design that complies with the Contract Documents. Where duplicate components are required, furnish products of the same manufacturer. However, the component parts of the system need not be the products of the same manufacturer.

All components listed are to be replaced in-kind. In the event of the item being no longer available, submit reasoning to the Engineer in writing for equivalent substitution. Provide manufacturers data cutsheets for engineer approval prior to purchase.

T468-2.1.1.1. Description of Work

See Section 3.2 for detailed list of items to be replaced. Reference summarized scope of work items as follows:

A. Furnish and install new Plain Spherical Bearings at Cardanic Ring assemblies.

B. Furnish and install new Plain Spherical Bearings at Upper Clevis assemblies.

C. Shim and adjust Live Load Shoe Assemblies.

D. Shim and adjust Span Lock Assemblies.

E. HPU and hydraulic system rehabilitation.

F. Apply Touch-up paint to new equipment and any existing components that were impacted by the work.

G. Perform field testing to be witnessed by the Engineer.

T468-2.1.1.2. Qualifications

If the work is subcontracted, use a qualified subcontractor for this work. The Subcontractor shall have had at least ten years' experience in the design, fabrication, and installation of major bridge mechanical systems for civil engineering applications of this size and type.

T468-2.1.2. Pins

Provide all pins with accurate finishes and ample radii at fillets. Ensure they are round, true, smooth and straight, and have round fillets at shoulders.

Accurately machine and polish all journal-bearing areas on pins, with no trace of tool marks or scratches on the journal surface or adjoining shoulder fillets.

T468-2.1.3. Castings

Provide castings that conform to AASHTO Requirements.

Ensure all castings are free of cracks, cold shuts, shrink holes, blow holes, porosity, are free of loose scale and sand, fins, seams, gates, risers and other irregularities. Cast unfinished edges of castings neatly with rounded corners with inside angles having ample fillets.

Unless otherwise indicated, perform, in the manufacturer's shop, for each casting:

A. Visual examination of all surfaces (100%) per ASTM A802, with Level II as the Acceptance Criteria. Linear discontinuities, cracks and tears are not permitted. Castings with test records meeting Level III may be considered for weld repair. All other discontinuities are unacceptable.

B. Liquid Penetrant exams in accordance with ASTM E165.

C. Magnetic Particle Testing (100 %) per ASTM E709, with acceptance criteria per ASTM E125. The Acceptance Criteria, as to the Type of Discontinuity and the Degree for acceptance, will be as follows:

Type I	Cracks/Hot tears	3/16” Maximum
Type II	Shrinkage	Degree 3
Type III	Inclusions	Degree 3
Type IV	Chaplets	Degree 2
Type V	Porosity	Degree 1

Surface discontinuities may be considered for weld repair.

D. Ultrasonic 100 percent volumetric examination per ASTM A609. All castings with solid sections of 4 inches thick or greater shall meet ASTM A609, Method A, Quality Level 3. Castings that do not pass this test will be rejected. Submit test results, whether positive or negative, to the Engineer.

Cast phosphor bronze castings into ingots and allow to cool, pour the casting from the remelted ingots. Furnish the chemical analysis of each heat, and ensure no alloy contains any more than 0.08% Sulphur. Perform physical tests in accordance with ASTM B22 Specification, and in addition, record the permanent set under a load of 350 psi for bearings. Cracks or other evidence of brittleness in compression test specimens after testing will be cause for rejection.

Suspend large castings and hammer all over.

Repair steel castings that develop cracks, flaws or other defects during hammering or from any other cause. The Engineer must approve Weld repair, after start of machining and/or assembly. Ensure all repairs conform to the required ASTM procedure.

If weld repair is approved by the Engineer following a review of the test results, submit detailed weld procedures, including a means to qualify the weld repair. Obtain approval from the Engineer before making any weld repairs. Perform weld repairs per ASTM A488 or equivalent, and radiographic examination of welds per ASTM E94.

T468-2.1.4. Forgings

Provide forgings that conform to AASHTO Specifications for Movable Bridges.

Perform, in the manufacturer’s shop, for each forging:

A. Liquid Penetrant exams in accordance with ASTM E165 or Magnetic Particle exams in accordance with ASTM A275 and ASTM E709. Acceptance criteria of ASTM A788, Supplementary Requirements S18 and S19, shall apply.

B. Ultrasonic exams in accordance with ASTM A388 or ASTM E2375. Acceptance criteria of ASTM A788, Supplementary Requirement S20, Level BR and Level S, shall apply.

T468-2.1.5. Cylinder Support Bearings

Where required, provide plain spherical bearings of the self-aligning type that are sized to meet L-10 life (as defined by the AFBMA at which 90 percent of a group of bearings will survive the identical loading conditions) of 40,000 hours under the power requirements defined in the AASHTO Movable Specifications or shown in the Plans. Design sliding contact surface shall be steel on steel configuration. All pins and attachments shall be machined to the dimensions and tolerances as specified by the Bearing Manufacturer. Unless otherwise specified in the Plans, provide all plain spherical bearings with double-lip seals to retain the lubrication and guard the spherical surfaces from contamination. New plain spherical bearings shall receive grease recommended by Bearing Manufacturer.

Bearings shall be a standard product of the manufacturer. Provide certified dimensional check details for each bearing manufactured for this project.

T468-2.1.6. Fasteners

A. Provide all bolts for connecting machinery parts to each other and to supporting members as shown in the Contract Documents and conform to one of the following types, as specified in the Plans :

1. Structural bolts.

2. High-strength turned bolts, turned cap screws, and turned studs.

B. Structural Bolts

1. Shall meet the requirements of ASTM F3125 Grade A325 Type 1. Ensure hole for the structural bolt is no larger than 1/16" over the nominal diameter of the bolt. Exclude threads from the shear plane.

2. Use nuts that conform to ASTM A563 or A194, Grade DH or 2H, heavy hex series.

C. High-strength Turned bolts, cap screws, and studs.

1. Turned fasteners shall meet the requirements of ASTM A449 Type 1.

2. Use only high strength bolts with heavy hexagonal heads. Wherever possible, install high-strength bolts connecting machinery components to structural elements or to other machinery components comprised of different thicknesses so that the bolt head is adjacent to the connected element with the least thickness.

3. Furnish high-strength turned bolts, turned cap screws, and turned studs with turned shanks and cut threads. Furnish turned bolts with semi-finished, washer-faced, hexagonal heads and nuts. Ensure all finished shanks of turned fasteners are 0.060-inch larger in diameter than the diameter of the thread, which determines the head and nut dimensions.

4. Ensure the shanks of all turned fasteners have a LC6 fit in the finished holes in accordance with ANSI B4.1.

5. Drill or ream-assemble all elements connected by bolts to assure accurate alignment of the hole and accurate clearance over the entire length of the bolt within the specified limits.

6. Use nuts that conform to ASTM A563 or A194, Grade DH, heavy hex series. Provide heavy series heads and nuts for turned bolts, screws, and studs.

7. Provide bolt heads, nuts, castle nuts, and hexagonal head cap screws dimensioned in accordance with ANSI B18.2.1, Hexagon Bolts and ANSI B18.2.2 Nuts.

8. Ensure the dimensions of socket-head cap screws, socket flathead cap screws, and socket-set screws conform to ANSI B18.3. Provide screws made of heat-treated alloy steel, cadmium-plated, and furnished with a self-locking nylon pellet embedded in the threaded section. Unless otherwise called for on the Contract Documents or specified herein, provide setscrews of the headless safety type with threads of coarse thread series and cup points. Do not use setscrews to transmit torsion nor as the fastening or stop for any equipment that contributes to the stability or operation of the bridge.

9. Unless otherwise called for, sub drill all bolt holes in machinery parts at least 0.030 inch smaller in diameter than the bolt diameter and ream assemble for the proper fit at assembly or at erection with the steel work after the parts are correctly assembled and aligned.

D. Provide cap screws with threads that conform to the coarse thread series and have a Class 2A tolerance. For bolts and nuts, ensure the bolts conform to the coarse thread series and have a Class 2A tolerance. Furnish Class 2B nuts in accordance with ANSI/ASME B1.1.

E. Spot face bolt holes square with the axis of the hole.

F. Do not use different size bolts when connecting components (i.e., gearbox to pedestal, bearing to pedestal). If a hole is over drilled requiring a bigger bolt, then furnish all bolts of the bigger size.

G. Provide cotters that conform to SAE standard dimensions and are made of half-round stainless-steel wire, ASTM A276, Type 316.

H. Provide anchor bolts for connecting machinery parts to masonry that comply with ASTM A307 material, hot-dipped galvanized per ASTM A153 unless otherwise approved by the Engineer. Furnish bolts as shown on the Contract Documents. Ensure the material and loading requirements is as shown on the Contract Documents. The filler material may be a non-shrink grout, Babbitt metal, or zinc.

I. Provide each anchor bolt a heavy hex nut meeting ASTM A194 Grade 2H and a hardened plain washer under each nut meeting ASTM F436.

T468-2.1.7. Shims

Provide ASTM A666 type 304 or 316 stainless steel, full depth shim packs, drilled for all bolts that pass through, trim to the dimensions of the assembled unit. Thin brass precision thickness shims may be used for final adjustment.

Provide full tapered shims, if required to obtain the specified alignment tolerances, at no additional cost.

Do not use resins in lieu of shims.

T468-2.1.8. Span Lock Assemblies

Perform shimming and adjustment work on front guides and receivers for movable leaf alignment with approach span. Provide shims per Section 2.1.7.

T468-2.1.9. Live Load Bearing Assemblies

Provide live load shoes shim adjustment materials as shown in the Plans. See Section 2.1.7 for shim material requirements.

Coordinate work with span lock adjustment work and cylinder bearing replacement.

T468-2.1.10. Lubrication of Machinery

Provide standard grease fittings for a pressure system of lubrication for all new bearings and surfaces requiring external lubrication. Replace existing fittings supplying new bearings. Provide pressure fittings rated at a minimum 10,000 psi. Provide fittings with a steel check valve that will receive grease and close against backpressure.

Locate grease fittings in bearings or attached with 0.54-inch diameter schedule 80 minimum size extra strong, threaded steel pipe and forged threaded fittings so that grease is introduced directly into the grease grooves for distribution. Extend tubing from the bearings to convenient lubrication stations but keep lines as short as practical. In such cases, securely support and locate the tubing to protect it from damage and prohibit vibration during application of live load.

Supply one grease gun for each type fitting.

Immediately after the completion of fabrication, plug all grease fittings until components are installed and regular lubrication is started.

Furnish the bridge with an appropriate amount of proper lubricant for new and rehabilitated machinery. Store the lubricant in steel containers at room temperature. Keep the lubricant for each type of machinery component separately in clearly marked containers. Take all measures necessary to prevent lubricant contamination.

Proprietary units: Provide lubricants approved by the manufacturer.

Other units: Provide the lubricants specified in the latest edition of the AASHTO Movable Bridge Inspection, Evaluation, and Maintenance.

T468-2.1.11. Painting of Machinery

Paint with a three-coat system in accordance with FDOT Specification Section 560 and Section 561. Paint all new machinery equipment and touch up all existing machinery equipment incidental to machinery replacement work.

Provide paint for the final field coat high-gloss enamel compatible with the intermediate coats and with colors meeting the Federal Standard No. 595 Color Number Code. Paint machinery surfaces with the final field coat in the following colors:

A. Federal safety Blue - for all fixed parts of the machinery, such as weldments, housings, and motors.

B. Federal safety Red - except rubbing surfaces, for all moving parts of the machinery, such as shafting, couplings, brakes, machinery guards, hydraulic cylinders, live load shoes, and load shoe masonry plates.

C. Federal Safety Yellow - non-corrosion resistant hydraulic power unit manifolds and components.

T468-2.2. Construction Requirements

T468-2.2.1. General

Follow the AASHTO Standard Specifications for Movable Highway Bridges requirements for field erection, workmanship, machining, finishing, aligning, testing, and inspection, unless otherwise specified in the Contract documents.

Structural Steel: Unless otherwise noted, construct structural steel fabrications in accordance with the provisions of FDOT Specification Section 460.

Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, furnish printed copies of these recommendations to the Engineer prior to installation. Do not install material until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

T468-2.2.2. Pins

Unless otherwise indicated in the Contract Documents, ensure the non-mated surfaces have a maximum roughness of 125-micro inch.

T468-2.2.3. Castings

Ensure weld repair of castings at the foundry conforms to the required ASTM procedure. Ensure weld repair, after start of machining and/or assembly, is approved by the Engineer.

Clean all castings free of loose scale and sand, fins, seams, gates, risers, and other irregularities.

Obtain prior approval from the Engineer before making any weld repairs that are not included in the original material specification.

T468-2.2.4. Forgings

Ensure weld repair of forgings conforms to the required ASTM and AWS procedures. Ensure weld repair, after start of machining and/or assembly, is approved by the Engineer.

Obtain prior approval from the Engineer before making any weld repairs that are not included in the original material specification.

T468-2.2.5. Cylinder Support Bearings

Utilize maintenance free, radial spherical plain bearings. Plain spherical bearing shall have a static loading rating and a dynamic load rating minimum as shown on the Plans. Refer to TSP T468-2.1.5 for additional requirements. Submit shop drawings and manufacturer's certified prints.

A. Replace maintenance free, Cardanic Ring radial spherical plain bearings.

B. Replace maintenance free upper clevis radial spherical plain bearings.

Plain Journal bearings to be refurbished by disassembly, cleaning and inspection of interior bearing housing surfaces, Glycodur bushing ID and trunnion pin shafts on the Cardanic Ring assembly. Inform engineer of any discrepancies.

C. Refurbish maintenance required, Cardanic Ring plain bearings.

1. Provide new cover plates and cover plate fasteners.
2. Provide new giant button head grease fittings.

T468-2.2.6. Fasteners

A. General:

1. Unless otherwise specified, all fasteners used for connecting machinery parts to each other and to supporting steel shall be HS turned bolts.
2. Install bolts connecting machinery components to structural elements or to other machinery components comprised of different thicknesses so that the bolt head is adjacent to the connected element with the least thickness.
3. Clean all contact surfaces of structural steel to be bolted together before bolting.
4. Spot face bolt holes square with the axis of the hole.
5. Spot face bolt holes through unfinished rough cast surfaces.
6. Drill or ream-assemble all elements connected by bolts to assure accurate alignment of the hole and accurate clearance over the entire length of the bolt within the specified limits.

7. Ream or drill holes in shims and fills for machinery parts to the same tolerances as that of the connected parts at final assembly.

8. Unless otherwise indicated in the Contract Documents, drill bolt holes in machinery parts for connection to supporting steelwork in the shop a minimum of 1/16 inch diameter smaller than the finished bolt diameter or drill from solid at assembly. Drill and ream for the required fit at final assembly.

9. Unless otherwise indicated in the Contract Documents, drill bolt holes in steelwork for turned bolts from solid at assembly or erection after proper alignment. Do not pre-drill holes full size prior to final assembly.

10. Do not use different size bolts when connecting components (i.e., bearing to pedestal). If a hole is over drilled requiring a bigger bolt, then furnish all bolts of the bigger size.

11. Fasteners that require tapped holes shall be detailed with a minimum thread engagement of 1½ times the nominal body diameter.

12. Countersunk fasteners shall be detailed with a minimum of a 1/16 inch recess.

B. HS Turned Bolts and HS Turned Studs:

1. HS turned bolts and HS turned studs shall not be used if previously torqued.

C. Tensioning:

1. Unless otherwise required in the Contract Documents, tension HS Turned Bolts, and HS Turned Studs used for connecting steel machinery parts together or to structural steel and whose nominal threaded diameter is less than or equal to 1½ inch in accordance with the Bolted Connection requirements of the FDOT Specifications for HS Turned Bolts based on thread diameter.

2. Tension HS Turned Bolts, and HS Turned Studs larger than 1½ inch (nominal thread diameter) by turning the nut ¼ turn past snug tight and adding a backing nut (double nuts) turned snug tight unless otherwise noted in the Contract Documents. If the Contract Documents require a HS Turned Bolts, or HS Turned Studs larger than 1½ inch to be tensioned, hydraulically tension the bolt as indicated herein.

3. Preload for High Strength SAE Bolts and Studs: Tension all bolts, cap screws, and other threaded fasteners as follows:

For permanent connections: $F_t = 0.75 \times A_t \times S_p$

Where: F_t = fastener preload

A_t = tensile area of the fastener

S_p = fastener proof strength

4. Utilize 50 percent of the proof strength for all HS Turned Bolts, or HS Turned Studs.

5. Preload may be applied by direct hydraulic tensioning or torque. Where using torque, calculate it as follows: $T = K \times F_t \times d$

Where: T = required wrench torque applied to fastener

K = constant dependent upon bolt size, material and lubrication.

d = nominal fastener diameter

6. For mild-steel fasteners use an average value of K = 0.2 for dry assembly. For lubricated assembly use K = 0.18 .

T468-2.2.7. Shims

Unless otherwise indicated in the Contract Documents, provide shim pack containing shims of decreasing thickness from full depth down to 0.010-inch, plus 2-0.005-inch shims. For example, a 0.5-inch shim pack would consist of the following shim thickness 0.500, 0.250, 0.125, 0.060, 0.040, 0.020, 0.010, 2-0.005-inch for a total of 9 shims.

Show and fully dimension shims as details on the shop drawings.

Do not use shims with open sided or U-shaped holes for bolts unless otherwise noted. Ensure no shims have less than two holes for bolts.

Neatly assemble shims not installed after final alignment, tag with the part number from the approved shop drawings and turn over to the County for future use.

Oversize bolts holes in shims by 1/8” for turned bolts.

T468-2.2.8. Span Lock Assemblies

Adjust Span Locks to the following conditions and tolerances:

A. Do not make the final adjustment of the lock bars until the live load shoes are properly adjusted, the elevations at the tip ends of the bascule girders are within 1/16-inch of one another, and the bridge is balanced within the final requirements detailed in the Technical Special Provisions.

B. Prior to installing the lock bar, place a straight edge vertically on the horizontal surface of the bronze bearings of the rear guide, front guide and the receiver to verify alignment. Ensure the straight edge contacts each of the shoes and the maximum allowable gap between the straight edge and the bronze bearings at any point is 0.003-inch.

C. Prior to installing the lock bar, place a straight edge horizontally on the vertical surface of the front guide and rear guide to verify alignment. Ensure the straight edge contacts each of the shoes and the maximum allowable gap between the straight edge and the bronze bearing at any point is 0.005-inch.

D. Ensure the position of the actuator relative to the lock bar is such that no more than 1/32-inch of offset misalignment and no more than 1/4-degree angular misalignment exists at the connection to the lock bar with the actuator in either the fully driven or fully retracted positions.

E. Ensure the position of the actuator is such that there is an equal amount of reserve stroke remaining following operation in the driving and in the retracting directions.

F. Adjust span locks such that driving and/or pulling the locks causes no change in the contact of the live load shoes.

Shim lock bars to obtain a total vertical clearance of RC9 fit between bar and socket. Clearance may vary between top and bottom faces of bar, but neither clearance can be less than 0.005-inch.

T468-2.2.9. Live Load Bearing Assemblies

Provide Shop Drawings in accordance with FDOT Standard Specifications Section 105, including but not limited to:

A. Fully detailed drawings of live load shoe shims.

B. Load Equalizing: When all four of the live load supports have been installed with the nominal shims indicated, lower each leaf until there is approximately 1/2-inch of space below each live load shoe. Use the following procedure to obtain equal loading on the two live load shoes for each leaf:

C. Release all brakes on the span drives for the leaf in question to allow the span to settle down bringing at least one live load shoe into contact with its strike plate. Note that the span locks should not be installed at this time.

D. If both live load shoes contact their strike plates, raise the leaf and insert a temporary shim 1/2-inch thick under the adjacent shoe (Sa). Lower the leaf by releasing the brakes. Measure the clearance (Co) under the opposite shoe (So). Raise the leaf and remove the 1/2-inch temporary shim from under the adjacent shoe and insert it under the opposite shoe. Lower the leaf by releasing the brakes. Measure the clearance (Ca) under the adjacent shoe. If the clearances Ca and Co measured under the two live load shoes with the temporary shim in place are equal, no additional shim adjustment is required at this time. If Ca is greater than Co, additional shims must be installed under Sa with a thickness of T= (Ca-Co)/2. If Co is greater than Ca, additional shims must be installed under So with a thickness of T= (Co-Ca)/2.

E. If one of the live load shoes does not contact its strike plate, measure the clearance (C1) under that shoe (S1). Raise the leaf and install a temporary shim of thickness (C1+1/2-inch) at S1. Lower the leaf and measure the resulting clearance C2 at the other shoe (S2). Install permanent shims at S1. The thickness (T) of the permanent shims will be T= [C1 + (1/2-inch-C2)/2)].

F. Span Vertical Alignment: After the shimming described above to equalize the loads on the live load supports has been completed for both leaves, additional shim adjustments may be required to bring the tips of the two leaves to the proper elevation and to align the roadways at the tips of the two leaves. Use the following procedures to complete the shimming of the live load supports:

G. Lower both leaves to the fully closed position with all four live load shoes in firm contact with their strike plates.

H. Measure the elevation of the tips of the two leaves at the center of the waterway with respect to the elevations of the roadways on the ends of the approach spans adjacent to the bascule spans.

I. Measure the differences in elevation between the roadways at the tips of the two leaves, at the center of the roadway, and at the point on the roadway 2-feet inboard of each curb.

J. Determine what adjustment in shim thickness is required at the live load supports to properly align the roadways at the tips of the two leaves and to position them at the proper elevation with respect to the approach span roadways. Ensure the difference in elevation from the span centerline to the rear joint between the fixed and bascule spans is as shown in the Contract documents ±1/8-inch.

K. Install additional shims (or remove shims) above the live load shoes as required to position the roadways at the tips of the leaves at the proper elevation with respect to the roadways on the approach spans and to properly align the roadways on the two leaves vertically with one another. An equal amount of shims must be added or removed from the two live load shoes on a given leaf.

L. After adjusting the thickness of the shims under each live load shoes, lower the leaves by releasing the brakes and check the tips of the bascule leaves to see if they are at the proper elevation and are properly aligned with one another. Readjust shims under the strike plate if necessary.

M. Alignment: The live load supports are properly aligned when the live load shoe is in full contact with the live load strike plate. Contact is full if a 0.002-inch feeler gage cannot be inserted between the shoe and the strike plate along the entire length of live load shoe.

T468-2.2.10. Welding and Weldments

Ensure that welding required conforms to the AASHTO/AWS D1.5 Bridge Welding Code for the material being welded.

Inspect all weldments utilizing Ultrasonic Testing or Radiographical Testing as per ASTM E164 and AWS D1.5. Unless otherwise noted, perform 100% magnetic-particle inspection of fillet welds and partial penetration welds of machinery weldments.

Perform coupon testing and provide a certified copy of test reports prior to any welding procedure involving attachment to existing steelwork. Provide report showing the chemical composition of the specific steel piece(s) to be welded. Design a weld procedure specific to this chemical composition.

Unless otherwise noted, treat all welded machinery and weldments that support machinery as main members, all welds as subject to tension or stress reversal, and all welds as joining primary components. Do not perform field welding on these elements unless specifically required in the Contract Documents.

Stress relieve all shop welds. Do not machine components until after welding and stress relieving. Unless otherwise shown in the Contract Documents, finish machined surfaces of weldments to flatness as required herein and finish machinery bearing surfaces parallel to each other and to the bottom of the base plate. Machine finish the height of the weldments supporting machinery, on shims, as measured from the bottom of the base plate to the top of the bearing surface, to Plan height plus or minus 1/8 inch. Grind all exposed edges of weldments to a chamfer or radius to eliminate sharp edges and burrs. Ensure that weldment base plates, placed against concrete or grout, have 3/4-inch minimum radii on the corners.

Submit shop drawings that include procedures for field structural welding with inspection requirements stipulated in the Contract Documents for approval prior to start of welding.

Include a certified copy of a test report showing the chemical composition of the specific steel piece(s) to be welded in any welding procedure involving attachment to existing steelwork. Consider this chemical composition in the welding procedure.

Unless otherwise shown in the Contract Documents, connect elements of weldments by complete joint penetration welds. Groove welds shall be complete joint penetration groove welds (CJP). Do not use fillet welds where they would require machining to provide clearance for machinery, fasteners, or other attachments. Clip stiffeners to avoid overlapping stiffener welds with welds at the intersection of main plates.

Ensure the fitting up and welding procedure is such that distortion of the work will be a minimum. If necessary to obtain this result, use suitable welding fixtures. Unless otherwise specifically stated, stress relieving is required for welded machinery parts prior to final machining.

Perform welding for steel HPU elements in accordance with the AWS D1.1 Structural Welding Code - Steel. Perform welding for stainless steel HPU and reservoir elements in accordance with the AWS D1.6 Structural Welding Code - Stainless Steel. Perform welding for hydraulic piping in accordance with the ASME B31.1 Code for Pressure Piping. Perform visual inspection and inspection documentation of all the above welds in accordance with the applicable welding code requirements.

Do not paint welded components until welds are inspected and approved.

Thoroughly coat finished mounting surfaces with an approved temporary protective coating that prevents oxidation and are skidded or crated for protection during handling, shipment and storage. Unless the weldment is galvanized and after weldment is accepted by the Engineer, prime base surfaces which will have concrete or grout cast against them, but do not finish coat them.

T468-2.2.11. Shop Assembly Operations

Shop assemble machinery components to verify their correct fit prior to shipment as far as the removed assembly components to be repair/reconditioned allows. Disassemble components not mounted in a common base for shipment. Match mark any components requiring selective assembly for future assembly.

T468-2.2.12. Erection and Testing

Erect and assemble machinery in accordance with part numbers and match marks. Adjust all parts for precise alignment by means of shims and pull parts tightly against supporting members by use of clamps, temporary bolts, or other approved means before drilling and reaming holes for connecting bolts. Install all machinery within the specified tolerances and such that satisfactory operation is achieved.

Do not install machinery unless mounting surfaces are clean of dirt, paint and other foreign materials.

Securely tighten connecting screws, bolts and nuts to specified torque values after approval of field alignment by the Engineer.

T468-2.2.13. Lubrication of Machinery

Connect grease fittings with tubing or fittings so that grease is introduced directly into the grease grooves for distribution. Tubing is to extend from the bearings to convenient lubrication stations. Install vibration absorbent braided stainless steel hose, 8-inch minimum length, between the pipe and the component lubricated on span lock components or other components subject to vibration or impact. Provide tubing supports at increments not to exceed 3-feet between supports.

T468-2.2.14. Painting of Machinery

Clean and paint all unfinished surfaces of new, re-used, or existing of machinery, equipment, hydraulic assemblies, supports, and structural members mating with machinery in accordance with FDOT Specification Section 560 and Section 561.

Paint with a three-coat system (Prime, Intermediate, and Finish coatings) in accordance with FDOT Specification Section 560 and Section 561.

Clean all machinery surfaces of all chips, dirt, rust, scale, sand, grease, and other foreign matter by solvent cleaning, wire brushing, or other approved means prior to painting.

Clean existing steel surfaces mating to new components per SSPC SP 3.

After proper surface preparation, apply one shop coat of primer to all machinery surfaces, except for rubbing surfaces.

After completing the operating tests and acceptance of the machinery, wash with approved solvent all accumulated oil, grease, dirt, and other foreign matter from exposed machinery surfaces, except rubbing surfaces. Give the exposed surfaces a final field coat.

Paint other supporting steel with the final field coat to match the structural steel in accordance with FDOT Specification Section 561. Do not paint stainless steel elements of hydraulic power unit assemblies, including support structure, reservoir, and drip pan unless approved by the Engineer.

Apply the finish coat to weldments, bearing housings, and other machinery as specified in this Technical Special Provision in the shop. Apply field touch-up paint to shop applied coatings damaged during construction.

Ensure nameplates on all proprietary elements are readable, clean, and free of all paint before acceptance of the machinery.

Protection For Shipment:

A. Coat all finished metal surfaces, not to be painted, as soon as practical after machining with a temporary protective coating that prevents oxidation. Coat non-stainless shims with a temporary protective coating that prevents oxidation prior to shipment and wipe clean before installation. Completely protect machinery parts from weather, dirt and foreign materials during manufacture and store indoors while awaiting erection. Exposed shaft journals shall be greased or coated with the oxidation preventative coating, wrapped in oil-soaked burlap and securely timber lagged for shipment. Any solvent used to clean a journal prior to assembly must be completely removed from the shaft and bearing prior to assembly. Assembled units – including lock bar operators and other devices having finished mounting surfaces shall have those surfaces thoroughly coated with a temporary protective coating that prevents oxidation and shall be skidded or crated for protection during handling, shipment and storage.

B. Bag and crate mounting hardware and other small parts for shipment. Label bags with all contents. Provide tags, recording the part number, secured to each part with wire or plastic ties prior to shipment.

C. Any coating removed for the purpose of installation or erection of equipment shall be reapplied as soon as practical until it is removed for the application of paint or installation into a lubricated assembly.

T468-3. HYDRAULIC OPERATING MACHINERY

T468-3.1. General

This Article defines the work requirements for the hydraulic machinery, components, and associated elements and electro-hydraulically operated equipment for use in movable bridge operation and control and movable bridge auxiliary devices.

T468-3.1.1. Description of Work

See Section 3.2 for detailed list of items to be replaced. Reference summarized scope of work items as follows:

A. Recondition existing Hydraulic Power Unit with replacement of subcomponents listed below.

B. Refurbish plain bearings inside Cardanic Rings. Disassemble the Cardanic Rings assemblies which include respective plain bearings. Clean and inspect trunnion pins and bearing interior cavities. Provide new Glycodur bushings, lubricate entire bearing assembly with grease at reassembly and installation.

C. Provide new Hydraulic fluid and perform filtering to the required cleanliness level shown in the Plans.

D. Remove and dispose of all subcomponents listed to be replaced according to local, state and federal regulatory standards. Perform removal of all listed (See Section 3.2) hydraulic fluid system subcomponents with systems depressurized and fluid drained from the section of system at which work is to be performed. Alternatively, drain entire system if no other means of fluid line isolation exists. Protect any exposed surfaces which normally would be enclosed or covered from contamination which may later result in damage of the local or global hydraulic system components.

T468-3.1.2. Qualifications

If the work is subcontracted, use a qualified subcontractor for this work. The Subcontractor shall have had at least ten years' experience in the design, fabrication, and installation of major hydraulic systems for civil engineering applications of this size and type.

Use Hydraulic Technicians or Industrial Hydraulic Mechanics who are Certified Fluid Power Engineers and/or Certified Fluid Power Specialists from the International Fluid Power Society. Use Certified Technician/Mechanics having prior experience on similar sized systems for installation, start-up, piping and flushing of hydraulic systems. Use Certified Technician/Mechanics with at least five years experience in the design, fabrication, and installation of hydraulic systems of this size and type.

Use only personnel with demonstrated skill in this type of work for installation and adjustment of hydraulic components.

T468-3.1.3. Field Hydraulic System Testing

Perform static and dynamic field tests of the hydraulic system as follows:

A. Hydraulic Static Field Testing:

1. Complete charging and flushing of hydraulic system prior to testing. After all components (tubing valves etc.) of the fluid system have been physically tightened and inspected, bleed all air from cylinders. Do not exceed creep speed velocity during these tests. Demonstrate that the current leaf condition is tip heavy within acceptable tolerances prior to initiating any tests or operations that require the cylinders to hold the load of the leaf. Submit balance calculations for review by the Engineer prior to testing.

2. Verify system directional control and cylinder manifold pilot operated check valve function (Suggested procedure: With the cylinders disconnected from the leaf, extend and retract the cylinders at creep speed or less).

3. Verify that rods do not drift unless actuated (Suggested procedure: extend cylinders and hold position).

4. Pressure test system to seating pressure level. Set the system pressure relief valves to the specified seating pressure. Set the flow control for creep speed. Perform this test with the leaf in the full open or full closed position.

a. If the Bascule Leaf is in the fully open position, block the leaf against the bumper blocks. Provide leaf restraints to prevent accidental lowering. Manually controlling the HPU, shift the directional control to the raise position. Verify system and cylinder pressures, leak free piping and control functions. Shut down power unit and bleed pressure from cylinders.

b. If the leaf is in the full closed position, verify that all live load shoes are in full contact with the masonry plates or temporary blocking. Provide leaf restraints to prevent accidental raising. Manually controlling the HPU, shift the directional control to the lower position. Verify system and cylinder pressures, leak free piping and control functions. Shut down power unit and bleed pressure from cylinders.

5. Test load holding and manual bleed down valve functions.

6. If initial Bascule Leaf operation is from the open position, perform the following test:

a. Manually lock the cylinders by closing all cylinder bleed down needle valves.

b. Partially release the Bascule Leaf restraints to produce slack of the equivalent of at least ½ inch and no more than 1 inch of cylinder stroke. Verify that the load is held by cylinders.

c. Open the cylinder blind end bleed down needle valve on one cylinder, verify that the other cylinder holds the load and that the leaf is tip heavy. If the leaf rotates further open discontinue the test until the span is rebalanced to a tip heavy condition.

d. Using manual control of the power unit and the auxiliary pump, raise the leaf back to its original position.

e. Repeat the above steps to test the holding capacity of the other cylinder.

7. If initial Bascule Leaf operation is from the closed position, perform the following test:

a. Using manual control of the power unit and the auxiliary pump, raise the Bascule Leaf approximately 2 to 3 inches of cylinder stroke. Stop the bridge.

b. Shut down the power unit and verify that the cylinders hold the load.

c. Open the cylinder blind end bleed down needle valve on one cylinder, verify that the other cylinder holds the load and that the leaf is tip heavy. If the leaf rotates further open discontinue the test until the span is rebalanced to a tip heavy condition.

d. Using manual control of the power unit and the auxiliary pump, raise the leaf back to its original position.

e. Repeat the above steps to test the holding capacity of the other cylinder.

B. Hydraulic Unit Dynamic Field Testing and Adjustment

1. Hydraulic Unit Dynamic Field Testing: Do not initialize dynamic testing until Hydraulic Static Field Testing and Initial Bridge Operation is completed and accepted by the Engineer.

2. Raise and lower the leaf in creep speed. Verify motion control signals and indicators, including limit switches, normal stop, and Emergency Stop.

3. After several operations check all areas for leaks, fluid temperature and motor current drain. Connect all control wiring for console system test.

4. If console is not available, use local manual control of movable span to demonstrate the operation of the hydraulic Bascule Leaf drive.

5. Install all limit switches and position indication devices to initial settings.

T468-3.1.4. Submittals

Submit all new hydraulic equipment component data to the Engineer for approval prior to fabrication. Label each submittal package as noted below and include all the required items for that section. Provide these labels in addition to sequential submittal numbers. Include the complete HPU schematic within the submission.

Use a Certified Fluid Power Engineer or Certified Fluid Power Specialist to prepare or check all calculations required to be performed for detailing the hydraulic systems. Provide calculations signed by the responsible Certified Fluid Power Engineer or Certified Fluid Power Specialist.

Indicate welded connections using standard AWS welding symbols.

Field verify all dimensions shall conform with existing conditions. Clearly indicate on all shop drawings all field verified dimensions.

Prepare and provide the following submittal packages as a minimum. Submit additional submittal packages as specified or as requested by the Engineer.

T468-3.1.4.1. Cylinders and Attachment Components

A. Bill of Materials for all new cylinders components including manufacturer's part numbers for ordering replacement seals.

B. Certified dimensional prints and assembly drawings of components with reference numbers matching the cylinder Bill of Materials. Include an assembly drawing of cylinders and attachments indicating clearances between the cylinders and adjacent structures, equipment, and walkways. Machining tolerances shall be clearly shown. Clearly state the rated pressure for cylinders and manifolds on the shop drawings.

C. Weld procedures for all clevis welds.

D. Cylinder clevis details.

E. Cylinder clevis bearings, including snap rings and hardware, and clevis pins.

F. Assembly drawing of cylinder manifolds.

G. Detailed alignment and installation procedures.

H. Paint material and painting procedures, including color identifications, surface preparation procedures and product specifications.

I. List of spare parts provided with manufacturer, model/part numbers and quantity to be supplied.

J. State design safety factor on shop drawing. Safety factor to meet AASHTO design requirements.

T468-3.1.4.2. Cylinder Cardanic Ring Assemblies

A. Bill of Materials for all components including manufacturer's part numbers for ordering replacement parts.

B. Field verified dimensions required to finalize envelope size of bearing and mounting bolt hole locations. This includes verifying location and size of existing bolt holes in existing structural support.

C. Provide manufacture's recommended loading requirement. State safety factor on shop drawing. Safety factor is based off the 3000 psi load rating of the cylinder. A minimum safety factor of three is required.

T468-3.1.4.3. Startup and Functional Testing

A. Detailed procedure for inspection, flushing, and fluid sampling for all hydraulic work.

B. Detailed procedure for Hydraulic Static Field Testing.

C. Detailed procedure for functional testing of the Main Hydraulic Drive System.

T468-3.1.4.4. Qualifications

A. Qualification demonstrating certification of Certified Fluid Power Engineer and/or Certified Fluid Power Specialist from the International Fluid Power Society.

B. Qualifications demonstrating certification of Certified Hydraulic Technician or Certified Industrial Hydraulic Mechanics from the International Fluid Power Society.

T468-3.2. Materials

Assemble hydraulic equipment in accordance with standard NFPA hydraulic practices. All components listed are to be replaced in-kind. In the event of the item being no longer available, submit reasoning to the Engineer in writing for equivalent substitution. Provide manufacturers data cutsheets for engineer approval prior to purchase. Work the material section with the Hydraulic schematics and tabulated item list in plans.

T468-3.2.1. Pumps

Provide hydraulic pumps of the variable displacement, axial piston type with swash plate design suitable for open-loop operation. Provide variable displacement pumps to requirements shown in the Plans. Provide pumps with the following:

A. Rated for continuous duty at 5000 psi or higher.

B. Clockwise and/or counterclockwise rotation.

C. Displacement tolerance of +/- 10% for 4.3 cubic inches (71 cc).

D. Max flow setting of 27.5 gpm.

E. Pressure compensator settings:

F. Low Pumps 1500 psi.

G. High Pumps 2650 psi.

H. Pump efficiency at 1800 psi pressure and full flow of 85 percent or better.

Provide direct coupling of each pump to an electric motor by use of a C faced adaptor bracket. Use electric motors that are in accordance with the requirements noted in this Section and Section T508.

Connect pumps and electric motors using a suitable flexible coupling with less than 0.005-inch parallel or angular misalignment. Coupling and shaft fit to be per manufacturer's recommendation. Secure coupling set screws with an approved thread locker. Mount the entire pump/motor assembly on standard vibration isolation shock mounts.

T468-3.2.2. Manifolds

Provide main system valving rated for its intended flow and pressure and suitable for the intended use in the hydraulic system with regard to function and performance throughout the anticipated range of operating conditions. Use ANSI/ISO standard subplate mounted or cartridge valves wherever possible for ease of servicing. Provide externally drained valves where required.

Provide valves with corrosion resistant bodies or paint valves in accordance with the requirements for painting machinery.

Use manifolds to house valving and other components as specified in the Plans. Unless otherwise specified in the Plans, fabricate manifolds from stainless steel as required for the specified working pressures.

T468-3.2.3. Temperature Switch

Provide fluid temperature switches for the following functions:

A. High operating fluid temperature pump shutdown and HPU immersion heater shutdown.

B. Low operating fluid temperature for HPU immersion heater activation.

T468-3.2.4. Hydraulic Plumbing and Fittings

Provide plumbing and fittings that conforms to current ASME and NFPA hydraulic system standards. Provide plumbing and fittings that conform to the following unless otherwise noted.

A. Rigid Hydraulic Tubing and Piping:

1. For rigid tubing use seamless, annealed ASTM A269 Type 304 stainless steel tube.
2. For piping use seamless, ASTM A312 Type 316 stainless steel.
3. For fittings for stainless tubing use SAE J518 four bolt welded O-ring flange, flat O-ring face seal fittings.
4. Long runs shall incorporate SAE four bolt split flange unions to facilitate easy installation and disassembly.
5. For threaded connections use SAE straight thread with O-ring. Provide all fittings of stainless steel.
6. For fittings for steel piping use SAE four bolt welded O-ring flange or flat O-ring faced seal.
7. For long runs incorporate SAE four bolt split flange unions to facilitate easy installation and disassembly.
8. Weld and pressure test all tubing and piping in the manufacturer's shop before installation. No field welding of plumbing or fittings will be permitted.
9. Use mechanical connections that incorporate O-rings as the primary pressure sealing component.
10. Size tubing, fittings and pipe to provide a minimum Factor of Safety of 4.0 against bursting (based on tensile strength). Calculate the bursting strength per the requirements of AASHTO LRFD Movable Specifications

B. Hydraulic Flexible Hoses:

1. Provide flexible hose of the proper SAE rating, consistent with working pressures noted on the Plans. As a minimum, use flexible hose for suction, drain, bypass and pressure lines connecting all pumps to the system.
2. Connect all hydraulic cylinders to fixed plumbing with flexible hose.
3. Assemble all hose assemblies with a suitable sealant.
4. Provide Type 316 stainless steel hose ends and hardware for all hoses.
5. Use JIC Code 61 or 62 four bolt flange, O-ring sealed fittings for hose connections.

T468-3.2.5. Hardware and Fasteners

Use ASTM A193, Grade B8M, Type 316 or ASTM A276 Type 316 Stainless Steel for all fastener bolts, nuts, washers and all other mounting hardware used on all the hydraulic equipment and power units, and plumbing unless otherwise specified. Provide valves with manufacturer recommended stainless steel hardware. Provide non-stainless-steel fasteners only under the following conditions:

A. Component fasteners subject to calculated forces due to hydraulic pressure and are not supplied in stainless steel by the component manufacturer, or;

B. Strength requires bolts to be heat treated alloy steel, SAE Grade 8.

Clean and paint non-stainless-steel hardware in accordance with the requirements for the connected components according to Section T468-2.2.14.

T468-3.2.6. Hydraulic Clamps

Use of hydraulic pipe clamps is mandatory. Clamp hydraulic tubing and piping using 1 5/8 inch Slotted Steel Channels and heavy-duty clamps. Provide sufficient clamps such that maximum pipe clamp spacing does not exceed 36 inches. Submit a fully detailed hydraulic piping layout drawing for review and approval by the Engineer prior to installation. Follow clamp manufacturer's specifications for installation. Use Type 316 stainless steel for all metallic clamp components, hardware, and channels.

T468-3.2.7. Hydraulic Fluid Filtering

Provide filters as shown on the plans.

T468-3.2.8. Return Line Components

Provide return line components as shown on the plans.

T468-3.2.9. Cylinder Assembly Valves and Components

Provide main-system valving rated for its intended flow and pressure, and suitable for the intended use in the hydraulic system with regard to function and performance throughout the anticipated range of operating conditions. Use ANSI/ISO standard subplate mounted or cartridge valves wherever possible for ease of servicing. Provide externally drained valves where required. Refer to Plans for valve performance requirements.

Provide valves with stainless steel, corrosion-resistant bodies. Utilize high temperature Viton seals for all valves.

A. Provide check valves that are leak free in the checked direction. Provide pilot operated check valves equipped with external drain and decompression poppet where specified.

B. In-Line Valving: Provide in line ball and needle valves with stainless steel housings. Provide in-line valves with ports at least as large as the adjoining plumbing and components.

C. Equip all pressure test and gauge ports in manifolds with a stainless-steel quick disconnect checked test coupling with protective cap. Connect test ports to gauges with a 0.08" nominal diameter test hose equipped with a swivel nut compatible with the test couplings. Provide sufficient hose length to allow hoses to be connected to a variety of test couplings. Tie excess hose lengths in neat loops and bind with plastic snap ties such that all test hoses are well organized and can be traced and serviced.

Refer to table in Plans for information and details of individual valves of the hydraulic system.

T468-3.2.10. Ball Valves

Replace ball valves as shown on the plans.

Replace ball valve limit switches, operator rotary levers, and limit switch support brackets as shown on the plans.

T468-3.2.11. Hydraulic Fluid

Provide all hydraulic fluid required to install and test the hydraulic systems. Flush entire existing hydraulic span drive fluid system and replace with new oil. Hydraulic oil shall be the same fluid currently used at the bridge. Confirm all new components are designed for the hydraulic fluid.

Provide components, seals, etc. that are compatible with the approved fluid.

T468-3.2.12. Flow Meter

Replace flow meter as shown on the plans. Ensure new flow meter meets 10-150 gpm range of flow with 5000 psi pressure rating. Provide flow meter with stainless steel body and code 62 mounting flange.

T468-3.2.13. Accumulator

Replace accumulator as shown on the plans.

T468-3.2.14. HPU Support Frame

Replace HPU Support frame and base as shown on the plans.

T468-3.2.15. HPU Miscellaneous Subcomponents

Replace HPU Subcomponents as shown on the plans.

T468-3.2.16. Filter Cart

Replace filter cart as shown on the plans.

T468-3.2.17. Piping Runs

Exclusive of hoses, terminal connectors and adaptors, make tubing runs integral and continuous from one device or component to another. Make tube or pipe branches only at terminal connectors or adaptors that are rigidly secured. Install pipe runs with a minimum number of fittings and bends.

Install piping runs across access ways for normal maintenance and inspection that do not interfere with passage. Rigidly support these runs and protect them from contact. For protection of piping mounted to a walkway floor, provide conduit protection fabricated from corrosion resistant materials with a non-skid surface, designed to support pedestrian loading. Provide a means for removal of conduit protection in the event service is required.

T468-3.2.18. Hoses

Manufacture hose assemblies to the proper length and install such that they only have sufficient length to avoid flexing and straining the hose during operation. Torsional deflection of hoses shall be minimized. Hoses that flex with the movement of components, such as hoses connected to the main hydraulic cylinders, shall be installed such that the flexure due to cylinder movement is in a single plane. Provide fittings, hardware, and hard piping to position and orient hose ends in a manner to limit flexure to a single plane. Hoses shall be located and installed such that they do not rub against or contact rigid objects or other hoses.

T468-3.2.19. Lubrication

Refer to Section T468-2.1.10 for lubrication type and procedures.

T468-3.2.20. Painting

Refer to Section 2.2.14 for paint material and procedures.

T468-3.3. Construction Requirements

T468-3.3.1. General

Disassemble and remove all valves before cleaning and painting manifold.

Perform charging and flushing only when atmospheric particles are at a minimum (no sandblasting or painting in progress). Check reservoir condition through cleanout covers prior to charging. All surfaces should be clean of dirt, rust or moisture. Once the reservoir has been cleaned, charge the reservoir with the fluid approved for final use in the system.

After system flushing of the main drive hydraulic system operate each system for a minimum of 10 complete cycles to allow cylinder and reservoir oil to become sufficiently mixed. Using proper NFPA techniques, draw a fluid sample from each system and analyze per the ISO Solid Contaminant Code. Flush, filter, and test fluid as required to obtain the required cleanliness level. Prior to final acceptance of the bridge hydraulic system, provide certified test evidence of fluid cleanliness for all units following the ISO standard.

Provide fluid at functional acceptance and final acceptance that is clean and in acceptable condition. Ensure fluid cleanliness level for all units is as shown on the plans, or cleaner. Replace any fluid that has been heated beyond 160°F at any time during construction or testing. Replace any fluid contaminated with water or other foreign materials detrimental to the fluid or hydraulic system components.

T468-3.3.2. Pumps

Set up and test pumps at the factory or shop. Set the pump controls and verify the performance curves for the pump such that the maximum flow is set at the value required for full speed operation, the pressure compensator is set to fully compensate the pump at the specified working setting shown in the Plans. Using a test stand, verify all pump settings and measure pump efficiencies at the seating pressure, maximum working pressure, and mid-point in between. Submit a report summarizing the test measurements to the Engineer.

A. Replace in-kind the primary (main) pumps, primary pump motor couplings, primary pump C-Face adaptors and primary pump supports. (Hydraulic schematic items 1.0.1 thru 1.0.4, 1.3.1 and 1.3.2).

B. Replace in-kind charge pump, charge pump motor coupling, charge pump C-Face adaptor and charge pump supports. (Hydraulic schematic items 4.1, 4.23, and 3.1.1, 3.1.2, 3.1.3, 3.1.4)

T468-3.3.3. Manifolds

Disassemble, clean and inspect the manifold housing and valve ports/threads marked for refurbishment. Report to the Engineer any unforeseen or unanticipated impediments to the intended function of the manifolds as discovered upon disassembly.

A. Refurbish Main Manifold (Hydraulic schematic item 2.0).
   1. Replace Directional Control Valve (Hydraulic schematic item 2.3).
   2. Replace Directional Control Valve (Hydraulic schematic item 2.6).
   3. Replace Solenoid Valve (Hydraulic schematic item 2.10).
   4. Replace Directional Control Valve (Hydraulic schematic item 5.1).
   5. Replace Mounting Plate
   6. Replace test point connection (Hydraulic schematic item 2.14.1).

B. Refurbish Manual Control (Auxiliary) Manifold (Hydraulic schematic item 4.0).
   1. Replace Proportional Control Valve (Hydraulic schematic item 4.11).
   2. Replace Directional Control Valve (Hydraulic schematic item 4.12).
   3. Replace Mounting Plate

C. Counterbalance (Central Pit) Manifold.
   1. Replace Directional Control Valve (Hydraulic schematic item 5.1).
   2. Replace test point connections (Hydraulic schematic items 5.11.1, 5.11.2, 5.11.3 and 5.6.1 and 5.6.2).
   3. Replace support bracket and bracket fasteners and concrete anchors.

D. Cylinder Manifolds (Central pit).
   1. Replace needle valves ((Hydraulic schematic items 6.4.1 thru 6.4.4).
   2. Replace relief valves (Hydraulic schematic items 6.5.1 thru 6.5.4).
   3. Check valves (bottom only) (Hydraulic schematic items 6.3.3 and 6.3.4).

T468-3.3.4. Temperature Switch

A. Replace in-kind temperature switches (Hydraulic schematic items 3.4. and 3.4.1).

T468-3.3.5. Hydraulic Plumbing and Fittings

A. Clean, inspect and coat with a long term 304/316 stainless steel rust inhibitor the rigid piping listed in this section as directed in the plans. In the event the piping or fitting requires replacement, provide engineer approved substitute meeting the associated requirements listed herein and in the plans. Mark location and report to the County any piping components that cannot be cleaned, or where cleaning resulted in a wall thickness reduction of 5% or more. Take precautions such that only corrosion is removed from the surfaces, leaving good material intact. Submit cleaning procedure for review and approval. Do not use power tools for cleaning of piping. Hydraulic Rigid Piping:

1. Clean, inspect and coat, if replacement is needed, replace with in-kind Accumulator line, 2" Schedule 160 pipe, approximately 32" long (Hydraulic schematic item E*). Note that the *Asterisk denotes line segment inside HPU room only.

2. Clean, inspect and coat, if replacement is needed, replace with in-kind Rod line, 1.25" Schedule 80 pipe, approximately 61" long (Hydraulic schematic item F*). Note that the *Asterisk denotes line segment inside HPU room only.

3. Clean, inspect and coat, if replacement is needed, replace with in-kind Blind line, 2" Schedule 160 pipe, approximately 61" long (Hydraulic schematic item G*). Note that the *Asterisk denotes line segment inside HPU room only.

4. Clean, inspect and coat, if replacement is needed, replace with in-kind Drain line, 1.25" Schedule 40 pipe, approximately 86" long (Hydraulic schematic item H*). Note that the *Asterisk denotes line segment inside HPU room only.

5. Clean, inspect and coat, if replacement is needed, replace with in-kind Rod line, 1.25" Schedule 80 pipe, approximately 582" long (Hydraulic schematic item F).

6. Clean, inspect and coat, if replacement is needed, replace with in-kind Blind line, 2" Schedule 160 pipe, approximately 582" long (Hydraulic schematic item G).

7. Clean, inspect and coat, if replacement is needed, replace with in-kind Drain line, 1.25" Schedule 40 pipe, approximately 582" long (Hydraulic schematic item H).

8. Clean, inspect and coat, if replacement is needed, replace with in-kind Rod line, 1" Schedule 80 pipe, approximately 132" long (Hydraulic schematic item K).

9. Clean, inspect and coat, if replacement is needed, replace with in-kind Blind line, 1.25" Schedule 80 pipe, approximately 132" long (Hydraulic schematic item N).

10. Clean, inspect and coat, if replacement is needed, replace with in-kind Drain line, 1" Schedule 40 pipe, approximately 132" long (Hydraulic schematic item Q).

11. Clean, inspect and coat, if replacement is needed, replace with in-kind Blind line, 1.25" Schedule 80 pipe, approximately 80" long (Hydraulic schematic item T).

Replace Hydraulic Flexible Hosing and associated hardware and split clamps. In the event the item or associated fitting is not available for in-kind replacement, provide engineer approved substitute meeting the associated requirements listed herein and in the plans.

B. Hydraulic Flexible Hoses:

1. Replace in-kind (2) Rod line, 1" SAE 100R13 Hose with minimum 3000 Psi working pressure rating, approximately 72" long each (Hydraulic schematic item M).

2. Replace in-kind (2) Blind line, 1.25" SAE 100R13 Hose with minimum 1000 Psi working pressure rating, approximately 72" long each (Hydraulic schematic item P).

3. Replace in-kind (2) Drain line, 1" SAE 100R9 Hose with minimum 3600 Psi working pressure rating, approximately 72" long each (Hydraulic schematic item R).

T468-3.3.6. Hydraulic Fluid Filtering

A. Replace in-kind pressure filter (Hydraulic schematic item 2.1.1 and 2.1.2).

B. Replace in-kind return filter (Hydraulic schematic item 3.3).

C. Replace in-kind fill line filter (Hydraulic schematic item 3.10).

T468-3.3.7. Return Line Components

A. Replace in-kind return line filter (Hydraulic schematic item 3.10).

B. Replace in-kind return line quick disconnects (Hydraulic schematic items 3.10.1 and 3.10.2).

T468-3.3.8. Cylinder Assembly Valves and Components

A. Replace Test point connections on cylinder blind end of each cylinder.

B. Replace blind end cushion adjustment needle valves.

C. Replace seal leak reservoir and support brackets (Hydraulic schematic item 6.10.1 and 6.10.2)

T468-3.3.9. Ball Valves

A. Replace in-kind ball valves as indicated in the plans.

1. Suction Line Ball Valves (Hydraulic schematic items 3.1.1 thru 3.1.4).
2. Accumulator Ball Valve (Hydraulic schematic item 2.12).
3. Manual Control Manifold Ball Valves (Hydraulic schematic items 4.17 and 4.18).
4. Main Manifold Ball Valves (Hydraulic schematic items 2.16 and 2.18).
5. Return Line Ball Valve (Hydraulic schematic item 3.12).
6. Cylinder Ball Valves (Hydraulic schematic items 5.7.1 and 5.7.2, 5.8.1 and 5.8.2, 5.9.1 and 5.9.2)

B. Replace in-kind ball valve limit switches, operator rotary levers, and limit switch support brackets (Hydraulic schematic items 3.11 and 3.11.1).

T468-3.3.10. Hydraulic Fluid

Provide all hydraulic fluid required to install and test the hydraulic systems. Flush entire existing hydraulic span drive fluid system and replace with new oil. Hydraulic oil shall be the same fluid currently used at the bridge. Ensure all new components are designed for the hydraulic fluid.

Provide components, seals, etc. that are compatible with the approved fluid.

T468-3.3.11. Flow Meter

A. Replace in-kind flow meter (Hydraulic schematic item 3.2).

T468-3.3.12. Accumulator

A. Replace in-kind accumulator and accumulator bracket (Hydraulic schematic item 2.11).

T468-3.3.13. HPU Support Frame

A. Replace in-kind HPU struts and bases that form the support frame as shown on the plans.

B. Provide new fasteners to secure new supports. Inspect the entire frame and replace any corroded fasteners with in-kind replacements.

C. All frame support hardware to be Bosch manufacturer standard or engineer approved equal.

T468-3.3.14. HPU Miscellaneous Subcomponents

A. Replace in-kind HPU reservoir mounting nuts and bolts.

B. Replace in-kind HPU gauge station bracket.

C. Replace in-kind HPU hand hole cover seals.

T468-3.3.15. Filter Cart

A. Replace in-kind filter cart.

T468-3.3.16. Piping Runs

Clean, inspect and coat piping runs if replacement required, replace per pressure and flow criteria listed in plans. Fully adhere to Section 2.2.10 requirements for welding hydraulic components.

T468-3.3.17. Hoses

Replace in-kind hoses per pressure and flow criteria listed in the plans.

T468-3.3.18. Hydraulic Cylinder Clevis Supports

Field verify all cylinder support component alignment prior to final mounting of cylinder support components.

Touch-up paint in the field as required following installation. Use paint color specified in these technical special provisions.

T468-3.3.19. Hydraulic Cylinder Clevis Pin Installation

Submit detailed procedure for installation of the Hydraulic Cylinder Clevis Pins.

T468-3.3.20. Hydraulic System Training

No training is required.

T468-4. METHOD OF MEASUREMENT

A. Spherical Bearings: The work of furnishing and installing the plain radial spherical bearings as detailed in this Technical Special Provision and on the Plans will be paid for at the Contract unit price per each item. Applicable to (6) Spherical Bearings and associated hardware.

B. Plain Journal Bearings: The work of reconditioning the plain journal bearings as detailed in this Technical Special Provision and on the Plans will be paid for at the Contract unit price per each item. Applicable to (4) Plain Journal Bearings and associated hardware.

C. Hydraulic Cylinders: The work of reconditioning the Hydraulic Cylinders and associated components as detailed in this Technical Special Provision and on the Plans will be paid for at the Contract unit price per each item. Applicable to (2) cylinder assemblies at machinery pit. This includes the Hydraulic Cylinders, Cylinder Manifolds and associated components, as shown on the Contract Plans.

D. Hydraulic Power Pack (HPU) Assembly: The work of reconditioning the HPU as detailed in this Technical Special Provision and on the Plans will be paid for at the Contract unit price per each item. Applicable to (1) HPU and associated hardware assembly. This includes all hydraulic system components, as shown on the Contract Plans, from the Hydraulic Power Units up to and including the Counterbalance Manifold as well as all rigid piping and hoses “E”-“T” on the hydraulic schematic.

E. Span Lock System: The work of rehabilitating the Span Lock system as detailed in this Technical Special Provision and on the Plans will be paid for at the Contract unit price per assembly. Applicable to (2) Span Lock assemblies.

F. Live Load Shoes: The work of shimming and adjusting of live load shoes as detailed in this Technical Special Provision and on the Plans will be paid for at the Contract unit price of lump sum. Applicable to (2) Live Load Bearing assemblies.

G. Other Machinery Components: The work of removing and disposing of specified span drive machinery components as detailed in this Technical Special Provision and on the Plans will be paid for at the Contract unit price of lump sum.

T468-5. BASIS OF PAYMENT

Price and payment will be full compensation for all work specified in this Section, including furnishing and installing all equipment and materials. When an item of Mechanical Equipment is included in the proposal, price and payment will be full compensation for all work and costs specified under this Section except as may be specifically covered for payment under other items.

Payment will be made under:

Pay Item No. 465-2-122	Movable Bridge Machinery & Castings- Rehab, Furnish & Install, Spherical Bearings	EA
Pay Item No. 465-2-421	Movable Bridge Machinery & Castings- Rehab, Recondition, Plain Journal Bearings	EA
Pay Item No. 465-2-452	Movable Bridge Machinery & Castings- Rehab, Recondition, Hydraulic Cylinders	EA
Pay Item No. 465-2-454	Movable Bridge Machinery & Castings- Rehab,	

	Recondition, Hydraulic Power Pack	EA
Pay Item No. 465-2-505	Movable Bridge Machinery & Castings- Rehab, Adjust/Modify, Span Locks	AS
Pay Item No. 465-2-508	Movable Bridge Machinery & Castings- Rehab, Adjust/Modify, Live Load Shoes	LS
Pay Item No. 465-2-660	Movable Bridge Machinery & Castings- Rehab, Remove & Dispose, Other Machinery Components	LS

TECHNICAL SPECIAL PROVISIONS – SUPPLEMENTAL ONE

FOR

SECTION T508 - ELECTRICAL CONSTRUCTION FOR MOVABLE BRIDGES

COUNTY PROJECT NUMBER: CN-1414-218

MATLACHA BASCULE BRIDGE EMERGENCY REPAIRS

BRIDGE NO. 124134

This Technical Special Provision has been digitally signed and sealed by Marco Lara, PE 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.

Engineer of Record: Marco Lara, PE
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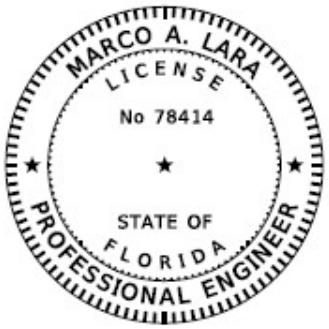
Pages: 1 through 41



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Section T508
Electrical Construction for Movable Bridges

T508-1 BASIC REQUIREMENTS

T508-1.1 Description of Work

Furnishing all labor and materials required to complete, make ready for operation, and make operational the installation of all items of work to provide a complete power, lighting, and control system for the bridge and control tower in accordance with this Technical Special Provision and the accompanying Contract Documents. Items of work include but are not limited to the following:

1. Perform testing and verify that the completed electrical system's installation and performance is satisfactory with respect to the requirements of this TSP.
2. Furnish and install all wire, cables, conduits, wiring devices, connections, terminations, motors, controllers, relays, control equipment traffic gates, safety switches, and all other apparatus and accessories required by the Contract Documents.
3. Furnish and install the connections to motors and to other equipment furnished and installed under other sections of the Contract Documents.
4. Furnish and install new electrical service conductors from the utility electrical service connection point to main disconnect switch located in the generator room via utility meter and main disconnect switches. Furnish and install service rated fused and non-fused disconnect switches.
5. Recondition and refurbish existing 3-phase, 4-wire motor control center and shown on the plans.
6. Recondition and refurbish existing hydraulic power unit control panel and replace all components including adjustable speed drives, starters, circuit breakers, relays, power blocks, terminal blocks, and all other apparatus and accessories required by the Contract Documents.
7. Furnish and install new traffic gates.
8. Furnish and install new pedestrian gates.
9. Repair existing barrier gate.
10. Furnish and install new surge suppression devices.
11. Furnish and install select PA communication devices.
12. Furnish and install navigational lighting system.
13. Furnish and install traffic signal assemblies and drawbridge ahead signs.
14. Furnish and install select general lighting and receptacle devices.
15. Furnish and install select CCTV camera and mounting hardware.
16. Furnish and install select complete roadway light pole assemblies and luminaire only poles and wiring.
17. Locate operating and control equipment to provide easy access and arrange entire electrical work with adequate access for operation and maintenance.
18. Provide shop drawings for electrical and control system conduit and conductors in accordance with Chapter 8 of the FDOT Structures Design Guidelines (SDG), latest edition. Wiring and conduit work includes: runs to traffic gates, pedestrian gates, traffic signals, local disconnect switches, navigation lights, intercom and PA system; CCTV camera system, system grounding scheme, Tender House amenities and equipment (including, but not limited to general lighting and receptacles), and any other component necessary for a complete electrical operating system.
19. Provide shop drawings for electrical and control system conduit and conductors in accordance with Chapter 8 of the FDOT Structures Design Guidelines, latest edition. Wiring and conduit work includes: runs to traffic gates, traffic signals, local disconnect switches, navigation lights, system grounding scheme, Tender House amenities and equipment and any other component necessary for a complete electrical operating system.

T508-1.1.1 Regulatory Requirements

Perform all work, and furnish and install all materials and equipment in accordance with the applicable sections of the latest edition, at time of Contract Plan signing, of the following:

1. National Electrical Code - NFPA 70 (NEC).
2. Electrical Safety in the Workplace - NFPA 70E.
3. National Electrical Safety Code - IEEE-C2 (NESC).
4. Life Safety Code (NFPA-101).
5. Underwriters Laboratories (UL) - all applicable UL standards where established for electrical materials, devices, and equipment
6. National Electrical Contractors Association (NECA-1).
7. Electrical Standard for Industrial Machinery - NFPA 79 (ESIM).
8. Standard for the Installation off Lightning Protection Systems - NFPA-780.
9. AASHTO LRFD Movable Highway Bridge Design Specifications (second edition 2007 and all interim revisions), published by the American Association of State Highway and Transportation Officials, Inc.
10. American National Standards Institute (ANSI).
11. National Electrical Manufacturers Association (NEMA) - NEMA- MG1, plus all NEMA standards where established for electrical devices, and equipment.
12. Institute of Electrical and Electronics Engineer (IEEE) - Ground Testing Standard 81.
13. Insulated Cable Engineers Association (ICEA).
14. International Electrical Testing Association (NETA) - ATS.

T508-1.1.2 Protection of Electrical Equipment

Protect electrical equipment from water damage, rain, condensation, and water dripping or splashing on equipment and wiring, at all times during shipment, storage and construction (prior to final acceptance). Provide temporary electrical connections to equipment heaters, or provide temporary heaters, as required to prevent damage from moisture.

Provide climate-controlled environment for the storage of control equipment/assemblies during construction.

Thoroughly dry out and put through special dielectric tests any equipment subjected to possible injury by water or dampness (including the interiors of motor control equipment or any other electrical devices).

Protect equipment from damage from mishandling, dropping, or impact. Do not install damaged equipment.

Provide spare parts in sealed, uniform-sized cartons, with typed and clearly varnished labels to indicate their contents and stored in a portioned lockable box. Also, provide a directory of permanent type describing the parts including the name of each part, the manufacturers' number, and the rating of the device for which the part is a spare. Mark the spare parts to correspond with their respective item numbers as indicated on the elementary wiring diagram.

Ensure spare parts are available at time of Functional Checkout. Replace spare parts used during Functional Checkout.

T508-1.1.3 Coordination of Electrical Work

The contract documents are diagrammatic in showing certain physical relationships within the electrical work, and must interface with other work including utilities and mechanical work.

T508-1.1.4 Materials and Equipment to Install

Use only new materials that conform to the standards of the UL in every case where such a standard has been established for the particular type of materials and its intended application.

Furnish and install all new conduit, wiring, disconnect switches, smoke detectors, panelboards, controls and relays, wiring devices, transformers, boxes, terminal blocks, electrical identification, motor controls, and supporting devices for a complete electrical installation on the bridge. Ensure that the materials are UL listed for the application.

Ensure all electrical equipment used outside of the conditioned spaces of the Tender House is suitable for use in a marine (salt atmosphere) environment.

T508-1.1.5 Electrical Journeymen

Ensure the individual filling this position meets the minimum requirements for 105-8.8.5.1. Electrical Journeyman of the FDOT Specifications.

Perform all electrical 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.

T508-1.1.6 Control Systems Engineer

Ensure the individual filling this position meets the minimum requirements for 105-8.8.5.2. Control Systems Engineer of the FDOT Specifications.

The Project's Control Systems Engineer serves as sole representative for the detail design, development, coordination, and testing of the leaf drives, interface to the existing electrical control system, including the Motor Control Center (MCC), the control console, and interfacing with the existing leaf drive system.

The Control System Engineer's responsibilities include directing all field-testing the new and existing equipment including the motor control center (MCC), the main distribution panel, motor controllers, the control panel, the control desk, motor drive program, and witnessing the shop testing of the mechanical operating equipment including the traffic gates.

The Control System Engineer is responsible for the review of shop drawings, prior to submission, to ensure that all components of the bridge operating system submitted for use are compatible in every respect and that all components meet or exceed the specific requirements and intent of the project.

Ensure the Control Systems Engineer is on site, directing all testing and commissioning of the existing and new bridge operating equipment and systems including the span locks, traffic barriers, sidewalk gates, and traffic gates in conjunction with the manufacturers' on-site field engineer representatives for the mechanical equipment.

The Control Systems Engineer must be a registered Professional Engineer licensed in Florida, through examination taken in the electrical engineering discipline.

T508-1.2 Quality Control

Ensure the Quality Control Plan includes all work under this Technical Special Provision. See FDOT Specification 105 for additional information.

T508-1.2.1 Test Procedures

Procedures for shop testing and functional acceptance testing as required under T465-5 Movable Bridge Functional Checkout.

T508-1.2.2 Tools and Procedures

Manufacturer Requirements: Install, apply, or adjust all electrical equipment and materials in accordance with the manufacturers' 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 manufacturers' approved equivalent to, the tooling utilized in the approval testing.

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

2. Where possible, the requirement to provide a level of workmanship quality is transferred to the tooling rather than the skills of the worker. For example:

3. Conductor Stripping: Depend upon the use of approved non-nicking strippers rather

than the operator's skill with knife edged stripping tools to prevent wire nicking.

4. Crimp Tightness: Proper crimping will depend upon the exclusive use of controlled cycle crimping tools that require the proper degree of compression before releasing the work rather than upon the operator's judgment in squeezing the tool handle.

5. Tie Tightness: Determine proper tensioning of cable and wrap ties by the use of the manufacturers' specified calibrated tensioning tool rather than the operator's judgment of what is "tight enough."

6. Fastener Torque: Tighten fasteners with a recommended torque, where the proper tightness is important to the performance of the function (which includes all electrical terminals), with a calibrated torque (limiting) screwdriver or other torque-indicating tool.

T508-1.2.3 Tool Verification

Whenever any other Article of this Section requires material submittals, when tooling is associated therewith, submit the manufacturers' tooling requirements and procedures, including catalog and calibration information, on the tooling that is proposed.

Document all tooling used as to the method of use and the calibration requirements and procedures. Provide calibrations that are 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 are available on the site for reference at any time.

T508-1.2.4 Tool Application

The journeyman electrician intending to operate a 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.

T508-1.2.5 Test Equipment

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 used and include manufacturers' specification data indicating the suitability of the instrument's specifications.

Use only test instruments calibrated and certified by an independent certification laboratory, to the required accuracy, in accordance with the instrument manufacturers' requirements within a maximum interval of the preceding 12 months. Certify all calibrations as traceable to the National Institute of Standards and Technology (NIST) or other recognized standardization authority.

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

T508-1.2.6 Test Result Reporting

Include the forms to be used for recording and submitting the data, where test or inspection data submittal is required by this TSP, in the Quality Control Plan.

For all electrical testing, record the weather conditions including temperature, rain/fair, and relative humidity, on the form twice daily or more frequently at appropriate intervals as determined by the changing meteorological conditions. Record wind velocity and direction for leaf related tests where the wind loading is a factor in the performance or results.

Record test instrument identification, including traceable serial number, for each measurement group. Include a copy of the Certificate of Calibration for the particular instrument in the submittal.

Have the Control Systems Engineer review and approve all test data submittals prior to

T508-1.2.7 Test Performance

Perform all tests in accordance to the latest edition of the International Electrical Testing

Association (NETA) Acceptance Testing Specifications.

T508-2 WORKING PLANS AND SHOP DRAWINGS

T508-2.1 Description

Provide Shop Drawings in accordance with FDOT Specification 5. Including but not limited to the following:

T508-2.1.1 Data Sheets

Label data sheets for individual components such as motors, limit switches, etc. with the identification numbers shown in the Contract Documents.

T508-2.1.2 Spare Parts

List of all manufacturers' recommended spare parts.

T508-2.1.3 Conduit Layout Drawings

Conduit layout drawings for conduit and wiring, including details of all conduit penetrations through structural elements, and each type of conduit and fitting. Include details of reinforcement in the penetration area on conduit penetration shop drawings. Show all conduit runs between all pieces of equipment in the drawings.

Outline and support point dimensions, voltage, main bus ampacity, integrated short-circuit ampere rating, circuit breaker arrangement and sizes. Provide manufacturers installation instructions, which indicate application conditions and limitations of use, stipulated by the product-testing agency. Include instructions for storage, handling, protection, examination, preparation, installation and starting of all products. Record actual locations of all products and indicate actual branch circuit arrangement.

T508-2.1.4 Existing Power Service

Power service detailing routing with dimensions, pull box locations, expansion joint fitting type and locations, and conduit support assembly details. Show electric meter detail and location.

T508-2.1.5 Electrical Shop Drawings

Prepare detailed electrical and hydraulic control system designs as required to fabricate and furnish the drive control equipment, define the installation and interconnection of the electrical equipment including all required interconnections with equipment furnished under other sections of the TSPs for Movable Bridge Construction.

T508-2.1.6 Fused Disconnect Switches

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.

T508-2.1.7 Disconnect Switches

Voltage and ampere ratings, construction material, NEMA classification, and dimensioned outline drawing for each type switch.

T508-2.1.8 Electrical Equipment

Catalog data sheets for conduit and fittings, wire, wiring devices, outlet boxes, fasteners, terminal blocks, mounting hardware, junction and pull boxes, grounding, and safety switches.

T508-2.1.9 Terminal Blocks

For each type and rating of terminal blocks, include voltage and ampere ratings, materials, and dimensioned outline drawings.

T508-2.1.10 Conductors

For each type of conductor to be used.

T508-2.1.11 Grounding

For each type of ground rod, clamp, well, and associated hardware.

T508-2.1.12 Boxes

For all Junction and pull boxes.

T508-2.1.14 Identification

For each type of identification device to be used for each electrical component. Provide an

engraving schedule for all laminated nameplates.

T508-2.1.15 Supporting Devices

For each type of strut, clamp, insert, and associated hardware; dimensional data for struts; and pullout data for anchors.

T508-2.1.16 Motors

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.

T508-2.1.17 Motor Control Center

Coordination evaluation report for over current protective devices, conductors, and transformers to be replaced. Ensure the report shows coordinated device trip settings for all the devices.

One-line and three line diagrams.

Schematic diagrams for each cubicle (including field wiring with wire numbers).

Wiring and Interconnection Diagrams for both starter cubicles and terminal only cubicles to be replaced.

Include field wiring in the schematic diagrams. Wire numbers for field wiring to match existing. Ensure that field terminals on wiring diagrams also indicate these numbers. It is preferred that the existing wire numbers be used for internal wiring as well. However, if different numbers are used, mark terminals for field wiring as "panel wire number/field wire number."

Elevation and dimensioned outline drawings detailing arrangement of sections, cubicles, wireway and conduit entry.

Equipment schedule (Bill of Materials) detailing all components (with manufacturer's part no.) for each controller (cubicle).

1. Surge suppressor details.
2. Phase-loss indicating instrumentation.
3. Engraving schedule for nameplates.

Descriptive data for all components circuit breakers (CBs), starters, overload (OL) relays, hand-off-automatic (HOA) switches, lights, indicators.

Furnish instruction manuals describing theory of operation, maintenance information and schematics of motor starter units.

Rubber Mats.

T508-2.1.18 Integrated Bridge Control System

All components (terminal blocks, relays, timers, fuses, circuit breakers, sensors, etc.). Provide instructions for adjusting and resetting time delay relays and timers.

Dimensioned fabrication details for Hydraulic Power Unit Control Panel back panel including, to scale, equipment layouts, punch-outs, nameplate schedules, and bill of materials. Label all components, for which identification numbers are provided in the Contract Documents, with that number.

Bill of materials. Provide some means of cross-referencing the item identification numbers to the materials list; either by schedule or labeling the applicable catalog data sheets.

Engraving schedule for nameplates.

Schematic diagrams including field wiring. Use existing wire numbers for each wire and

include in the schematic and wiring diagrams.

Procedures for shop test and functional acceptance testing.

Perform the detailed design of the control system using information in the Contract Documents.

T508-2.1.20 Traffic Gate Assemblies

Refer to TSP 465-4 Traffic Gate Assemblies.

Maintain these construction shop drawings as working drawings for the duration of construction. Required working drawings include conduit routing plans, schematic diagrams, interconnection wiring diagrams, and conduit and cable schedules. Make working drawings available to the Engineer, on request, for review of construction issues.

Maintain a full set of working drawings on the jobsite at all times.

The working drawings must be available at the time of the Functional Checkout, and Start-up and Commissioning as defined in TSP T465. Unavailability of the working drawings is sufficient reason to cancel the Functional Checkout, and Start-up and Commissioning.

T508-2.1.21 As – Built Drawings and Operation Manual

Provide As-Built Drawings and Operations and Maintenance Manuals in accordance with Technical Special Provision T465-5.1.

T508-3 MATERIALS AND EQUIPMENT

Furnish only new materials that conform to the standards of the UL, in every case where such a standard is 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, submit a complete list of all such materials and equipment including manufacturers' catalog numbers, catalog data sheets, illustrations, and shop drawings to the Engineer for approval.

T508-3.1 Wire and Cable

T508-3.1.1 Description

Work under this Article includes but is not limited to the following: wire and cable, wiring connectors, and connections. Wire and cable routing shown is approximate unless dimensioned. Route wire and cable to meet project conditions. Determine exact routing and lengths required unless shown on the Plans.

T508-3.1.1.1 Quality Control

The Quality Control Plan includes, but is not be limited to, the following:

Test Reports: including procedures used and values obtained.

Manufacturer's installation instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

T508-3.1.1.2 Regulatory Requirements

Conform to requirements of NFPA 70.

Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

Determine required separation between cable and other work.

Determine cable routing to avoid interference with other work.

T508-3.1.1.3 Definitions

The following definitions only apply to this Technical Special Provisions.

Power Conductor: Any wire that feeds power to a field device (i.e. gate motors, span lock motors, traffic signals, etc.).

Control Wire: Any wire that goes to a pilot device (i.e. limit switches, pressure switches, etc.).

Field Wire: Any wire that leaves the tender house. Consider the machinery platform to be outside the tender house.

T508-3.1.2 Materials

Stranded copper wire and cable. Note: Do not use aluminum conductors.

Single conductor insulated wire. Provide XHHW-2 rated 600 V_{AC} unless otherwise noted. Provide SE, or RHW-2 insulated wire for incoming services unless otherwise noted.

Use seven or nineteen strand copper, minimum 98% conductivity conductors for field wiring. Furnish connector accessories for copper in sufficient quantities for a complete installation. Do not use aluminum or solid copper conductors. In cases of low level audio or digital signals, use twisted shielded pairs when required.

Use no wire smaller than No. 12 AWG for power and lighting circuits and no smaller than No. 14 AWG for control wiring between cabinets, except that control wiring within a manufactured cabinet may be smaller. Use of wires smaller than No. 18 AWG requires approval. If approved, use multi-conductor ribbon cables between components within a cabinet. Install per the requirements of UL 508.

Minimum field wire size is No. 12 AWG for control conductors between cabinets and field devices and No. 10 AWG for motor loads. Use pigtails, no longer than 12 inch, for connection of field devices that cannot accommodate a No. 12 AWG wire. Use No. 10 AWG for 20 A, 120 V_{AC}, branch circuit home runs longer than 75 feet, and for 20 A, 277 V_{AC}, branch circuit home runs longer than 200 feet. Maximum wire size allowed is 500 kcmil, use parallel runs as needed for larger loads.

T508-3.1.3 Construction Requirements

Installation includes placement, splicing, terminating, identifying, testing, and verifying each circuit and conductor. Do not splice wires (except for "pigtail" leads and lighting circuits), use insulated terminal blocks rated for 600 V_{AC} in enclosures.

Do not mix power and control conductors in the same conduit.

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

Cover any uninsulated conductors and connectors with heat shrink insulation rated for 600 V_{AC}. 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.

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

Use only water based, wax free, UL listed wire pulling lubricant for pulling wire and cables. Do not exceed the pulling tensions recommended by the manufacturer; pulling may be witnessed by the Engineer. Cap all conduit ends with threaded PVC or nylon bushings. Take precautions to avoid "sawing" through PVC conduit or the end cap bushings. Use only braided pull ropes. Do not pull bare conductors through PVC conduits. Swab conduit with a lubricant approved by the Engineer prior to pulling the conductors.

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

Perform the insulation resistance testing for motor windings and conductor insulation as required by the NETA ATS (International Electrical Testing Association-Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems - latest edition), including dielectric absorption testing. Any measured resistance values less than 100 M ohms are not acceptable. The Engineer will witness the test. Record the test results and submit 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 recording future readings.

T508-3.2 Grounding

T508-3.2.1 Description

Ground the electrical power and control system in accordance with NEC Article 250 requirements. Furnish and install replacement service point ground rods, and grounding conductors as shown in the Plans.

T508-3.2.2 Materials

Use only insulated soft drawn annealed copper grounding conductors unless otherwise noted in the plans.

Use 1-inch diameter, 10 foot, copper clad steel ground rods.

Provide ground well 10 inches in diameter, 24 inches long, PVC, with a belled hub and a galvanized steel cover.

Use tin plated, high-pressure compression, one-hole lug connections for grounding equipment. Use only exothermically welded connections to ground rods.

T508-3.2.3 Construction Requirements

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

Size grounding conductors in any conduit in accordance with NEC Table 250.122, or the same AWG as the largest current carrying conductor in the conduit, whichever is larger.

Provide two ground rods and wells at the service entrance main disconnect switch in accordance with the NEC. Locate ground wells within 10 feet of the main disconnect switch mounting support. If the resistance between the two ground rods exceeds 25 ohms, add extensions and drive rods deeper if required.

Provide, as a minimum, a No. 2/0 AWG service entrance grounding conductor from the case ground to the well. Install the ground well so that the top of the well is 1/2 inch above the finished grade and drive the rod to just below the top. Fill well with gravel.

Bond the electrical system to the lightning protection system ground at the lightning grounding electrode (rod) closest to the motor control center in the bridge pier and the ground buss in the motor control center.

T508-3.3 Supporting Devices

T508-3.3.1 Description

Provide hangers and supporting devices as required by AASHTO, the NEC, and this TSP.

T508-3.3.2 Materials

Provide brass or stainless steel mounting bolts, nuts, washers, and other hardware used for fastening boxes, disconnect switches, devices, lighting outlet boxes, conduit clamps, and similar devices. Use hexagonal bolt heads and nuts. Do not use bolts smaller than 3/8 inch in diameter except as may be necessary to fit the mounting holes in small devices, outlet boxes, and similar standard equipment.

Provide PVC coated steel support struts and clamps to support PVC coated conduits.

Furnish products listed and classified by UL as suitable for purpose specified and shown. Provide adequate corrosion resistance and ensure that the material selected for the hardware is compatible with the material of the device supported.

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. Provide stainless steel framework for supporting boxes, switches, and other externally mounted electrical devices fabricated from stainless steel not less than 3/8 inch thick. If material of thickness less than 3/8 inch is used, obtain approval of the Engineer.

For U-Channel strut systems utilizing bolted construction, provide stainless steel, 12 gage and 1-1/2 inch width minimum components from the same manufacturer.

T508-3.3.3 Construction Requirements

Do not use powder-actuated anchors, drill or weld structural steel members; or fasten supports to piping, ductwork, mechanical equipment, or conduit. In addition, do not allow piping, or other

trades to fasten to electrical conduits and supports.

A. Use hexagonal bolt heads and nuts with spring lock washers under all nuts.
B. Provide conduit supports at no more than 5 foot spacing between supports and no more than 12 inches from box or fixture.
C. Fasten hanger rods, conduit clamps, and outlet and junction boxes to structure using proper fasteners. 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.
D. Use stainless steel straps or hangers held at not less than two points for attachment to steel or concrete. Provide insulation protection between conduit and straps to protect against dissimilar metal corrosion.
E. Provide type 316 stainless steel concrete inserts with concrete work.
F. Install surface-mounted cabinets and panelboards with minimum of four anchors. Fasten device boxes to the mounting surface with not less than two anchors sized per manufacturer's recommendations.
G. Fasten hanger rods, conduit clamps, and outlet and junction boxes to structure using proper fasteners.
H. Ensure that cut offs are cut square, ground smooth and de-burred. Where PVC coated steel has damage to the coating, coat the exposed steel with the manufacturers' touch up coating, to the same thickness as the original, prior to installation.
I. Use stainless steel cast in place inserts for overhead supports.

T508-3.4 Conduit and Raceways

T508-3.4.1 Description

Furnish and install conduit and raceways in the quantities and sizes required to complete the work as shown in the Plans. If the Plans do not show conduit size, determine the size as required by the NEC, minimum conduit size allowed is 3/4 inch. Furnish products listed and classified by UL for purpose specified and shown. Do not use non-metallic flexible conduit, aluminum conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT). Recombine conduit and circuits indicated in the Plans, diagrams, and schedules where appropriate and as approved.

T508-3.4.2 Materials

T508-3.4.2.1 PVC Coated and Metal Conduit

Hot dipped galvanized, inside and out, rigid steel conduit (ANSI C80.1) with hot galvanized threads and external PVC coating 40 mils thick; meeting the requirements of NEMA RN 1 and fittings and conduit bodies meeting the requirements of ANSI/NEMA FB 1 with steel fittings with internal and external PVC coatings to match conduit. Provide 40 mils thick PVC coating on the outside of conduit couplings and a series of raised longitudinal ribs to protect the coating from tool damage during installation.

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 as described in NEMA Standard RN-1, section 3.8.

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. 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.

Furnish right angle beam clamps and U-bolts specially formed and sized to fit the

outside diameter of the PVC coated conduit. Supply all U-bolts with plastic encapsulated nuts that cover the exposed portions of the threads.

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 certified in the installation and use of PVC coated conduit and fittings by the manufacturer.

Ensure that the same manufacturer supplies all PVC coated conduit, fittings, and accessories.

T508-3.4.2.2 Liquid-Tight Flexible Metal Conduit

UL 360 listed, interlocked galvanized steel construction, with integral ground continuity and PVC jacket. Use only PVC coated fittings, meeting the requirements of ANSI/NEMA FB 1.

Use liquidtight flexible galvanized steel metal conduit only for the connection of motors, limit switches, and other devices that must be periodically adjusted in position. Make connections between the rigid galvanized steel conduit system and all motors, and movable limit switches with flexible conduit with couplings and threaded terminal fittings. Use only fully interlocked flexible conduit. Do not use flexible metal conduit extensions longer than 3 feet in length and provide with bonding jumpers.

Install conduit in accordance with NECA "Standard of Installation."

Provide separate conduits for control (up to 120 V_{AC}) conductors and power conductors.

T508-3.4.2.3 Non-Metallic Conduit

UL listed Schedule 80 PVC conduit meeting the requirements of NEMA TC 2 and Fittings and Conduit Bodies meeting the requirements of NEMA TC 3.

T508-3.4.2.4 HDPE Conduit

UL listed for electrical use Schedule 80 conduit meeting the requirements of NEMA TC 7. Use only UL listed fittings.

T508-3.4.3 Construction Requirements

A. Use 1 inch minimum size Schedule 80 PVC or Reinforced Thermosetting Resin conduit for underground installations when installation is more than 5 feet from bascule pier wall. Use 1- inch minimum size Schedule 80 PVC conduit for underground installations when installation is within 5 feet from bascule pier wall.
B. Use 1 inch minimum size Schedule 80 PVC in slab above grade (embedded).
C. Use 1 inch minimum rigid galvanized steel (PVC coated) for outdoor locations, above grade, exposed (leaf) and exposed in dry locations (in pier, control house).
D. Use 3/4 inch minimum size Schedule 80 PVC for wet and damp locations (fender).
E. Use 3/4 inch minimum size rigid galvanized steel (PVC coated) for lighting and receptacle circuits in bascule piers.
F. Use HDPE conduit for submarine cable installation only.

G. Install conduit in accordance with NECA Standard Practice and in accordance with manufacturers' instructions.
H. Do not use plastic straps or plastic hangers. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary support.
I. Run exposed raceway straight and parallel or at right angles to the general structure lines.
J. Change conduit elevation when changing direction to avoid blocking the path of other conduits.
K. Support all conduits on strut fabricated from type 316 stainless steel.
L. Use only 316 stainless steel conduit mounting hardware. To prevent dissimilar metal corrosion, provide isolation bushings or washers where stainless steel touches other metals.
M. Group related conduits; support using conduit rack. Construct rack using stainless steel channel; provide space on each for 25% additional conduits.
N. 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 drain properly and provide drainage tees at low points where required.
O. At any point where a conduit crosses an expansion joint, or where movement between adjacent sections of conduit is expected, install bronze or alloy expansion fittings. 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- inch crossing and 12-inch paralleling clearance between conduit and from surfaces with temperatures exceeding 40°C.
P. Install flexible metal conduits as to drain away from the device they serve.
Q. Provide both ends of each conduit run with a brass tag having a number stamped thereon in accordance with the conduit diagrams. Use bare copper wire to fasten these tags securely and permanently to the conduit ends.
R. Wherever possible, run conduits in the control room and bascule piers exposed and not concealed in the walls, ceiling, or floor. Where conduits pass through the floors or walls of the control room, provide Schedule 80 PVC conduit sleeves allowing free passage of the conduits. After installing couplings, caulk openings with an approved UL listed fire stop material for airtight fits. Provide escutcheon plates on the interior walls, ceilings, and floors.
S. Connect conduit sections to each other with approved couplings; do not use aluminum couplings. 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 being capped or well plugged overnight and when the work is temporarily suspended. Set conduits mounted exteriorly on parts of the steel work not less than 1-1/2 inch clear from the supporting structure to prevent accumulation of dirt. Space parallel horizontal conduit 1 inch apart and securely clamp to the steel work to prevent rattling and wear.
T. Cut conduit square using saw or pipe cutter; de-burr cut ends. Clean and swab conduit after threading. Bring conduit to shoulder of fittings; fasten securely. Do not use long running threads. Tighten conduits until the cuff of the PVC coated fitting or coupling conceals all threads.
U. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum. Provide embedded conduit stub-outs with threaded 316 stainless steel couplings.
V. Install no more than the 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 will be long sweep, with a radius 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 conduit lengths will permit.

W. Use suitable caps to protect installed conduit against entrance of dirt and moisture. Upon completion of the conduit installation, 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 draw in the conductors. Provide suitable pull string in each empty conduit.

T508-3.5 Boxes

T508-3.5.1 Description

Provide pull boxes and junction boxes as shown in the Contract Plans, at locations where more than eight conductors are gathered, and as required by the NEC.

T508-3.5.2 Materials

Provide NEMA 4X type 316 stainless steel boxes in all exposed areas and machinery room. NEMA 12 in the enclosed areas of the Tender House.

Ensure 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 stainless steel. Provide drip proof enclosure opening with a rolled edge and cover held closed with clamps.

Provide drain holes in the boxes with protective drain fittings. Provide drain fittings with neoprene tube. Ensure drain seals provide continuous draining and thereby prevent water accumulation. Drain seals range in size from 1/2 inch to 4 inches inclusive. Provide drain seals with one opening for draining and one for filling, a rubber tube to form drain passage.

Provide enclosures larger than 12 inches in any dimension with a continuous stainless steel hinged cover with a glued in neoprene gasket.

Provide sheet metal enclosures with “O”-ring sealing hub connectors, drain fittings, and not less than four mounting lugs.

Provide all enclosures with grounding terminals, and bond to ground.

Connect conduit to boxes using threaded hubs with grounding lugs, and where required, furnish isolation washers to protect against dissimilar metal corrosion. Bond hubs to ground.

T508-3.5.3 Construction Requirements

Install insulated bushings on conduit ends projecting into all boxes and enclosures. Do not drill box or enclosure for more conduits than actually enter it.

In locations exposed to weather use side or bottom conduit entries boxes only.

Use of wireways (metallic or non-metallic) and/or sheet metal troughs with hinged or removable covers is not acceptable.

Size boxes per NEC requirements for the size and number of conduits. Additionally, size boxes to include provisions for terminal block wiring clearance. Do not use boxes smaller than 8 by 8 by 4 inches.

Provide all boxes with mounting lugs and securely fasten to the structure with not less than four stainless steel fasteners. Bond all enclosure covers and doors to ground.

T508-3.6 Terminal Blocks

T508-3.6.1 Description

Provide terminal blocks for internal circuits; circuits crossing shipping splits; where it will facilitate equipment parts replacement and maintenance; 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.

T508-3.6.2 Materials

Furnish and install terminal blocks rated at 600 V. Furnish channel mounted, screw cage,

box clamp type, terminal blocks for No. 8 AWG and smaller conductors, with vibration proof nonferrous screw. Provide terminal blocks in groups of 12 with interlocking “finger safe” type barriers with white marking strips.

Furnish power distribution terminal blocks for No. 6 AWG and larger conductors, three-pole, suitable for copper conductors, UL rated for amperage equal to the largest conductor it accommodates and made out of copper.

Provide all current carrying components with corrosion resistant plating on nonferrous hardware. Do not use aluminum components if installed outside of the conditioned spaces of the Tender House.

Provide terminal blocks with wire protectors that physically isolate the conductor from the terminal screw.

Do not use terminal blocks that require special tools.

T508-3.6.3 Construction Requirements

Group terminal blocks for easy accessibility unrestricted by interference from structural members and instruments.

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

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

Permanently label each terminal block, device, fuse block, and both ends of each conductor to coincide with the identification indicated on the schematic and wiring diagrams. Ensure that terminal blocks and devices already numbered on the plans have the same numbers on the equipment supplied.

T508-3.7 Electrical Identification

T508-3.7.1 Description

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

T508-3.7.2 Materials

T508-3.7.2.1 Nameplates

Provide legend nameplates for all major pieces of equipment named on the plans, and for all control devices.

Provide legend nameplates for devices that show the device designation and name used on the schematic wiring diagram. Provide fuse legend nameplates that show the type, ampere, and voltage rating of the fuses.

Provide typewritten directories, with covers and directory pockets, for all panelboards. Provide identification for each branch circuit in a panelboard.

Provide nameplates of minimum letter height as scheduled below:

Panelboards, Switchboards, and Motor Control Centers: 1/4 inch, identify equipment designation. 1/8 inch, identify voltage rating and source.

Individual Circuit Breakers, Switches, and Motor Starters in Panelboards, Switchboards, and Motor Control Centers: 1/8 inch, identify circuit and load served, including location.

Individual Circuit Breakers, Enclosed Switches, and Motor Starters: 1/8 inch, identify load served. Transformers: 1/4 inch, identify equipment designation. 1/8 inch, identify primary and secondary voltages, primary source, and secondary load and location.

Switches, control relays, timers and other control devices: 1/8 inch, identify load and source and tag identification number.

Control Panel switches, pushbuttons, indicating lights, meters: 1/8 inch, identify function (Raise, Lower, Pull, Drive, etc.). Provide these nameplates in addition to the lettering provided on the switch, button or lightface.

T508-3.7.2.2 Conduit Markers

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

Provide snap-on type plastic markers. Indicate voltage ratings of conductors where above 240 V. 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 spacing of not more than 50 feet along each run of exposed conduit. Do not mark switch-leg conduit and short branches (less than 24 inches) for power connections, except where conduit is larger than 1 inch.

Provide both ends of each marked conduit run with a brass tag having a number stamped thereon in accordance with the conduit diagrams. Fasten these tags to the conduit ends securely and permanently with bare copper or stainless steel wire.

T508-3.7.2.3 Conductor Identification

Furnish UL listed, typed heat shrink tubing type wire and cable markers installed per the manufacturer's recommendations.

Use numbers as indicated in the Contract Plans, or the approved shop drawings if numbers are not shown in the Contract Plans.

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

T508-3.7.2.4 Underground Warning Tape

Provide 4 inches wide plastic tape, colored yellow with suitable warning legend describing buried electrical lines in every conduit trench. Install the tape 12 inches above the conduit in the trench.

T508-3.7.3 Construction Requirements

Degrease and clean surfaces to receive nameplates and tape labels. Install nameplates and tape labels parallel to equipment lines. Secure nameplates to equipment fronts using stainless steel screws and epoxy.

Secure nameplates to inside of recessed panelboard doors in finished locations. Use embossed tape only for identification of individual wall switches and receptacles

Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. 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 manufacturers' shop drawings for control wiring for equipment to be replaced. Place existing wire number label adjacent to the manufacturers' number where equipment already has manufacturers' wire number.

T508-3.8 Dry-Type Transformers

T508-3.8.1 Description

Furnish and install dry type ventilated transformers in existing motor control center and as indicated in the Contract Plans.

T508-3.8.1.1 Delivery, Storage, and Handling

Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow.

T508-3.8.2 Materials

Ventilated dry type transformers designed according to the latest revision of ANSI/NEMA ST-20 and for continuous operation at rated kVA, 24 hours a day, 365 days a year, with normal life expectancy. Ensure required performance is obtained without exceeding 150°C average temperature rise by resistance or 180°C hot spot temperature rise in a 40°C maximum ambient and 30°C average ambient. Maximum coil hot spot temperature not to exceed 220°C Provide transformers with proven 220°C UL tested insulation system. Use copper wound coils. Ensure that materials in the

transformer are flame retardant and do not support combustion as defined in ASTM D635. Final insulation treatment will be total immersion in a 220°C insulating varnish that maintains superior bond strength, high dielectric strength, and power factors at temperatures normally associated with 220°C system. After immersion, cure the varnish thoroughly at normal operating temperatures to assure the scourging of all volatiles in the varnish solvent.

Provide transformers constructed with core materials of high quality and low loss characteristics to minimize exciting currents, no-load loss, and interlaminar vibrations. Incorporate built-in vibration dampening systems in the design to minimize and isolate sound transmission. Mechanically brace the core-coil assembly to withstand short circuit tests as defined in NEMA TR-27. Coil construction and mechanical bracing members must prevent mechanical degradation of the insulation structure during the short circuit. Provide self-bracing transformer enclosure with drip-proof and rodent-proof protection. Include convenient knockouts for conduit entrance. Locate terminal compartment in bottom of transformer, below the core-coil assembly, for side or bottom conduit entrance. Temperature rise in terminal compartment must not exceed 5°C above ambient.

Provide transformers with 2 2-1/2% full capacity taps above rated voltage and 2 2-1/2% full capacity taps below rated voltage. Minimum basic impulse level (BIL) allowed is 10 kV. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap. Provide transformers 75 kVA and less suitable for wall, floor, or trapeze mounting; transformers larger than 75 kVA suitable for floor or trapeze mounting. Ensure coils are continuous windings with terminations brazed or welded. Include factory nameplate with transformer connection data and overload capacity based on rated allowable temperature rise.

Conduct the following tests at the factory: Applied voltage test (one minute) 4 kV; induced voltage test - two times normal for 7,200 cycles; and ratio and phase relation. Test reports on electrically duplicated units certify that the first rating of any design passed the following tests: no load losses, induced voltage, total losses, sound level, applied voltage, impulse test, and temperature rise. Submit copies of test results to the Engineer for approval.

T508-3.8.3 Construction Requirements

Transformer to be installed in existing Motor Control Center.

T508-3.9 Wiring Devices

T508-3.9.1 Description

Provide wiring devices as required.

T508-3.9.2 Materials

Toggle Switches: Provide heavy-duty use, totally enclosed type with bodies and handles of thermosetting plastic, supported on a metal mounting strap. Provide switches with screw type wiring terminals, side-wired. Do not use back-wired, clamp-type terminals. Provide snap type switches with toggle handle, rated quiet type, AC only, 20 A, 120/277 V, single pole.

Receptacles: Provide heavy-duty use, duplex grounding type rated 20 A and 125 V. Provide thermosetting plastic composition bodies, supported on a metal mounting strap. Provide side wired receptacles with binding-type terminals. Back-wired, clamp-type terminals are not allowable. Ensure that the grounded pole connects to the mounting strap.

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

T508-3.9.3 Construction Requirements

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.

Furnish and install three-way switches as indicated in the Contract Documents.

Install surface mounted devices in weatherproof boxes. Inside the control house and other environmentally controlled rooms, provide 1/16 inch thick satin finished Type 302 stainless steel cover plates.

Use GFCI type receptacles in all outside locations, rest room, and sink area.

For exterior locations, provide weather proof, corrosion resistant, plates with spring loaded snap covers. Consider the machinery floor area as an outside location.

T508-4 MOTORS

T508-4.1 Description

Furnish and install motors as indicated in the Contract Documents.

T508-4.2 Materials

Furnish motors designed for continuous operation in 40°C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

Provide stamped, stainless steel nameplate indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturers' name and model and serial number, design class and service factor.

Provide conduit connection boxes, threaded for conduit. For fractional horsepower motors, where connecting directly, provide conduit connection in end frame.

Provide bolted compression lugs connections.

Provide double-ended shafts on all motors requiring motor brakes.

Provide motor heaters and install in accordance with the manufacturer's recommendations.

Furnish and install gearmotors with integral speed reducers as required. Refer to the Technical Special Provisions Section T468 for speed reducer requirements.

T508-4.2.1 Three Phase Motors

A. Start-Ups: 12 per hour. Two per ten-minute period.

B. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque:

1. NEMA Design B Characteristics for pumps and span drive motors.
2. NEMA Design D for mechanical locks, auxiliary drive, and gate operators.

C. Insulation System: NEMA Class F or better.

D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B and D Motors.

E. Test in accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data. Perform additional testing to determine speed/torque curve relationship.

F. Motor Frames: NEMA Standard T-frames of steel or cast iron (no aluminum frames allowed) with end brackets of cast iron with steel inserts. Furnish totally enclosed fan cooled construction for motors 10 hp and larger.

G. Thermistor System (Motor Sizes 25 hp and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid-state control relay for wiring into motor starter.

H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for lubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centerline at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

I. Sound Power Levels: To NEMA MG 1.

J. Nominal Efficiency: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.

K. Nominal Power Factor: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.

L. Service Factor: 1.0 for mechanical drives and 1.15 for hydraulic pump motors. Reference

horsepower ratings from a 1.0 service factor.

T508-4.2.2 Storage

Provide temporary power connection to internal motor heaters, or provide external heater, to maintain constantly elevated internal temperature to assure prevention of condensation or moisture accumulation. Manually rotate the rotor every thirty days to prevent flattening of bearings. If the storage arrangement permits, rotate the entire housing 90 degrees every sixty days. The storage period continues after installation of the motors until they start actual repetitive service that will produce heat from operation.

T508-4.3 Construction Requirements

Install motors per manufacturers' instructions. Utilize millwright for field installations, base modifications, and shaft alignment with the machinery and the brakes.

Provide motor mounting bases as required for accommodating motors. Properly align motor shaft with speed reducer shaft before connecting motor coupling. Properly align brake drums with brakes. Align if required.

Coordinate motor shaft diameter and length with requirements for machine, service brakes, and tachometer. Verify alignment of motor shafts with machinery and brakes prior to installation of shaft couplings; correct as required to provide proper alignment within coupling misalignment tolerances.

T508-4.3.1 Quality Control

Perform a no-load spin test and megger tests on main drive motors to verify compliance with the manufacturers' specifications prior to make-up of machinery couplings.

T508-5 MOTOR CONTROL CENTER

T508-5.1 Description

Furnish and install select components within the existing Motor Control Center (MCC) as shown in the Contract Documents and including adequate capacities for bus ampacity, three phase circuit breakers and contactors. Refurbish and recondition existing MCC. Clean and remove debris and surface from exterior/interior sections.

Where indicated or required, furnish and install motor controls having the electrical characteristics, ratings, and modifications to match the existing equipment or as shown on the Plans.

T508-5.1.1 Manufacturer

Furnish Motor Control Center components from in-kind manufacturing company. Do not use a value added reseller as a source.

T508-5.2 Materials

T508-5.2.1 MCC Sections

Provide a storage pocket on the inside of the cabinet door for the schematics. Furnish instruction manuals, including the theory of operation, maintenance information, and plastic laminated schematics on all units within the MCC.

Replace engraved nameplates for each cubicle (including blank nameplates for unused spaces, and blank nameplates for spare cubicles). Submit nameplate-engraving schedule for approval. Fasten nameplates using stainless steel screws.

T508-5.2.2 Circuit Breakers

Provide 3-pole, heavy duty, 600 V_{AC}, quick-make, quick-break molded case circuit breakers and MCPs. Provide a molded case type main breaker with an adjustable electronic trip unit. Furnish a 3-pole lighting panel circuit breaker as shown in the Plans. Provide an operating handle that always remains connected to the MCP or circuit breaker. Do not mount the operating handle on the door of the enclosure, but to the side of the door for safe "stand-aside" operation. Position of the operating handle will indicate ON, OFF, or TRIPPED condition. Provide interlock to prevent unauthorized opening or closing of the cubicle door with the circuit breaker in the ON position as well as turning the circuit

breaker ON with the door open.

T508-5.2.3 Magnetic Across the Line Starters

Furnish 120 V_{AC} magnetic starter coils. Equip all magnetic starter coils with a combination R/C-MOV surge suppressor across the coil circuit to prevent inductive switching transients from damaging any connected circuitry.

Furnish motor starters of the Combination Motor Starters type (across-the-line non-reversing or reversing combination starters for motors up to 100 hp, 600 V_{AC}). Combine motor starters with disconnecting means, as indicated in the Contract Documents, in common enclosure. Provide a Motor Circuit Protector (MCP), or MCP with Current Limiter, as disconnecting means. Build and test motor starters in accordance with the latest NEMA standards. Equip combination motor starters with three NEMA Class 20 overload relays. Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Provide quick-make, quick-break, and load interrupter enclosed knife switch with externally operable handle.

Furnish AC magnetic controllers designed for full voltage or across the line starting of induction motors rated in horsepower. Furnish starters with provision for field installation of up to 3 N.O. and 4 N.C., 10 A., auxiliary contacts in addition to the hold-in interlock. Supply a minimum of two Normally Open and two Normally Closed contacts with each magnetic motor starter. Provide additional contacts if required. Provide starters with encapsulated coils and enclosure as required to meet conditions of installation. Overload relays should be block-type with a push-to-test feature. Provide an isolated, field-mountable alarm contact.

Provide 3-pole, 480 V_{AC}, full voltage, NEMA type, magnetic combination type starters. Provide motor starters that are a combination circuit breaker and NEMA controller with overload relay protection. Connect to the bus with stab-type contacts, including ground, and a screw-type locking mechanism to hold the chassis firmly in place. Provide quantities as shown in the Plans. Where specified, provide control voltage transformers with fused secondary. Provide OL TRIPPED status and through-the-door overload RESET button.

Furnish Non-Reversing Starters (Across-the-line magnetic starters for motors up to 100 hp, 600 V_{AC}) built and tested in accordance with the latest NEMA standards. Equip non-reversing starters with three NEMA Class 20 overload relays. Provide a HAND-OFF-AUTO switch and pilot lights for OFF, RUN, and OL TRIPPED status. For FVR units provide a HAND-OFF-AUTO switch, a FORWARD-OFF-REVERSE switch and pilot lights for FORWARD, OFF, REVERSE, and OL TRIPPED status.

Provide reversing Starters (Reversing magnetic starters for motors up to 100 hp) built and tested in accordance with the latest NEMA standards. Equip reversing starters with three NEMA Class 20 overload relays.

T508-5.3 Construction Requirements

Install MCC components, where indicated, in accordance with applicable NEC standards, Manufacturers' written instructions and recognized industry practices, to comply with requirements and serve intended purposes. Install fuses, if any, in MCC units. Tighten bus connections and mechanical fasteners. Adjust operating mechanisms for free mechanical movement. Touch-up scratched or marred surfaces to match original finish.

Clean and recondition existing MCC. Prior to energizing the MCC, Megger check phase-to-phase and phase-to-ground insulation for proper resistance levels. Prior to energizing the circuitry, check MCC electrical circuits for continuity and for short-circuits. Subsequent to wire and cable hook-ups, energize MCC and demonstrate functioning in accordance with requirements.

T508-6 SPAN MOTOR AND VECTOR CONTROLLED ADJUSTABLE SPEED DRIVE

T508-6.1 Description

Furnish and install in kind replacement of existing motor and drive system as described in this article. Furnish and install a in kind replacement of span drive system consisting of span drive motors, electronic drive units, panels, relays, and other components integral to the drive system. Existing hydraulic power unit control panel cabinet to remain. Furnish systems engineered, assembled, and furnished by a single manufacturer. Procure the engineered drive system from the manufacturer of the electronic drive unit or a recognized manufacturer of factory engineered drive systems. Ensure the engineered drive system supplier is not a value added reseller nor the control system contractor or supplier.

T508-6.2 Materials

T508-6.2.1 Span Drive Motor

A. Provide TEFC, NEMA Design B motors, stainless steel shaft, with auxiliary blower (if required).

B. Provide a closed keyway on the machinery end of the shaft. Coordinate motor coupling and installation details with the machinery manufacturer. Provide approved shop drawings to the machinery manufacturer for their use in the machinery assembly drawings.

C. Provide motors rated for inverter duty and suitable for use in a sensor-less vector controlled variable speed drive application.

D. Start-Ups: 12 per hour, 2 per ten-minute period.

E. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B Characteristics.

F. Insulation System: NEMA Class F or better.

G. Testing Procedure: In accordance with IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data. Perform additional testing to determine speed/torque curve relationship.

H. Motor Frames: NEMA Standard T-frames of steel or cast iron (no aluminum frames allowed) with end brackets of cast iron with steel inserts.

I. Thermistor System (Motor Sizes 25 hp and larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid-state control relay for wiring into motor starter.

J. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centerline at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

K. Sound Power Levels: To NEMA MG 1.

L. Nominal Efficiency: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with IEEE 112.

M. Ship motors to a facility for dynamometer testing with the variable speed drives.

T508-6.2.2 Adjustable Speed Drivers (ASD)

A. This is a functional specification, ensure that the manufacturer sizes the motors and drives to provide the torque and speed requirements to match the existing.

B. Design the ASD system to provide reversing, continuous speed adjustment with acceleration and deceleration control, of three-phase motors without exceeding the specified maximum motor and machinery torque. Provide an ASD system capable of supplying power to the motor(s) for the required motor torques. Provide a control capable of providing selectable current limit settings. Provide a drive that is able to withstand output terminal line-to-line short circuits without component failure, be insensitive to input line rotation, and be capable of power ride-thru of 15 mS at full load.

C. Furnish the drive with internal over temperature protection.

D. 115 VAC input control logic board option. Provide inputs that include, enable, run, reverse, and full speed. Provide a drive that responds to inputs with preset direction and speed to accelerate and decelerate the bridge leaf to follow a trapezoidal speed curve as shown in the Plans.

E. Contact outputs: Four form "c" min. (functionally programmable). Provide outputs that include overload alarm, drive fault, and brake release.

F. Provide dynamic braking function (with power resistors) capable of 100% braking of full load motor torque for 3 minutes.

G. Provide drives capable of converting incoming three-phase, 460 VAC (-10% of min. +10% of max.) and 60 Hz (plus or minus 2 Hz) power to a variable potential DC bus level. Invert the DC voltage to pulse width modulated waveform with an adjusted 0 to 420 Hz frequency output.

H. Ensure displacement power factor ranges between 1.0 and 0.95, lagging over the entire speed range.

I. Provide an ASD capable of operating, without derating, in an ambient temperature of 0 to 40°C, an altitude of up to 3,300 feet above sea level, and humidity of 5% to 95%, non-condensing.

J. Provide ASDs in NEMA 12 enclosures with complete front accessibility with easily removable assemblies.

K. Include the following items in the ASD's enclosures:

- Feeder disconnect. Input AC circuit breaker or fused switch with an interlocked, pad lockable handle mechanism accessible without opening the drive door and capable of breaking under load.
- Isolated process follow input and output.
- Motor mechanical brake contactor.
- Brake chopper module for control of Dynamic Braking Resistors. Mount resistors externally.
- Electronic over current trip for instantaneous and inverse time overload protection.
- Human interface module with START-STOP pushbuttons, power ON indicating light, and speed control potentiometer, door mounted.
  - Human interface module with alphanumeric display of run, stop, forward, reverse, fault, over frequency, instantaneous over current, DC over voltage, AC under voltage/loss of phase, emergency stop, overload, Over temperature, inverter pole trip, and stand-by modes, door mounted.
  - Run, fault, and control power indicators, door mounted. Local/Remote operation indicating lights, door mounted.
  - Electrical isolation between the power and logic circuits, as well as between the 120 V_{AC} control power.
  - Line transient voltage protection.

L. Provide the following independent adjustments on the ASD:

- Output frequency range: 0 to 400 Hz.
- Programmable current limits from 20%-160% of rated current. Acceleration time: 0-3600 sec. with two independently programmable timers.

- Deceleration time: 0-3600 sec. with two independently programmable timers.
- Start boost control.
- Volts per Hertz - programmable for start boost, run boost, slope, and custom operation.
- Slip compensation speed regulation to 0.5%.
- Provide ASD run, fault, and control power indications visible with the controller door closed. Provide an ASD reset button as part of the human interface module. Provide remotely resettable faults from a "clear fault" input line of the ASD.
- Enclosure Construction: Furnish two ground lugs, one for incoming line power and one for outgoing motor ground connections. Provide enclosures no less than 16-gage steel and finished in standard manufacturers' finish.

T508-6.3 Construction Requirements

The Leaf drive electrical and hydraulic elements shall function as a single, integrated machine and function and perform the same as the existing drive system. The drive controls shall sequence the operation of the Variable Speed drive, the flow control valves, and pressure control valves in response to input signals from the integrated bridge control panel and the leaf position transmitter and limit switches. Acceleration, deceleration, and correction of the pump motor speed shall utilize an S curve function in the Variable Speed drive programming. The manufacturer must certify that all other units are reasonably similar.

Test the ASD and supply test results to substantiate designs according to applicable ANSI and NEMA Standards. The tests must verify not only the performance of the unit and integrated assembly, but also the suitability of the enclosure venting and rigidity.

T508-6.3.1 Shop Testing of Adjustable Speed Drives

Perform shop testing on the adjustable speed drives to insure compliance with the performance requirements of this Article before acceptance of Adjustable Speed Drive-Motor combinations. The Engineer may witness the testing based on approved shop drawings and test procedures. Testing procedures will be as follows:

Apply load equal to the torque specified for TCV (Maximum Constant Velocity Torque per AASHTO 5.4.2, formerly Condition A) to motor shaft. Run motor at 100% speed for 3 minutes (driving). Motor-drive combination should be capable of driving the load without excessive heating.

Apply overhauling load equal to TCV (formerly Condition A) torque to motor shaft. Run motor at 100% speed for 3 minutes (dynamic braking). Motor-drive combination should be capable of dynamically braking the load without excessive heating. Demonstrate that motor drive can produce TS (Maximum Starting Torque per AASHTO 5.4.2, formerly Condition C) torque at no less than or equal to 50% speed for one minute. Demonstrate that motor drive can dynamic brake TS (formerly Condition C) torque at no less than or equal to 50% speed for one minute without excessive heating. Demonstrate that motor drive cannot produce or exceed the Never-Exceed torque value at zero, defined as 0-20 RPM maximum, or any other speed.

T508-6.3.2 Installation

Install motors per manufacturers' instructions.

Install motor mounting bases as required to accommodate motors. Properly align motor shaft with driven shaft before connecting motor coupling. Align if required. Megger motors before final connection. Record these readings and submit with "As-Built" drawings.

Adjusting: Make final adjustments to installed drive to assure proper operation of fan system if so equipped. Obtain performance requirements from installer of driven loads.

Cleaning: Touch up scratched or marred surfaces to match original finish.

Demonstration: Demonstrate operation of controllers in automatic and manual modes.

T508-7 INTEGRATED BRIDGE CONTROL SYSTEM

T508-7.1 Description

Furnish and install replacement components for the existing Hydraulic Power Unit Control Panel (HPUCP). Perform the detailed design of the hydraulic control system using information in the Contract Documents and FDOT Design Aids with adjustments as required for the equipment provided. Refer to as-built plans for additional information.

T508-7.2 Materials

T508-7.2.1 Cabinet

The hydraulic power unit control panel cabinet to remain. Clean and recondition existing HPUCP enclosure to like new condition. Clean and remove dirt, debris and surface corrosion from interior and exterior. Furnish and install replacement HPUCP backpanel with components including drives, circuit breakers, terminal blocks, fuses, distribution blocks, relays, starters, thermostat, wireways, enclosure lights, din rails, surge suppressors and all components to match existing and as shown on the Plans.

Provide vents (louvers with filters) and interior fans to keep temperatures to reasonable operating limits within the cabinets. Provide a temperature switch to alarm when temperatures inside exceed 40°C. Fasten a fluorescent fixture with 20-watt (min.) lamp to the inside of panel HPUCP. Install an appropriate switch as indicated in the Plans. Install a duplex receptacle on the same circuit and mount inside the cabinet. Connect both light and receptacle to a common one-pole circuit breaker. Install ground lug in all panels for bonding of enclosures.

T508-7.2.2 Wiring

Provide interconnection wiring between all electrical devices mounted in the panels and enclosures. If the devices are to be connected to external equipment use terminal blocks. Install all interior wiring neatly and carefully, and terminate on UL approved terminal blocks as per manufacturers' instructions.

Individually bundle wiring to each control switch and install with a "drop loop" of sufficient length to allow its removal for maintenance without disconnecting the wiring. Use plastic wireways (open slot type) for routing all internal wiring in the control desk. Install internal wiring in factory prewired electronic system cabinets in compliance with the requirements of T508-3.1., except that SIS insulation is allowed for wiring within a cabinet. Segregate all low voltage signal wiring, such as data, audio, and video lines, from AC lines. Do not splice low voltage signal and data lines.

T508-7.2.3 Terminal Blocks

For internal circuits crossing shipping splits, and to facilitate equipment parts replacement and maintenance, provide terminal blocks for conductors requiring connection to circuits external to the specified equipment. Furnish rail mounted, tubular screw clamp type terminal blocks. Group terminal blocks for easy accessibility unrestricted by interference from structural members and instruments. Provide sufficient space (2-inch minimum) on each side of each terminal block to allow an orderly arrangement of all leads terminating on the block. Do not terminate more than two wires on any one terminal position.

Permanently label each terminal block, device, fuse block, terminal, and both ends of each conductor to coincide with the identification indicated on the manufacturers' wiring diagrams. Number terminal blocks and devices on the equipment supplied using the same numbers shown in the Contract Documents. Identify mounted electronic components by marking with contrasting colored ink beside the component. Permanently identify individual conductors using a sleeve not less than 1/2 inch long. Mark each sleeve so that the identifications are permanent and waterproof. Adhesive type labels are not acceptable.

T508-7.2.6 Pushbuttons and Operator Interface

Indicating Lights: 120 V, bright LED type, 30.5 mm, corrosion resistant, heavy duty, oil-tight, NEMA 13. Lens color as indicated in the Plans and approved shop drawings.

Pushbuttons: Single button operator, contacts as required, 30.5 mm, corrosion resistant, heavy duty, oil-tight.

Selector Switch: Number of positions as required, maintained, lever operator knob, one N.O. and one N.C. contact in each position, 30.5 mm, corrosion resistant, heavy duty, oil-tight. Contacts as indicated in the Contract Plans and approved shop drawings.

Emergency Stop Button: Single button mushroom operator, 30.5 mm, corrosion resistant, heavy duty, oil tight. Maintained contacts, 3 contacts (min), closed when button pulled out, open when button pushed in, 1 contact (min), open when button pulled out, closed when button pushed in. Red, 67 mm, jumbo mushroom button.

T508-7.2.10 Contact Blocks

Provide contact blocks rated at 10 A, NEMA Class A600. Use clear, oil-tight, blocks to allow visual inspection.

T508-7.2.11 Legend Plates

Square or rectangular, manufactured out of laminated plastic or any similar non-metal corrosion resistant material. Provide white plates with black lettering.

T508-7.2.12 Relays

Control Relays and Plug-In Relays.

1. Contacts: NEMA ICS 1, Form C. 2 or 4 pole.
2. Contact Ratings: NEMA ICS 1; Class C300, 7 amps.
3. Coil Voltage: 120 V_{AC}, 60 Hz.
4. Provide indicating lamp or LED across coil.
5. Provide push-to-test button.
6. Clear dust cover and spade terminals.
7. Socket mounted, provide track-mounted socket.
8. Furnish and install plug-in surge suppressor on each coil.

Industrial Control Relays: Contacts rated at 10 A, NEMA Class A600, with replaceable contact cartridges. Coil voltage as indicated in the Plans. Furnish and install surge suppressor on each coil.

Contactors: Lighting type contactors, open type, and electronically held. 20 A contacts min., (field convertible) other rating as show in Contract Plans. Coil voltage as shown in Contract Plans.

T508-7.2.13 Time Delay Relays

NEMA Class B600 solid-state time-delay relay with adjustable time delays as indicated in the Contract Plans with contacts rated 5 A minimum, 600 V_{AC}. Coil voltage as indicated on the Contract Plans. Furnish and install surge suppressor on each coil.

T508-7.2.14 Control Power Transformers

NEMA ST 1 rated machine tool transformer with isolated secondary winding with power rating as required for application. Voltage Rating: Line volts primary; 480/120 V_{AC} secondary, or secondary voltages as shown in the Plans or required by specific device.

T508-7.2.15 Control Circuit Breakers

Provide control circuit breakers with current rating as shown in the Contract Plans to isolate the individual control circuits and to provide selective overcurrent and short-circuit protection. Provide thermal-magnetic type circuit breakers for control circuits, rated 300 VAC, 10 kA interrupting, UL listed for control circuit application.

T508-7.2.16 Control Fuses

Provide control fuses with current rating as shown in the Contract Plans to isolate the individual control circuits and to provide selective overcurrent and short-circuit protection. Provide indicating type fuses for control circuits, ceramic or fiberglass body, midget type, rated 250 V_{AC}, 10 kA interrupting, UL listed for control circuit application. Automotive type, glass body fuses are not acceptable. Provide terminal block style, with isolating feature, fuse blocks to house the control fuses. Provide rail mounted fuse block, rated 600 V_{AC}, 30 A maximum for midget type fuses. Provide a hinge type cover for isolating and automatic fuse extraction from circuit when lifting the cover.

T508-7.3 Construction Requirements

T508-7.3.1 Field Inspection and Testing

Ensure that the equipment to be replaced (including existing HPUCP, MCC, ASD, and navigation light interfaces) are functionally tested together with existing electrical equipment and systems to be replaced to assure completeness and correct operation of the entire bridge control system. It is the responsibility of the Control Systems Engineer to coordinate the field inspection and testing of existing and new equipment. The Engineer may witness the testing as a complete control system.

Prepare and submit a complete set of test procedures and schedules for approval. Give the County sufficient notice of 30 days prior to testing in order to make arrangements. The procedure includes a systematic description of all semi-automatic actions and the expected control response, output, or sequence of outputs.

Include exercising the entire control system, simulating failures including loss of utility power, equipment failures, and Emergency Stops in the procedures. Ensure the actual testing demonstrates conformance to the requirements and intent of the Contract Documents.

T508-8 COMMUNICATIONS EQUIPMENT

T508-8.1 Description

Furnish and install replacement communications equipment in locations as shown on the Plans. Interface PA and Common audio party signal lines to the existing copper conductor submarine conduit wiring system.

T508-8.2 Materials

Equipment will be NEMA Class 4 wall mounted unit incorporating an intercom and public address systems served by a common handset, as specified below. Supply equipment to match existing equipment. Lay out the communications system with the capability of providing several different communications functions. Depressing a pushbutton switch will allow the operator to select the desired communication system function. Functions include one-way page (PA system) and Intercom communications. Provide a common interface for switching the handset (and speaker) between communications zones, matching impedance to selected zone.

Furnish one distributed P.A. amplifier per speaker and mount in close proximity to the speaker.

Furnish an amplifier that delivers 10 watts RMS minimum to each speaker. Two speakers for roadway and two speakers for marine channel (separately controlled) are required. Ensure maximum distortion does not exceed 5% for 1st and 3rd harmonics. Use industrial type equipment. Provide speakers immune to salt spray and capable of 120 degrees dispersion at 12 watts. Frequency response at 3 dB to be 450 to 8000 Hz, plus or minus 5 dB. Minimum of four speakers are required.

Furnish replacement intercom system devices that consists of page/party stations located at the locations shown on the Plans. Furnish interior or exterior type units as required and provide with 25 feet coiled cords. Equip units with page speakers. Page and private voice communication (party line communication) between Intercom Station locations indicated in the Plans. Provide transmit/receive page line communication with duplex party line communication between two or more intercom stations. One master station; speaker/microphone stations (each station on a separate zone) duplex party line as required, with two-way page line.

T508-8.3 Construction Requirements

Provide manufacturer recommended cables and wiring, consult with the PA/IC manufacturer, and provide a system that is void of feedback, hum, distortion, and noise. Adjust the PA/IC system for maximum performance as determined.

T508-9 SURGE SUPPRESSION SYSTEM

T508-9.1 Description Materials

Provide surge suppression equipment for all equipment to be replaced and as described in this article and shown in the Plans. Transient voltage surge suppression as outlined herein applies to all of the electrical power, control, signaling, utility, and communications systems and circuits that are part of this contract.

Transient surge suppression is required on electronic apparatus and other transient sensitive apparatus residing outside the confines of the protected tender house. Inter-communications amplifiers, solid-state or reed-relay position sensors, and solid-state rectifiers and flashers are examples of these types of devices. Conventional electro-mechanical devices such as motors, mechanical limit switches, or lighting devices do not require additional surge protection if all circuits connecting to such devices are protected where they enter the tender house.

Reference UL Standard for Safety for Surge Protective Devices, UL 1449, Third Edition.

T508-9.1.1 General

Provide Surge Protective Devices (SPD) UL listed and labeled for the location in which they are installed.

T508-9.1.2 Suppressors for Electrical Services

Install Transient Voltage Surge Suppressors i.e. Lightning Arrester, on each normal and emergency service entering and leaving the tender house. Bridge house service-entrance points are typically remote from the power source; consider these as delta configuration for transient protection purposes. Furnish suppressors that provide clamping phase to phase and from each phase conductor to ground. Provide a multi-stage hybrid shunt-series-shunt design, rated for Type 1, service suppressor. Provide visible indication of suppressor failure. Arrange shunt TVSS elements to fail open.

Provide suppressors that meet the following criteria: Single impulse withstand rating of 25,000 A (8 by 20 μS waveform) per phase; Pulse lifetime rating (10,000 A - 8 by 20 μS plus power-follow) of 1000 occurrences; Maximum clamping voltage (voltage with input current of 10,000 A - 8 by 20 μS) of approx. 400% normal voltage and energy rating of 10,000 joules.

T508-9.1.3 Suppressors for Feeders and General Purpose Branch Power Circuits

Install transient Voltage Surge Suppressors rated for Type 2, on each power feeder, general purpose branch circuit, and non-motor load circuit (including lighting and signaling circuits) entering or leaving the tender house. Provide multi-stage hybrid shunt-series-shunt design power circuit suppressors inserted in series with all conductors of a circuit (including neutral) and clamping between all conductors and from each conductor to ground.

Rate suppressors for dedicated loads for a minimum of 125% of their continuous load. Rate suppressors for utility circuits based on the circuit overload protection. Provide visible indication of suppressor failure. Arrange shunt TVSS elements to fail open.

Provide power circuit suppressors that meet or exceed the following minimum criteria: Single impulse withstand rating of 10,000 A (8 by 20 μS waveform) plus power-follow per wire; Pulse lifetime rating (3,000 A - 8 by 20 μS plus power-follow) of 1,000 occurrences. Worst-case response time of 5 ηS; Maximum clamping voltage (voltage with input current of 3,000 A - 8 by 20 μS plus power-follow) of approx. 400% normal voltage and minimum energy handling capability of 1,500 joules.

T508-9.1.4 Suppressors for Motor Branch Circuits

Install Transient Voltage Surge Suppressors on each motor branch circuit entering or leaving the tender house's protected perimeter. Install motor circuit suppressors in the motor starter cubicle that are parallel shunt design clamping each conductor to ground, rated Type 2. Install motor circuit suppressors meeting these specifications on the power input of any field-mounted motor determined, to require supplemental protection. Provide visible indication of suppressor failure. Arrange shunt TVSS elements to fail open.

Provide motor circuit suppressors that meet or exceed the following minimum criteria: Single impulse withstand rating of 25,000 A (8 by 20 μS waveform) plus power-follow per wire; Pulse lifetime rating (3,000 A - 8 by 20 μS plus power-follow) of 1,000 occurrences. Worst-case response time of 5 ηS; Maximum clamping voltage (voltage with input current of 3,000 A - 8 by 20 μS plus power-follow) of approx. 400% normal voltage and Minimum energy handling capability of 1,500 joules.

T508-9.1.5 Suppressors for Control and Signal Circuit Protection

Install Transient Voltage Surge Suppressors for control and signal circuits on each control or signal circuit entering or leaving the tender house. Install control circuit suppressors in a cabinet. Provide multi-stage hybrid shunt-series-shunt design, rated Type 3, clamping each conductor to ground. Provide suppressors for balanced (two-conductor) circuits that clamp conductor to conductor when required by the nature of the circuit. Provide suppression devices for control circuit protection in single or multi-circuit plug-in modules with DIN rail mounted bases. Provide suppression modules with visual "health" indication.

Minimum performance criteria (each circuit) is as follows: Maximum single impulse conductor-to-ground current withstand of 10,000 A (8 by 20 μS waveform) plus power-follow; Pulse lifetime rating (8 by 20 μS @ 3,000 A plus power-follow) of 1,000 occurrences. Worst-case response time: 5 μS; Maximum clamping voltage (3,000 A @ 8 by 20 μS) of 200% of normal operating voltage amplitude and polarized or bipolar as appropriate for each circuit type and Minimum energy handling capability - 500 joules per conductor. Initial clamping voltage of 150% of normal operating voltage peak amplitude 5%.

T508 9.2 Construction Requirements

T508-9.2.1 Segregation of Wiring

Classify all system wiring into protected and non-protected categories. Wiring on the exposed side of suppression devices is unprotected. Surge suppressor grounding and bonding conductors also fall into this category. All wiring between surge suppressors and protected equipment is protected. Provide a minimum of 3-inch of separation between parallel runs of protected and unprotected wiring in control panels, terminal cabinets, terminal boards, and other locations. Never bundle together, or rout through the same wireway, protected and unprotected wiring.

Where bundles of protected and unprotected wiring cross, make such crossing at right angles with a minimum of 1-inch of separation or a ferrous shield between the conductors. Do not install any unprotected wiring within the protected perimeter of the tender house or any other system protected as a cluster.

Install individual suppressors as close as possible to the equipment to be protected, consistent with available space. Where space permits and no code restrictions apply, install suppressors

within the same cabinet as the protected equipment. Suppressors installed in this manner may utilize the equipment chassis as a medium for bonding of their ground terminals. Install bonding jumpers not exceeding 2-inches between the chassis and suppressor ground terminals. Use bolted connections with star washers to insure electrical and mechanical integrity of connections to the equipment chassis. Install suppressors in a neat, competent manner. Ensure lead dress is consistent with recommended industry practices. Keep bonding between ground terminals for power and control or signal line suppressors serving a particular item or cluster of equipment as short as possible. Where practical, install suppressors in a common location for the cluster with the ground terminals bonded closely together

T508-10 CCTV SYSTEM

T508-10.1 Description

Remove existing CCTV system and furnish and install in-kind CCTV cameras, conduit, wiring, junction boxes, and associated components and mounting brackets.

T508-10.2 Materials

A. Network cameras shall produce high resolutions up to 704x480 at 30 fps (NSTC). Network camera shall provide remote monitoring with pan, tilt and zoom through operator control over IP networks. Camera shall provide a minimum illumination and light sensitivity of at least 0.1 lux (B/W), 1 lux (color), F1.6; using builtin IR light in complete darkness up to 3 m (9.6ft). Cameras shall have a 26x optical and 12x digital zoom with auto focus.

B. Network cameras shall provide ¼ inch Interlaced CCD format.

C. Network cameras shall provide auto-iris control system for the automatic lens system.

D. The network cameras system shall include an auto-iris lens compatible with the camera to produce a high-quality flicker, smear and noise free picture. No video artifacts shall be accepted.

E. The network cameras shall operate in an outside enclosure at 11.5 to 14 VDC, 60 Hz.

F. Network cameras shall produce a picture of at least 480 TV lines of horizontal resolution.

G. The network cameras shall operate in a +41 to +104 degrees F environment.

H. The network cameras shall provide Transient Suppressor at the power input.

I. Camera enclosure shall be rated for Outdoor, Harsh Environment, Dust-Tight, and Waterproof applications. Enclosure shall be lightweight and constructed of vandal resistant cast aluminum top, with UV protected polycarbonate lower dome and meet NEMA 4X and IP66 standards. Enclosure shall include a sun shroud, heater/controller/defroster to eliminate fogging, obstructions, and visual artifacts. Enclosure shall be size and compatible with camera, lens, mounts, and accessories required. All external connections shall be through watertight fittings. Enclosure shall be serviceable and provide stainless steel fasteners.

J. Network cameras shall be mounted on an integrated support bracket and outdoor power box with built in 2.4 GHz wireless access point and Ethernet 10BaseT/100BaseTx, RJ-45 cables for video and terminal strip for power and ground(s). Power inputs shall be tolerate of noise.

K. Camera assemblies shall be supplied by a manufacturer regularly engaged in providing similar type and quality of equipment for at least the last five years.

L. Install all interior wiring neatly and carefully with proper connectors of video power connections per Manufacturer's instructions.

M. All external video cables shall be Belden 7504A or approved equal. Shielded twisted pair cables can be substituted so long as the frequency response and impedance is demonstrated to be equal to or better than Belden 7504A.

T508-10.3 Construction Requirements

A. Verify system voltage matches camera requirements.
B. Install in accordance with Manufacturer's instructions.
C. Attached the proper test instruments, video levels, and field of vision to ensure proper operation for day, night and inclement conditions. Do not rely on video monitors only to properly adjust levels.
D. Test all connections for tightness and for intermittent connections.
E. Furnish and install new camera assemblies into enclosures at the locations shown in the plans.
F. Make all electrical connections and adjustments to provide proper operation of the cameras as specified herein.
G. Replace any mounting hardware and fasteners that are deteriorated, damaged or corroded.

T508-11 NAVIGATION LIGHTS AND AIDS

T508-11.1 Description

Furnish and install a complete navigation lighting system per the Plans and including the following equipment: Fender lights, vertical clearance lights, clearance gauge floodlights, and backup power supply (12 VDC/120 VAC inverter).

T508-11.2 References

Code of Federal Regulations CFR 33 Navigation and Navigable Waters Part 118 Bridge Lighting and Other Signals, further clarified in U.S. Coast Guard (USCG) Publication "A Guide to Bridge Lighting".

T508-11.3 Materials

T508-11.3.1 General

Equip fender and clearance lights with shockproof LED lamps and surge suppressors. In the event of failure of one or more individual LEDs, remaining LEDs will continue to operate. Provide LEDs with a MTBF of 100,000 hours when installed in the fixture.

Provide UV Polycarbonate lamp lenses. Wattage consumption should not exceed 8 watts. Overall luminosity of the LED array should be not less than 78 candela for red, 270 candela for green. Provide lamps with integral surge suppression with a clamping voltage of not less than 380 VAC @ 2 A. Provide lamps that have been field tested and documented for not less than six months continuous service in extremely high vibration movable bridge applications.

Provide backup power to the navigation and clearance gauge lights by a gel cell battery and inverter system. Navigation lighting fixtures, lighting contactors and photoelectric cell will be remotely located.

T508-11.3.2 Lights

Fender Lights: Furnish and install unpainted housings of cast aluminum construction with a 1 inch threaded conduit opening at the bottom, equipped with a 180 degrees, standard marine fresnel type, rigid, red colored heat resistant glass lens, 7- to 8-inch diameter, I.D. Furnish all stainless steel closure bolts, lens tie rods, and attachment hardware. Use only marine type junction boxes. Seal joints, including lid, with weatherproof gaskets. Provide tamper resistant fastenings. Provide access cover that requires a special wrench to open.

Channel Lights: Furnish and install unpainted housings of cast aluminum with cushioned lenses, weatherproof gasketed joints and large service access door equipped with 180 degrees, standard marine molded single-piece Fresnel type, rigid, heat resistant glass, 7- to 8-inch diameter, I.D. with the Lower Section; Red, Upper Section; Green. Furnish all stainless steel closure bolts, lens tie rods, and attachment hardware. Ensure swivel assembly is cast bronze housing and bracket with stainless steel pivot, watertight "O" ring seal, bronze bearings, cable entrance fitting, and No. 35 stainless steel service chain rated for 225 pounds. Use a hanger stem 1-1/2- or 2-inch galvanized pipe as recommended by

Manufacturer with anti-swing brake and automatic lock.

Clearance Gauge Lights: Furnish and install one piece, die-cast aluminum, fixture housing fitted with watertight gasket, stainless steel hinges and fasteners, and adjustable aiming capability with 120 VAC, 35 watt, high-pressure sodium lamp. Use heavy cast aluminum junction box body, NEMA 4X, and cover with stainless steel swing bolts, water tight gasket and provisions for mounting to a platform with four 3/8-inch diameter lag bolts or screws.

T508-11.3.3 Construction Requirements

Install Navigation Lights and Aids as shown in the Plans.

Test operation of backup power supply by turning off branch circuit breaker.

T508-12 START UP, COMMISSIONING, AND FUNCTIONAL CHECKOUT

T508-12.1 Description

Start-up and Commissioning Work includes:

Additional specific testing is included in this TSP for the Integrated Bridge Control System, TSP T465, and TSP T468 for the Mechanical Systems. The work in this article includes testing of all new and existing bridge electrical equipment, bridge mechanical systems, and integrated bridge operations in addition to specific testing requirements listed in other sections.

T508-12.1.1 Electrical Testing and Installation Check Out

Provide circuit continuity test and megger test for conductor and motor insulation.

Ensure that all electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with the Contract Documents. Ensure the testing is complete and includes all materials, instruments, labor and supervision to perform such tests and inspections for the following:

1. Transformer/panelboard.
2. Grounding system.
3. Motor and motor starters.
4. Conductors.

T508-12.2 Quality Control

A. Functional Checkout: Submit a systematic procedure to demonstrate the bridge systems. Number the procedure and include Pass and Fail check blanks.

B. Testing at Electrical Installation: Provide test reports, bound and signed. Include the following:
   - Summary of test.
   - Description of equipment tested.
   - Description of test procedure.
   - List of test equipment and calibration date.
   - Test results.
   - Recommendations.
   - Appendix – including all field test reports.

C. Comply with Manufacturer's instructions and maintenance manuals for each particular apparatus.

D. Furnish and use safety devices such as rubber gloves and blankets, protective screens, barriers and danger signs to adequately protect and warn all personnel in the vicinity of the tests.

E. Use calibrated test equipment and certified traceable to the National Bureau of Standards. Ensure the data is no older than 12 months.

F. Perform the testing of the various components and completion of any corrective work prior to placing equipment into service. Perform all testing after the equipment has been set in its final location.

G. Utilize qualified personnel for the testing having a minimum of 2 years experience

performing the type of tests required.

H. Conduct tests in the presence of the Engineer, except when advised in writing by the Engineer that his presence will not be necessary.
I. Include all tests and inspections recommended by NETA Acceptance Testing Specifications.
J. Maintain a written record of all tests showing the date, personnel making the tests, equipment or material tested, tests performed, manufacturer, serial number of testing equipment, and results.
K. To prevent accidents, perform testing only during periods when traffic is off the bridge unless approved in advance in writing by the Engineer.

T508-13.3 Technical Requirements

Insulation Resistance Tests (Megger)

1. Test all conductors with a 1000 megohm DC megger, correctly calibrated, with 500V, 1000V, and 2500V settings.
2. Notify the Engineer immediately of any cable insulation defects as detected by the megger tests.
3. The minimum acceptable values of test results will be as indicated in these TSPs. In the event that these minimum values are not achieved, advise the Engineer, who will direct what subsequent action will be required.

Perform the testing in compliance with the latest edition of NETA ATS 1 International Electrical Testing Association - Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems, and as specified in the TSPs. The values of the insulation resistance measurements required by the NETA ATS 1 International Electrical Testing Association - Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems will be the minimum acceptable values for this project.

T508-13.3.1 Panelboards (including incoming section of Motor Control Center)

Megger test 240V_{AC}, and 120V_{AC} panelboards.

Check the internal components for the following:

1. Bus and cable connections to assure proper torque and tightness.
2. Mechanical and electrical check of disconnecting devices.
3. Electrical operation of all meters and relays.
4. Polarity of current and potential transformers.
5. Ratio of current and potential transformers.
6. Wiring and operation of all control switches.

Perform testing in compliance with the latest edition of NETA ATS 1 International Electrical Testing Association - Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems, and as specified in this TSP.

T508-13.3.2 Grounding Systems

Include measurement of ground resistance at the following equipment and structures.

1. All neutral grounds.
2. Other miscellaneous grounds selected at random in a manner to be representative of the entire installation.

Perform ground tests on system ground rods using the “3 PROBE - FALL OF POTENTIAL” method. All other ground tests may be measured to system ground by use of ground reference method.

Prior to testing, verify that the equipment installation is correct.

Resistance values of more than 25 ohms to ground are not acceptable unless approved by the Engineer.

Perform the testing in compliance with the latest edition of NETA ATS 1 International Electrical Testing Association - Acceptance Testing Specifications for Electric Power Distribution

Equipment and Systems, IEEE Standard No. 81, and as specified in this TSP.

T508-13.3.3 Cable

600V Insulation Cable:

1. Feeders for motors: Check insulation resistance of all $600V_{AC}$ rated motor feeders with a 1000V megger. Take readings with all motor wiring connected, with all disconnect switches of combination starters in the open position, and with all starter contactors mechanically held open. Take readings between phases and between each phase and ground. Mark for replacement, and replace, conductors reading less than the insulation resistance measurements required by the NETA ATS 1 International Electrical Testing Association - Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems.
2. Feeders: Check insulation resistance of all $600V_{AC}$ feeders with a 1000V megger. Take readings after pulling the wires but before connections are made to equipment. Take readings between phases and between each phase and ground. Mark for replacement, and replace, conductors reading less than the insulation resistance measurements required by the NETA ATS 1 International Electrical Testing Association - Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems.

T508-13.3.4 Control Cables

Test all control cables for continuity.

T508-13.3.5 Motor Starter and Motor

A. Inspect all motor control centers and starters for missing parts and any damage.
B. Check all bus and cable connections for tightness. Check all contacts for proper alignment and pressure. Verify that all movable parts are free to operate and that all bolts are tight.
C. Megger test all motor control centers and starters in accordance with the manufacturer's recommendations.
D. Mechanically and electrically, check all disconnecting devices.
E. Install fuses and overload devices. Prepare motor list showing the following:
F. Motor nameplate data, including horsepower, full load and locked rotor amperes.
G. RPM, voltage, service factor, and temperature rise.
H. Manufacturer's overload heater code number used for motor protection.
I. Fuse size and type.
J. Make a complete operational test of each motor control from each point to assure correctness of sequencing, interlocking, and other control functions of the equipment under test.
K. Check motors for proper lubrication.
L. Check motors for proper rotation after insulation tests and lubrication check but before coupling motor to the load.
M. Perform insulation resistance test from load side of motor starter on each complete motor circuit, both phase-to-phase and phase-to-ground. Perform insulation resistance testing of the motor windings. Testing shall be performed in compliance with the latest edition of NETA ATS 1 International Electrical Testing Association - Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems, and as specified in the TSPs. The values of the insulation resistance measurements required by the NETA ATS 1 International Electrical Testing Association - Acceptance Testing Specifications

for Electric Power Distribution Equipment and Systems will be the minimum acceptable values. Record results and submit to the Engineer.

T508-13.4 Movable Bridge Functional Checkout

Meet the requirements of TSP T465.

T508-14 METHOD OF MEASUREMENT

T508-14.1 **Movable Bridge Gate**

The quantity to be paid for removal, furnish and install the replacement of movable bridge traffic gate assemblies will be at the Contractor assembly price. The quantity to be paid for furnish and install the sidewalk gate assemblies will be at the Contractor assembly price. The quantity to be paid for furnish and install internal components of the barrier gate enclosure will be at the Contractor assembly price.

T508-14.2 **Movable Bridge Signal**

The quantity to be paid for removal, furnish and install the replacement of movable bridge traffic signal and sign assemblies will be at the Contractor assembly price.

T508-14.3 **Movable Bridge Electrical Equipment**

The quantity to be paid for the rehabilitation, removal, and replacement of movable bridge electrical equipment, including, replacement of the main service feeders, meter, disconnect switches, surge suppressors, grounding, conduit, wiring, conduit supports, mounting hardware, CCTV cameras, navigational lights, sump pump, communication systems, submarine cable supports, new lighting and receptacles throughout the control house building and bascule piers (machinery room, outside of control house), conduits, wiring, start-up and commissioning, will be at the Contractor lump sum price.

T508-14.4 **Movable Bridge - Rehab, Span Motors & Controllers**

The quantity to be paid for removal of movable bridge main span motors and auxiliary motor will be at the Contractor lump sum price.

T508-14.5 **Movable Bridge-Rehab, Control Panel - Motor Controller**

The quantity to be paid for removal or furnishing and installing of movable Motor Control Center (MCC) starters and components shall be the plan quantity completed and accepted.

T508-14.6 **Movable Bridge-Rehab, Integrated Drive System**

The quantity to be paid for furnish and install the replacement of the movable bridge drive control system assembly including drives, relays, starters, circuit breakers, pilot lights, terminal block and all components associated will be at the Contractor hydraulic power unit control panel assembly price.

T508-14.7 **Light Pole Complete - Special Design**

The quantity to be paid for removal, or furnishing and installing of roadway light poles and components shall be the plan quantity completed and accepted.

T508-14.8 **Luminaire**

The quantity to be paid for removal, or furnishing and installing of luminaires on existing roadway light poles and components shall be the plan quantity completed and accepted.

T508-14.9 **Lighting Conductors – No. 8-6**

The quantity to be paid for removal, or furnishing and installing of conductors to the roadway light poles and components shall be the plan quantity completed and accepted.

T508-14.10 **Lighting Conductors – No. 4-2**

The quantity to be paid for removal, or furnishing and installing of conductors to the roadway light poles and components shall be the plan quantity completed and accepted.

T508-15 BASIS OF PAYMENT

Price and payment will be full compensation for all work specified in this Technical Special Provision.

Item No. 508-2-1 Movable Bridge Gate, F&I ……..……...(AS)

Item No. 508-2-5 Movable Bridge Gate, Adjust/Modify/Rehab…….……...(AS)

Item No. 508-2-6 Movable Bridge Gate, Remove & Dispose …….…..……(AS)

Item No. 508-3-5 Movable Bridge Signal, F&I…… …….……(AS)

Item No. 508-4 Movable Bridge Electrical Equipment, Rehabilitation …….……(LS)

Item No. 508-76-1 Movable Bridge - Rehab, Span Motors & Controllers, F&I ….……. (LS)

Item No. 508-76-4 Movable Bridge - Rehab, Span Motors & Controllers, Remove……..... (LS)

Item No. 508-82-5 Movable Bridge-Rehab, Control Panel - Motor Controller, Replace ……..…...(EA)

Item No. 508-83-103 Movable Bridge-Rehab Integrated Drive System Replace – (41–60 KW)…. (AS)

Item No. 715-1-12 Lighting Conductors, Insulated, No. 8-6, F&I……..……..…… (LF)

Item No. 715-1-13 Lighting Conductors, Insulated, No. 4-2, F&I……..……..…… (LF)

Item No. 715-11-213 Luminaire – Replace Luminaire on existing Pole/Arm, Roadway (F&I) …. (EA)

Item No. 715-515-240 Light Pole Complete (F&I) Bridge Mounted (40'MH)….…… (EA)