465 MOVABLE BRIDGES.
(REV 8-2-02) (FA 9-3-02) (7-03)

SECTION 465 (Pages 620-623) is deleted and the following substituted:

SECTION 465
MOVABLE BRIDGES

465-1 Description.
Construct and rehabilitate movable bridges.

465-2 Qualification Requirements for Supervisory Personnel.
465-2.1 General: Submit qualifications of supervisory personnel to the Engineer at the pre-construction conference. Do not begin Movable Bridge Construction operations until the Engineer has approved the qualifications of supervisory personnel.

465-2.2 Proof of License or Certification: Submit a copy of their Professional Engineer license current and in force issued by the state in which they hold registration. Submit a copy of the license issued by the State of Florida for tradesmen that require license indicating that the license is in force and is current. Submit a copy of the certification issued by the Instrumentation, Systems and Automation Society of America for each Certified Control Systems Technician.

465-2.3 Experience Record: Submit the following information for supervisory personnel in order to substantiate their experience record. The supervisor (engineer, superintendent/manager or foreman) seeking approval must provide a notarized certification statement attesting to the completeness and accuracy of the information submitted. Provide the following experience information for each individual seeking approval as a supervisor:

Project owner's name and telephone number of an owner's representative, project identification number, state, city, county, highway number and feature intersected.

Provide a detailed description of the Bascule Bridge Construction experience, and the level of supervisory authority during that experience. Report the duration in weeks, as well as begin and end dates, for each experience period.

Provide the name, address and telephone number of an individual that can verify that the experience being reported is accurate. This individual should have been an immediate supervisor unless the supervisor cannot be contacted in which case another individual with direct knowledge of the experience is acceptable.

465-2.4 Qualification Requirements*:* Ensure the Electrical Journeyman holds, an active journeyman electrician's license and has at least five years experience in industrial electrical work and has successfully completed the installation of one similar drawbridge electrical system during the last three years, or is a Certified Control Systems Technician. A Certified Control Systems Technician will not be permitted to perform electrical power work including, but not limited to, conduit and wire-way installation or power conductor connection.

Ensure the Control Systems Engineer and Mechanical Systems Engineer are licensed registered Professional Engineers with knowledge of commonly used bridge leaf motion control techniques used in Florida and are familiar with bascule bridge mechanical equipment and arrangements to be used on this project. Also they must have been in responsible control of the design and implementation of at least three drawbridge electrical control/drive systems within the past 10 years of which, at least one of the three bridges was within the last three years. Ensure that at least one of the three bridge designs incorporated the same type of leaf motion control system specified for this project.

465-2.5 Failure to comply with Qualification Requirements: After the project is underway, the Contractor may fail to be in compliance with the provisions of this article due to normal employee turnover. Under this circumstance, the Contractor must make an immediate "Good Faith" effort to reestablish compliance. If a Good Faith effort is not put forth, as determined by the Engineer, payment for the Movable Bridge Construction operations that require supervisors to be qualified under this provision will be withheld up to 90 days. If the Contractor is not in compliance after 90 days, regardless of how much Good Faith effort is put forth, Movable Bridge Construction operations must cease entirely until compliance is reestablished.

465-3 Alternate Design for Bascule.

Refer to the plans for details of the bascule span. With the written approval of the Engineer, bolted construction may be used in lieu of welded construction.

Submit proposed alternate designs with complete plans, Technical Special Provisions, and design calculations. Ensure that the design is in accordance with the AASHTO LRFD Movable Highway Bridge Design Specifications, First Edition, 2000, hereafter referred to in this Section as the AASHTO Specifications and to the satisfaction of the Engineer For bolted alternates, comply with the following:

a. Use structural steel complying with ASTM A 709 [ASTM A 709M].

b. Design members for the loads, moments, and stresses shown on the Contract Documents.

c. Use the same general arrangement of members shown on the plans.

d. Use all members except girder flanges and girder stiffeners that are the same size as shown in the plans.

e. Design the girder flange for the allowable stresses for ASTM A 709 [ASTM A 709M] steel.

f. Use angle stiffeners in lieu of plates and of the thickness and width shown in the plans.

465-4 Materials.

465-4.1 General: Meet the following:

Structural Concrete	Section 400
Reinforcing Steel	Section 415
Structural Steel and Miscellaneous Metals	Section 460
Steel Grid Floors	Section 504
Electrical Equipment	Section 508
Control House	Section 512
Portland Cement Concrete	Section 346

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/electrical connections and control devices.

Ensure that materials specified in the Contract Documents conform to the current applicable ASTMs. The use of 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 before initiating manufacture or construction of any products.

Use only materials and equipment that are standard catalogued products of manufacturers regularly engaged in production of such materials or equipment, are the manufacturer's latest standard design that complies with the Contract Documents requirements and have been in satisfactory commercial or industrial use at least 2 years before bid opening.

Where two units of the same class of equipment are required, these units must be products of the same manufacturer. However, the component parts of the system need not be the products of the same manufacturer.

Provide each piece of mechanical equipment and apparatus with a permanent, corrosion-resisting metal nameplate on which is stamped the name of the manufacturer, the catalog or model number, and the rating or capacity of the equipment or apparatus. The nameplate of the distributing agent is not acceptable.

465-4.2 Shop Inspection and Testing: Provide sufficient notice to the Engineer at the beginning of work done at foundries, forge and machine shops so that inspection may be arranged. Provide free access to all premises where preparation, manufacture, assembly and testing of raw materials, materials in process and assembly is conducted. Such inspections are to facilitate work and avoid errors, but it is understood that they do not constitute a release of the responsibility for compliance to Contract Documents or for replacing defective materials and workmanship.

Provide the Engineer with all test results and certifications of compliance with these Specifications. Initial acceptance of materials and finished parts and assemblies will not preclude subsequent rejection if found deficient. Replace such materials at no cost to the Department.

465-4.2.1 Castings: Provide castings that conform to AASHTO Specifications. Ensure that weld repair at the foundry conforms to the applicable ASTM procedure. Obtain approval from the Engineer before performing any weld repair after start of machining and/or assembly. Remove all free loose scale and sand, fins, seams, gates, risers, and other irregularities from all castings. Ensure that all unfinished edges of castings are neatly cast with rounded corners, and provide all inside angles with ample fillets.

Unless otherwise indicated in the Contract Documents, perform visual surface examinations per ASTM A 802, liquid penetrant exams in accordance with ASTM E 165 or magnetic particle exams in accordance with ASTM E 709 in the manufacturer's shop, for each casting.

Before testing, verify that the casting is free of adhering sand, scale, cracks, cold shuts, shrink holes, blowholes, porosity, and hot tears.

Identify and remove unacceptable surface discontinuities in accordance with ASTM A 802.

Obtain approval from the Engineer before making any necessary major (as defined in ASTM A781 S16 Weld Repair Charts) weld repairs. Perform radiographic examination of welds per ASTM E94.

465-4.2.2 Forgings: When called for in the Contract Documents, perform, liquid penetrant exams in accordance with ASTM E 165 or Magnetic Particle exams in accordance with ASTM A 275 and ASTM E 709 and ultrasonic exams in accordance with ASTM A 609 in the manufacturer's shop, for each forging.

465-4.2.3 Welding: Perform all welding and weld inspections of machinery in accordance with ANSI/AASHTO AWS D1.5, unless otherwise noted in the Contract Documents. Treat all machinery and weldments that support machinery as main members, all welds as joining primary components, unless otherwise specified in the Contract Documents. Do not perform field welding on these components unless specified in the Contract Documents. Submit procedures for structural welding in the field will be submitted in shop drawing form (i.e., with inspection requirements stipulated in the plans) for approval before welding is begun. Perform all machining after welding and stress relieving.

Ensure that any welding of an attachment(s) to existing steelwork includes a certified copy of a test report showing the chemical composition of the steel piece(s) to be welded and the chemical composition is considered in the weld procedure.

465-4.2.4 Shop Assembly Operations: will Assemble all machinery components to verify correct fit in the shop and furnish a motor to test run the assembled machinery components for a four hour test run, two hours in each direction at normal operating speeds before shipment. Disassemble components not mounted in a common base for shipment. Match mark any components requiring selective assembly for future assembly. Notify the Engineer two weeks before performing test and ensure the Engineer is present during testing.

Submit to the Engineer, upon completion of testing, duplicate certificates of compliance. Any parts or assemblies that do not meet the requirements of the Contract Documents must be approved by the Engineer before use.

465-5 Certification of Compliance.

Provide certification that all materials and components furnished and installed have been tested and meets all the requirements of the Contract Documents.

465-6 Working Plans and Shop Drawings.

465-6.1 Shop Assembly Procedure: Prepare and submit for review by the Engineer a written alignment/assembly procedure for components requiring shop assembly. Do not start shop assembly until the procedures have been approved.

Ensure the procedure includes, demonstration and documentation of:

1. The squareness of each bridge leaf structural frame.
2. The elevation dimensions at each floor beam and counterweight beam connection to the main girder.
3. The axial, linear, and perpendicular alignment of the trunnion shafts with respect to each other and to the structural frame.
4. The concentric, axial, and linear alignment of the gear racks with respect to each other and to the trunnion shafts.
5. The concentric, axial, and linear alignment of the clevis brackets with respect to each other and to the trunnion shafts.

Apply, scribe or punch marks on the assembled members, detailed with sketches, to allow recreation during field erection of the documented shop assembly alignment dimensions.

Provide details of the dimensional tolerances for use by QC/QA in checking the final shop assembly.

Submit the documentation of the final assembly alignment to the Engineer for review, after all fabrication operations associated with shop assembly are complete. Do not disassemble the structure without the Engineer's approval.

465-6.2 Manufacturer's Instructions: Identify conflicts between manufacturers' instructions and Contract Documents and submit resolution for review and approval by the Engineer. Identify variations from the Contract Documents and product, or system limitations that may be detrimental to successful performance of the completed work and submit resolution for review and approval by the Engineer.

Ensure that all sheets are either stamped, signed or initialed, certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the work and Contract Documents.

Submit all shop drawings, manufacturer's literature, certified materials documents, catalog data, and other documents related to the satisfactory fabrication, installation, and operation of any item in one group for review. Time lost because of rejection of any submittal under this Article due to incorrect or lack of information or improper coordination by will not be considered as a proper cause for a Time Extension to the total contract time nor to the achievement of any contract "Milestone."

Submit to the Engineer a schedule and list of shop drawings and related document submittals in accordance with 465-6. Include:

a. List of all items to be reviewed.
b. Anticipated date of delivery of documents to the Engineer.
c. Anticipated required date of document approval and return.
d. Requests for expedited review, with complete justification for such requests.

The Engineer will coordinate the review and render a decision on the acceptability of the proposed schedule within thirty (30) calendar days of receipt.

Obtain all necessary field dimensions to provide proper fit of the new components before preparation of shop drawings for new components that must mate with the existing structure. Where new components are to be attached to the existing structure where existing fasteners exist, ensure that any fastener holes in the new components will mate with the bolts/holes in the existing material.

Clearly identify all dimensions shown on the shop drawings that were obtained by field measurements. Verify these dimensions. Mark standard drawings showing more than one model or size to indicate the model or size proposed.

Submit shop drawings of cabinets containing electrical equipment and include outside dimensions, areas for conduit penetrations, one-line and three-line diagrams, wiring diagrams, schematic and interconnection diagrams, terminal block arrangements and numbers (if such terminal blocks are intended for connection in the field) and operating instructions. Provide layout drawings and geographic diagrams for the complete electrical and hydraulic systems. Submit shop drawings when installation and mounting details of switches, fixtures, and devices are different from or not specifically detailed on the plans.

When requested by the Engineer, submit for inspection, samples and five sets of support data of the proposed substitute items at no cost to the Department. The Department will not be liable for any materials purchased or work done or any delay incurred before their review. Failure of the Engineer to note unsatisfactory materials as received will not constitute a relief from responsibility. Deliver manufacturers' guarantees or warranties on materials to the Engineer upon receipt of the materials.

465-7 Machinery Requirements.

465-7.1 General: Refer to the plans for requirements for machinery for each movable bridge. Design machinery and proportion operating parts in accordance with the AASHTO Specifications.

465-7.2 General Machinery Layout: The ratios of teeth between individual pairs of gears and the layout and arrangement of parts may be varied to permit maximum use of manufacturer's standard patterns and shop procedures. However, maintain the overall ratios and times of operation for manual and motor power, as specified. Proportion the sizes and strengths of all machinery parts to meet the requirements of the AASHTO Specifications. Maintain the standard of quality in details as shown by the plans.

465-7.3 Detailed Layout: Detail structural support for machinery, and exact positions of parts, after determining the final machinery layout. Detail minor parts that are required, but not shown in detail in the plans, in accordance with the AASHTO Specifications and best standard practice. Parts may be rearranged and varied to permit the use of standard patterns or alternate schemes of operation, subject to the limitations and requirements given herein.

Use the general details shown in the plans as a standard of quality for any substitution, and ensure that any alternate types or parts provide performance and quality equivalent in all respects, as determined by the Engineer, to machinery construction in accordance with the plans.

465-7.4 Lubrication: Lubricate all moving parts as specified in the Contract Documents, or in accordance with AASHTO Specifications and the latest edition of the Bridge Operations and Maintenance Manual. Provide pressure grease fittings for all journal bearings. For bascule spans, make provisions for lubricating all mechanisms. Provide a lubrication system that generally consists of rigid piping, fittings, and flexible lubrication hose attached to the parts, with pressure grease fittings at their tops, extending and connected to the deck near the curbs where they will be accessible out of the roadway lanes. Lubricate all mechanisms at the time of installation, during use, and at the time the Engineer accepts the structure for maintenance.

465-7.5 Equipment for Limit Switches: Ensure that the machinery manufacturer supplies all the necessary gearing and couplings for limit switches to be operated by the bridge machinery for electrically controlled installations.

465-7.6 Gears: Cut the teeth for the racks of the bascule leafs on continually indexed gear tooth cutter to AGMA QUALITY 6 or higher. Scribe an accurate pitch line on each side of each gear to a depth

of not less than 0.02 inch [0.5 mm]. Ensure that the teeth are 20-degree full-depth, involute in accordance with the proportions of ANSI B6.1 and AGMA 201.02 unless otherwise shown on the plans.

465-7.7 Alignment of Open Gearing: Ensure the face of each tooth of all racks (as measured on the pitch point line) are parallel to the trunnion reference centerline within 0.008 inch [0.2 mm]. This condition must be met at all stages of shop fabrication of the rack segments, shop assembly of the rack to the rack frame, and the rack frame to the main girder.

Where practical, align open gearing by adjusting the location of bearings before drilling holes in supports. During assembly, fine tune alignment by adjusting shims between the bearing and support. Align and adjust to satisfy the following criteria for tooth contact, backlash and center distance. Align open gears such that the gear tooth makes contact with the mating pinion tooth over 70 percent of the tooth width. This criterion must be satisfied by 80 percent of the gear and pinion teeth. Up to 20 percent of the gear teeth may have less than 70 percent contact but no less than 50 percent contact. Check gear contact under no-load conditions and verify during normal operation under full load. Demonstrate the contact on all teeth through application of prussion blue or other generally accepted contact testing. Provide documentation of the contact through transfer tape, photographs or other acceptable means for each tooth of rack and pinion set. Any grease applied before contact testing must be removed before application of the bluing.

Ensure that gear set backlash is within the tolerances established by AGMA for spur gears, based upon center-to-center distances unless otherwise specifically defined in the Plans. Set the center-to-center distance between gear and pinion to within the tolerances established by AGMA for spur gears during alignment.

465-8 Main Span Machinery Drive Speed Reducer.

465-8.1 General: Furnish and install speed reducers. Speed reducers for each bridge must be models from one manufacturer unless otherwise approved by the Engineer.

465-8.2 Shop Drawings Submittal: Submit shop drawings to the Engineer, showing interface with other equipment and including the following:

a. Main drive speed reducers with bill of materials.
b. Main drive open gearing system.
c. Gear ratios, dimensions, construction details, and AGMA ratings.
d. Installation, Operation and Maintenance Manual sheets.
e. Operational experience record for model supplied.
f. Product data for all components.
g. Certified test data for all factory tests and
h. As-Built Plans.
i. Calculations including AGMA ratings for gear sets, bearing ratings, and shaft sizing.

465-8.2.1 Shop Testing and Inspection: Use a qualified shop for the fabrication and/or refurbishment of the speed reducer units. Ensure the following information is provided:

a. NDT testing documentation for Ultrasonically or radiographically testing all welds for all gearing components.
b. Test reports for materials used in the manufacture of the gears and pinions.
c. Heat treatment documentation, through hardening, induction hardening for the gears and pinions.
d. Hardness quality control documentation and case depth measurements.
e. Lead, profile, spacing, and run-out measurements for gears and pinions.
f. Summary computer printout calculations of all gear/pinion sets.
g. The specific design criteria for the speed reducer; i.e., material requirements on the housing, gears, pinions, shafts, bearings, seals, lubrication, factory finish, etc.

465-8.3 Speed Reducers: Provide the reducer design calculations and internal drawings showing each gearbox component with part numbers to the Engineer for approval before construction of the unit.

Ensure that speed reducers meet the requirements of the latest edition of ANSI/AGMA 6010 Standard for Spur, Helical, Herringbone and Bevel Enclosed Drives. A reverse bending factor of 0.8 is required in the strength rating. (Not required for vertical lift drives). Allowable contact stress numbers, Sac and Sat, must conform to AGMA Grade 1 materials as defined in ANSI/AGMA 2001. Grade 2 materials will be permitted only with an approved verification procedure and a sample inspection as per the instructions of the Engineer.

Ensure that all component parts of the Speed Reducers in the operating machinery power train will be capable of sustaining 300% of the full-load motor torque as a momentary overload.

Furnish gearing that is helical or herringbone types on parallel shafts and right angle reductions of spiral bevel design. Spur gears are not acceptable. Where differentials are required, they must be bevel gear types. All gears on parallel shafts will preferably be through hardened steel.

Furnish and install anti-friction type bearings, except where rehabilitation of existing boxes requires sleeve type, with a L-10 life of 40,000 hours at the rated speed, horsepower, and service factor of the unit.

Use housings with welded steel plate or cast steel with removable inspection covers to facilitate viewing the gearing (except differential gears). Equip the gear box with a means of filling and draining with drains having shut-off valves. Accessible devices for observing the lubricant level in the gear box must include both a dipstick and sight glass of rugged construction and protected against breakage. Ensure that the breathers are moisture trap, desiccant types with a color indicator to show the desiccant moisture state.

Manufacture reducers in accordance with the requirements of the AGMA and AASHTO and provide nameplates giving the rated horsepower, ratio, speed, service factor, and AGMA symbols. Extend the reducer bases sufficiently past the body of the reducers to allow for mounting bolt hole reaming and bolt installation from above the unit. Provide clearance for hydraulically tension testing of anchor bolts.

Rehabilitate the gear reducer by cleaning the gear reducer housing down to metal, prime and paint. Rehabilitate access plates for servicing and maintenance, sight glass, fill port, drain, vent, and two lifting eyes as required.

465-8.3.1 Gears: Ensure, as a minimum, that all gears meet the requirements of ANSI 4140 steel hardened to 320/360 Brinell by oil quench and temper. Thermally stress relieve fabricated gears after welding and before machining. Machine finish all gears to AGMA quality 8 to 9 minimum. All gears will conform to all applicable AGMA standards for enclosed spur gearing.

465-8.3.2 Pinions: Ensure as a minimum that all pinions meet the requirements of ANSI 4140 through hardened to 265/305 Brinell by oil quench and temper and induction hardened to a case hardness of 45-53 Rockwell C and a minimum case depth of 0.010 inch [0.254 mm]. Pinions may be solid on shaft. Machine finish all pinions to AGMA quality 8 to 9 minimum. Provide pinions that conform to all applicable AGMA standards for enclosed helical gearing.

465-8.3.3 Shafts: Furnish ANSI 4140 steel shafts of not less than 2 1/2 inches [63.5 mm] in diameter as a minimum.

465-8.3.4 Lubrication: Ensure that the oil viscosity is in accordance with ANSI/AGMA, 9005-A94, Industrial Gear Lubrication. Provide splash lubrication of the gears and bearings when the unit is in operation. Do not use pressurized lubrication systems for speed reducers unless specifically approved by the Engineer or specified in the Contract Documents. When a pressurized lubrication system is required for the reducer, provide a redundant lubrication system so that both systems operate concurrently.

If a lubrication system malfunction can occur, provide a contact for remote alarm indication.

465-8.3.5 Shop Testing and Inspection: Provide two weeks notice to the Engineer of the reducer testing schedule.

After assembly of the reducer, conduct a no load spin test at 115% of rated speed one hour in each direction. Sound level readings taken at 5 feet from the reducer surface cannot exceed 90 DBA with the unit running at 115% of rated speed. Closely monitor the reducer during the spin test for oil leaks, excessive heating of bearings, excessive vibrations, and any other abnormalities.

Following the no load spin test, run speed reducers at rated speed at 50% and 100% of full load motor torque for thirty minutes in each direction, and 150% of full load motor torque for ninety minutes in each direction. Monitor for oil leaks, excessive heating of bearings, excessive vibration, and any other abnormalities.

For new reducers, run a load test with the box loaded to 300% of the full motor torque, at rated speed, for 10 revolutions of the output shaft in each direction.

At the end of these tests, dismantle the box and examine for excessive wear and damage. Examine gear teeth for contact patterns. A minimum of 85% tooth flank contact must be evident. Replace all out of tolerance parts and adjust as required. After the discrepancies are corrected, retest the reducer until all satisfactory conditions are met. Submit a report of the testing and any abnormal conditions to the Engineer for review and acceptance.

After reassembly of the speed reducer and acceptance by the Engineer, if no material modifications were required, run the unit at 100% full speed at no load for 30 minutes in each direction and monitor for abnormal changes in operating conditions. If material modifications were required following the initial load test, perform additional load tests up to and including the 300% load test as required by the Engineer at no additional cost to the Department.

Conduct any required NDT testing of the speed reducer(s) in the manufacturers' shop and closely inspect the gearbox for any oil leaks and repair if necessary.

465-8.3.6 Shipping and Handling: Coat, as soon as practical after machining, all finished metal surfaces with an anti oxidant. Coat shims with an anti oxidant before shipment and wipe clean before installation. Completely protect machinery parts from weather, dirt and foreign materials during manufacture and store indoors while awaiting erection. Coat all internal parts of the reducer with a non-contaminating type rust inhibitor suitable for six months storage time. Completely fill the reducer with the proper oil and rotate the shaft until all surfaces are completely lubricated. If the reducer is to be stored for a period longer than six months, rotate the shaft periodically to ensure all surfaces remain completely lubricated. Grease, wrap in oil-soaked burlap, and securely timber lag exposed shaft journals for shipment.

Ensure that all assembled units, gear reducers, bearings, and other devices having finished machined surfaces have those surfaces thoroughly coated with an anti oxidant and are skidded or crated for protection during handling, shipment and storage. Bag and crate mounting hardware and other small parts for shipment. Wire tags recording the part number to each part before shipment.

465-9 Live Load Shoes.

Furnish, install, and adjust live load shoe assemblies. Live load shoe assemblies include live load shoes, fasteners, shims, masonry plates, anchor bolts, and high strength grout.

Submit a complete fully detailed shop drawings of live load shoe assemblies, including live load shoes, masonry plates, fasteners, and anchor bolts. Ensure the shop drawing shows the fit, finish, size, type of fasteners, accessories and the anchor bolt tensioning or nut tightening required. Submit manufacturer's data sheets for epoxy leveling grout.

Shim as required to align the two leafs within an average vertical height of 0.125 inches based upon 3 measurements taken at the centerline between the two leafs; the two outboard measurements are to be taken 2 feet from the curb, the third measurement is to be taken at the center of the roadway. Perform the live load shoe adjustment with all locks disengaged and no traffic on the bridge.

Provide type 304 or 316 stainless steel shims, live load shoe, masonry plate, and anchor bolt materials as shown in the plans, and epoxy leveling grout between concrete pier and masonry plate.

465-10 Span Lock Assemblies.

465-10.1 General Requirements: Furnish and install span locks, which includes positive displacement type span lock self-contained hydraulic units. Provide a pressure switch set for 760 psi [110 kPa] open on rising pressure. Use a signal from this switch to indicate on the console A/N display if the pressure setting is exceeded.

Unless otherwise specified in the Contract Documents use span lock cylinders meeting the following requirements: 2 1/2 inch [63.5 mm] bore by 15 inch [381 mm] stroke span lock cylinders with a 1 3/8 inch [34.93 mm] rod and 1-1/4-12 male end, with a required pushing force of 3000 lb [13.344 kN]. Provide each cylinder with adjustable pressure relief valves and configured for horizontal side lug mounting.

Mount the span lock system valves on the self-contained power unit.

Ensure that connections for an auxiliary hydraulic hand pump for manual operation of the span lock bar is installed and operational. Deliver one new hydraulic auxiliary hand pump complete with hoses, connections, and oil supply suitably boxed for safe storage to the Department.

Do not field cut or alter structural members without authorization of the Engineer. After erection, prime welds, abrasions, bolts, and surfaces not shop primed. Grind all exposed joints flush and smooth with adjacent finish surface, make all exposed joints butt tight, flush, and hairline and ease exposed edges to small uniform radius.

465-10.2 Span lock Adjustment: Shim lock bars to obtain a total vertical clearance of 0.010/0.025 inch [0.254/0.635 mm] between bar and socket. Clearance may vary between top and bottom faces of bar, but neither clearance can be less than 0.005 inch [0.127 mm]. After adjustment is complete, perform a test of both power driven and auxiliary operations of the span locks.

465-10.3 Submittals: Submit shop drawings showing fits, finishes, profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, span lock power unit layout with component configuration, and details where applicable. Indicate welded connections using standard AWS welding symbols and net weld lengths.

465-11 Trunnion Assemblies.

465-11.1 General Requirements: Furnish and install trunnion assemblies, which includes trunnions, trunnion hubs, trunnion hub rings, trunnion alignment plugs, eccentric assemblies, trunnion bearings, trunnion bearing pedestals and all related fasteners, and hardware. Each movable leaf requires two complete trunnion assemblies. The work includes shop drawing preparation, detailing, fabrication, erection, alignment, testing and adjustment as required to place the movable span trunnions into working condition.

465-11.2 Submittals: Submit complete fully detailed shop drawings of the trunnion assembly and all parts. Indicate fits, finishes, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Submit detailed systematic procedures for installation of the trunnion into the trunnion hub. Include methods of cooling and/or heating and target temperatures and clearances. Include list of equipment and tools used to measure temperatures and clearances. Include a table to be completed before the procedure with as-built trunnion and hub dimensions.

Submit detailed systematic procedures for machining the bascule main girder and trunnion girder webs and installation of the trunnion/hub assembly into the main girder and hub ring. Include methods of cooling and/or heating and target temperatures and clearances. Include list of equipment and tools used to measure temperatures and clearances. Include a table to be completed before the procedure with as-built trunnion and hub dimensions.

Submit shop erection drawings indicating the shop alignment tolerances for the trunnion assemblies and field erection drawings indicating field alignment tolerances for the trunnion assemblies. Provide plan and elevation drawings of trunnion assembly indicating reference datum established on the structural steel. Show all temporary supports, false work, alignment jigs, etc., to be used to install the

trunnion assemblies and adjust alignment. Detail all fastener installation (permanent and temporary) and tensioning or torque values.

Provide all equipment and materials required for obtaining and verifying the specified alignment of the trunnions, including, but not limited to, jacks, shims, music wire, alignment plugs, etc.

465-12 Bascule Leaf Alignment Requirements.

465-12.1 Alignment Responsibility: Develop and implement procedures necessary to obtain satisfactory alignment. Develop and implement all necessary temporary supports, tiebacks, false work, shoring, jacking, etc. and procedures to safely erect the bascule leafs.

Review and approval by the Engineer of alignment procedures and temporary supports, tie-backs, false work, shoring, and/or jacking systems submitted is for compliance with the requirements of the Contract Documents and does not constitute a relief of responsibility for the satisfactory alignment and safe erection of the bascule spans.

Perform shop fabrication of the structural steel for the bascule leafs in accordance with the provisions stated herein, the plans, approved shop drawings, Section 460 and AASHTO/ANSI/AWS Bridge Welding Code.

Use only bascule leafs fabricated and shop assembled by a shop certified under the AISC Quality Certification program as meeting the requirements of Category IIIF or Cbr (Major Bridge).

465-12.2 Submittal: Submit the following documents to the Engineer for review and approval before the start of bascule leaf fabrication:

a. Prepare detailed Shop Drawings for the Structural Steel.

b. Prepare a detailed Bascule Leaf Shop Fabrication and Alignment Procedure, which specifically address the proposed methods for establishing and maintaining alignment of the bascule leafs during shop fabrication and assembly to the tolerance specified herein. Where tolerances are not specifically defined herein, fabricate and assemble the structural steel to the tolerances defined in the AASHTO/ANSI/AWS Bridge Welding Code and standard industry practice. The Procedure will list the equipment and the accuracy of the equipment that will be used to measure each of the control dimensions and the means used to mark, label, and preserve control points. The Procedure will describe and/or detail the temporary supports, tiebacks, shoring, false work and/or jacks for support and adjustment of the structural steel during shop assembly and alignment. The Procedure will describe and/or detail the trunnion alignment wire set-up. The Procedure will describe the methods used to establish alignment of bolt holes in connections (e.g., drilling to full size from blank at assembly, drilling from templates, numerically controlled drilling, etc.) and the methods to maintain alignment (e.g., drift pins, temporary undersize bolts, etc.) during assembly, drilling and reaming operations. The Procedure will be complete with sketches, calculations, pictures, etc. to supplement the written text.

c. Prepare and maintain a record of the control dimensions of the bascule leafs during shop fabrication and assembly, which includes a layout of the dimensions, the date, time and temperature the measurements were recorded, the names of the individual persons that performed and recorded the measurements, and a listing of the specified dimensions, the measured dimensions, the computed difference between the specified and measured dimensions and the allowable tolerance. The record documents will as a minimum include all horizontal control dimensions for each leaf, vertical elevations/profile grade measurements, and trunnion alignment measurements. Submit a sample of the proposed format to the Engineer for review before the start of fabrication.

d. Upon completion and approval of the shop fabrication and alignment for each of the bascule leafs, prepare and submit for approval as-built drawings containing all information in the final dimensional control records necessary to repeat the shop alignment in the field. As-built dimensions will be measured from a set established control points marked, labeled and preserved on the top of the bascule leaf framing.

e. Prepare a detailed Bascule Leaf Field Erection and Alignment Procedure which specifically address the methods and equipment for establishing and maintaining alignment of the bascule

leafs during field erection to the shop assembly tolerances and addition tolerances defined herein including the alignment of the bascule leafs to each other. The Procedure will describe and/or detail the equipment and temporary supports, tiebacks, false work, shoring, jacking equipment, etc. to be used and will describe and/or detail the trunnion alignment wire set-up. The Procedure will address the bascule leaf position during erection (i.e., raised or lowered) and the restrictions to the navigable waterway including durations of restrictions, size and location of the barges within the waterway, etc. The Procedure will be complete with sketches, calculations, pictures, etc. to supplement the written text.

f. Prepare a detailed Bascule Leaf Construction Balance Procedure, which specifically address the magnitude of unbalance and the associated loads and forces that must be resisted during the various stages of bascule leaf erection proposed in the Bascule Leaf Field Erection and Alignment Procedure. The Procedure will include balance calculation and calculations of the reactions that control design of the span lifting equipment (e.g., cranes, etc.), temporary supports, tiebacks, shoring, false work, and/or jacking equipment. Similarly, the Procedure will include calculations of maximum forces on the bascule leaf operating machinery if used to operate the bascule leaf under a significantly unbalanced condition (i.e., anytime the final unbalance exceeds 330 klb-ft [450kN-m].) Balance calculations will be in accordance with the same requirements for final span balance calculations. The Procedure will include a step-by-step balancing sequence during bascule leaf erection with balance calculations for each stage of the work. Include details of any temporary ballast, not a permanent component of the bascule leaf, used to adjust the balance and the means used to secure the ballast to the bascule leaf.

g. Prepare and maintain a record of the control dimensions of the bascule leafs during erection, which includes a layout of the dimensions, the date, time and temperature the measurements were recorded, the names of the individual persons that performed and recorded the measurements, and a listing of the specified dimensions, the measured dimensions, the computed difference between the specified and measured dimensions and the allowable tolerance. The record data will as a minimum include all horizontal control dimensions for each leaf, the control dimensions for alignment of the bascule leafs to the bridge and to each other, vertical elevation/profile grade measurements, and trunnion alignment measurements. Submit a sample of the proposed format to the Engineer for review before the start of erection.

h. Prepare detailed shop drawings including all design calculations for temporary supports, tie-backs, shoring, false work, jacking members and other similar elements used in the erection of the bascule leaf. Ensure that these drawings are signed and sealed by a Specialty Engineer registered to practice in the State of Florida and approved by the Engineer before using any of these elements in the bascule leaf erection. The design of these elements must account for maximum leaf unbalance expected during erection and construction per the Bascule Leaf Construction Balance Procedure, loads imposed by construction equipment, and appropriate AASHTO wind loads. Implement redundancy into the temporary members and systems where practical.

465-13 Counterweight Work and Bridge Balance.

465-13.1 General Requirements: Prepare balance calculations for estimating the bascule leaf weight and location of the center of gravity. Based on approved balance calculations, fully detail the counterweight including determination of the final counterweight outline, reinforcement, counterweight concrete density, and initial number and location of balance blocks, to achieve properly balanced bascule leafs.

Construct the counterweights including balance blocks of portland cement concrete in accordance with the Plans, Specifications and approved counterweight shop drawings. Obtain actual weights of each grid deck panel after fabrication and galvanizing. Use the actual concrete unit weights obtained by unit weight testing and grid deck weights obtained by weight measurements in the preparation of the balance calculations.

Record span balance data for use in making adjustments in the counterweight balance blocks. Adjust the number and location of balance blocks in the counterweight adjustment pockets as directed by the Engineer.

Assume full responsibility for the correctness of final detailing and construction of the counterweight, so that when completed, the bridge will be properly balanced for all angles of operation and the counterweight will adequately clear adjacent pier walls, slabs, railings, beams, columns, machinery, etc. Provide counterweight adjustment pockets properly sized to allow adjustment to accommodate a 3.5% under run and 5% overrun in the moment forward of the trunnion.

Perform test for the purpose of determining the unit weight of the concrete for the counterweight concrete and bascule leaf deck concrete, at least 60 days before final detailing and completion of the center of gravity calculations. Use the same materials proposed for use in the final construction in making the test cylinders. To establish a close average unit weight of the concrete, make not less than ten cylinders of each design mix and weigh the blocks not more than two days after pouring. During this time, store the cylinders under shelter in the open air and do not apply water.

Make an additional set of ten test cylinders of each design mix, cured and weighed just before pouring the deck or counterweight concrete for verifying the weight of concrete places. Make test cylinders of the portland cement concrete actually poured per Section 346.

465-13.2 Submittals: Submit the following documents to the Engineer for review and approval before beginning any construction on the counterweight (i.e., placement of the counterweight concrete).

Submit all concrete unit weight test data, complete balance calculations and counterweight shop drawings. Provide certification that the calculations have been fully checked before submission.

465-14 Maintenance Instruction Books.

465-14.1 General: Integrate and assemble information for instruction books and submit six bound copies each to the Engineer. The materials will be bound into each instruction booklet between rigid plastic or cloth binding covers. The instruction booklets will be approximately 9 by 12 inches [229 by 305 mm], and the diagram booklet will be of sufficient size to contain the drawings without excessive folding so that they may be easily opened. Neatly label the booklets with a descriptive title, the name of the project, the location, the year of installation, the Owner, the Contractor and the Engineer. Copies of drawings will be in black on white background and will be easily legible. The arrangements of the booklets, the method of binding the materials to be included, and the composition will all be reviewed and approved by the Engineer.

465-14.2 First Booklet: Include the following items in the first booklet:

1. Table of Contents.

2. Operator's Instructions, which will cover in full the systematic sequence of operation of the bridge and its auxiliaries, and will note all precautions required for correct operation. Include complete instructions for the following:

a. Selection of the power supply (commercial or stand-by).

b. Normal operation of the bascule leaf drive electric motors on commercial power source.

c. Auxiliary operation of bascule leafs with either bascule leaf drive motor energized by the stand-by generator. Include in this description the method of transfer to stand-by operation, the arrangement of the machinery, and the necessary controls.

d. Emergency Operation of bascule leafs by use of the emergency procedures. Include in this description the method of transfer, the arrangement of the machinery, the necessary controls, and a systematic sequence of operation under the conditions of a functioning Programmable Logic Controller and a nonfunctioning Programmable Logic Controller.

3. Detailed maintenance instructions for adjusting, calibrating and operating all of the electrical and instrumentation equipment, including the manufacturer's recommended preventative maintenance lubrication schedule.

4. A set of descriptive leaflets, bulletins, and drawings covering all items of equipment and apparatus made a part of the completed bridge operation and control, the service lighting system, the heating system, the instrumentation system, the lightning protection system, and the grounding system.

5. The catalog number of each piece and, where applicable, a complete parts list, to be used in case it becomes necessary to order replacement parts from the manufacturer. Furnish this information for all equipment such as motors, switches, circuit breakers, relays, controllers, cables, hydraulic system, etc.

6. Copies of all warranties on equipment supplied to the project.

465-14.3 Second Booklet: Include, in the second booklet, legible reduced size photostatic copies of the following drawings, corrected to show the work as constructed:

1. The complete spare parts list.
2. All schematic wiring diagrams and mechanical schematic diagrams.
3. The control console and control panel layouts and wiring diagrams for all equipment.
4. The schedule of electrical and mechanical apparatus.
5. The complete speed-torque-current curves for main drive motors (i.e., factory test data).
6. All conduit and piping layout and installation drawings.
7. All approved electrical and mechanical shop drawings.

465-14.4 Lubrication Charts: In addition to providing lubrication charts in the instruction books, mount full size wall charts on walls where directed by the Engineer. Mount copies of the first chart in each pier area near each piece of main drive machinery. Mount a copy of the second chart in the Control House. These mounted charts will be at least 22 inches by 36 inches [560 by 915 mm] in size, mounted in a permanent Plexiglas covered frame. Furnish two (2) full size permanent type reproducible of these charts to the Engineer.

465-15 Movable Bridge Functional Checkout.

465-15.1 Design Operational Demonstrations and Testing: Design and perform functional acceptance testing of the new or rehabilitated 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. Collect full documentation of the test requirements and provide in booklet form.

Provide in shop drawing format for approval, test procedures for specific tests to be performed and their criteria for acceptance. The Engineer will review and approve each procedure before and after the tests.

465-15.2 Functional Acceptance Test Books: The functional acceptance tests consists of Preliminary Checkout, Functional Tests (three phases) and Operational Testing Period.
Integrate and assemble information required for Functional Test into a book and submit to the Engineer. Bind the information into each instruction (test procedure) section between rigid plastic or cloth binding covers. The book will be approximately 9 inches by 12 inches [230 by 305 mm]. Neatly label the book with a descriptive title, the name of the project, the location, the year of test, the owner, the Contractor, and the Engineer. Provide black on white background, easily legible, copies of drawings, figures, and data. The Engineer will review and approve the arrangements of the book, the method of binding, the materials to be included, and the composition.

465-15.3 Engineer Notification: Provide adequate notice before all tests such that the Engineer can witness and accept the method and result of the testing. Ensure that there are representatives of the bridge drive and electrical control equipment present for each test. Ensure that these representatives are

prepared to adjust the equipment, to locate faults or defects and correct them, and to obtain from the manufacturers, without delay, new parts or replacements of apparatus that, in the opinion of the Engineer, do not perform satisfactorily.

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.

465-16 Testing Requirements.

465-16.1 General: Construction the bridge will be in phases, the phases will consist of installing systems first in one pair of bascule leafs (Phase A), secondly in the other pair of leafs (Phase B), and thirdly completing the integrated system (Phase C). Each phase will require complete, independent, functional acceptance testing.

Once a structure is closed to vehicular traffic and rehabilitation work or new construction is begun, that structure will not be opened to traffic until the detailed requirements for preliminary and functional testing as described below, is completed and approved by the Engineer. Functions which are completed to the extent required of the testing may be accepted in part, provided the cause has been documented, an approved plan of corrective action submitted, and an approved method of providing a safe substitute function has been submitted and implemented. For example, gate functions may be provided by temporary flagmen.

Acceptance of a structure for operation and receipt of all required records and documentation will constitute completion of a phase (A or B) of the Movable Bridge Functional Checkout. Completion of Phase C will be accepted only when the entire integrated system has been tested and accepted, all temporary functions have been removed, all required records and documentation have been provided, and the Operational Testing Period has been successfully completed.

The Functional Acceptance Tests will be specific, systematic procedures to demonstrate and provide data for evaluation of each function of the movable bridge. Each test will include quantitative measurements (i.e., watts, pressure, etc.) and their method of measurement and recording.

Acceptance criteria will be concise and void of ambiguities. The criteria will establish the specific performance of each component or function with regards to the requirements of the design and each unique condition of performance. Conditions include all normal and emergency operating conditions as defined in the Contract Documents and all maintenance modes of operation.

465-16.2 Preliminary Checkout: Before 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. Insure that all control wiring has been completed 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 drive system tests during periods in which the span (or leaf) being tested is normally closed (i.e., closed to marine traffic). Provide backup means of lowering the leaf(s) if vehicular traffic is scheduled to use the bridge. Run the bridge continuously in normal mode (not manual mode) for at least five days before performing the Functional Checkout.

Record the following during the preliminary checkout (each record will have the time as the base measurement):

a. Chart recorded wattmeter readings for each main drive motor and lock motor during their full cycle of operation.

b. Chart recorded pressure readings for both ends of each cylinder during their full cycle of operation.

465-16.3 Functional Tests: Upon approval of the Engineer to proceed, conduct the Functional Acceptance Tests. The tests include the following functional tests and Acceptance Criteria:

465-16.3.1 Control Functions (testing both manual and semi-automatic operations): Demonstrate the correct operation of the bridge as described in the plans. Demonstrate EMERGENCY

STOP of each span (leaf) at or during each phase of opening and closing the bridge (phases include ramping up or down, full speed, and creep speed).

465-16.3.2 Interlocks: Simulate the operation of each limit switch to demonstrate correct operation and interlocking of systems. Demonstrate BYPASS operation for each failure for each required bypass as described in Section 508. Simulate each failure for which there is an alarm message to demonstrate correct message displays. Testing of interlocks will be sufficient to demonstrate that unsafe or out of sequence operations are prevented.

465-16.3.3 Position Indicator: Observe readings with bridge full closed and full open to assure correct readings.

465-16.3.4 Navigation Lights: Ensure that all lamps are working. Demonstrate the operation of the transfer relays and indicators for each light if so equipped. Demonstrate proper change of channel lights from red to green. Demonstrate Battery Backup by simulating a power outage.

465-16.3.5 Traffic Gates: Ensure proper operation of each gate arm and demonstrate opening or closing times. Time should not exceed 15 seconds in either direction.

465-16.3.6 Span Locks: Operate each span lock through one complete cycle and record, with chart recorder, motor power (watts) throughout the operation, record lockbar to guide and lockbar to receiver, clearances. Operate each lock with hand crank or manual pump for one complete cycle.

465-16.3.7 Emergency Power: Ensure the test results from the tests specified in Section 508 available for inspection.

465-16.3.8 Automatic Transfer Switch: Perform automatic transfer by simulating loss of normal power and return to normal power. Monitor and verify correct operation and timing of: normal voltage sensing relays, engine start sequence, time delay upon transfer, alternate voltage sensing relays, automatic transfer operation, interlocks and limit switch function, timing delay and retransfer upon normal power restoration, and engine shut-down feature.

465-16.3.9 Programmable Controller Program: Demonstrate the completed program's capability before installation or connection of the system to the bridge. Coordinate the arrangements and scheduling for the demonstration with the Engineer. Prepare a detailed field test procedure and provide to the Engineer for approval. It will provide for testing as listed below:

a. Exercise all remote limit switches to simulate faults (including locks, gates, traffic lights etc.). Readouts will appear on the alphanumeric display.

b. When the local testing of all individual remote components is completed, check all individual manual override selections for proper operation at the console. When all override selections have checked out satisfactorily, put the system in automatic (PLC) mode and exercise for a full raise and lower cycle. It should operate as diagramed on the plan sheet for the sequence of events.

c. A PLC sequence of operation will then be exercised interweaving the by-pass functions with the automatic functions for all remote equipment.

d. Remove the power from the input utility lines, at which time, the Automatic Transfer Switch should activate the engine-generator to supply power. The bridge will then be raised and lowered again; the bascule leafs should operate in sequence (one side of the bridge at a time). Upon completion of test, reapply utility power to the ATS; load should switch over to utility for normal operation.

e. Include, in the testing, verification that all safety features are included in the program and that the program will not accept commands that are contrary to the basic sequence diagram. Include the failure mode testing in the written field test procedure submitted for approval.

465-16.3.10 Hydraulic Functions: Operate each of the leafs' main hydraulic power units under the following conditions; record flow and pressure, and angle of opening versus time during operation.

a. Operation with both pumps and all cylinders on line.

b. Operation with one pump and all cylinders on-line (one test per pump).

c. Operation with both pumps and two cylinders; two cylinders will be taken off line and disconnected from the leaf.

Demonstrate operation of temperature and low level switches by lowering the fluid level to just above low-level point and attempt operation of the leaf. Heat the hydraulic fluid to shutdown temperature with immersion heater.

Demonstrate manual release of fluid in cylinders back to tank under no power condition.

465-17 Conditional Acceptance and Contractor's Warranty of Movable Bridges.

The Engineer will make a conditional acceptance upon completion of the project with the condition of acceptance being that the movable portions of the bridge be maintained and operated for a period of 60 days. Open the bridge a minimum of four times daily during the 60-day period. During the last 15 days of this 60-day period, train the Department in the maintenance and operation of the bridge. Repair or replace, at no expense to the Department, any mechanical or electrical component of the bridge that becomes inoperative during the 60-day period.

The Department will not charge Contract Time for this 60-day period.

After the 60-day operation and training period, and as a condition precedent to final acceptance of all work under the Contract in accordance with 5-11, provide a Maintenance Bond for the repair or replacement of any defective mechanical or electrical components of the movable portions of the bridge which will be in effect for a one year period after final acceptance in accordance with 5-11. Include the costs of the bond in the costs of other bid items.

In addition to satisfying the provisions of Section 287.0935, Florida Statutes, the bonding company is required to have a A.M. Best rating of "A" or better. If the bonding company drops below the "A" rating during the one year Maintenance Bond period, provide a new Maintenance Bond for the balance of the one year period from a bonding company with an "A" or better rating. In such event, all costs of the premium for the new Maintenance Bond will be at the Contractor's expense.

The Maintenance Bond will be written and issued in the amount of the total sums bid for the mechanical and electrical components of the movable portions of the bridge.

At the end of the one-year warranty period, the Engineer will issue a release from further warranty work and responsibility, provided all previous warranty work and remedial work, if any, has been completed satisfactorily.

465-18 Method of Measurement.

The work described and specified in this Section will be measured and paid for as provided in the applicable Sections for the various items making up the complete structure, as follows:

Structural Concrete	Section 400
Reinforcing Steel	Section 415
Structural Steel and Miscellaneous Metals	Section 460
Steel Grid Floors	Section 504
Electrical Equipment	Section 508
Control House	Section 512

465-19 Basis of Payment.

Price and payment will constitute full compensation for all work specified in this Section.