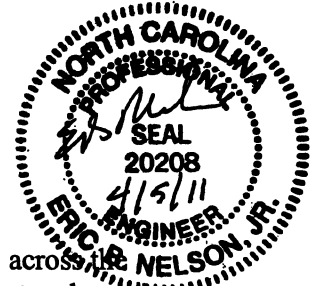


**PROJECT SPECIAL PROVISIONS****SCOPE OF WORK****Location and Description of Bridge**

Bridge No. 11 New Hanover County was built in 1980 and carries US 74/NC 133 across the Cape Fear River in Wilmington, NC. The bridge has an overall length of 2,270 feet and consists of 25 approach spans and a 316' double leaf bascule span. The clear roadway width is 62' with navigation clearances of 43' vertical and 200' horizontal for the bascule span.

Bridge No. 13 New Hanover County was built in 1969 and carries US 17/74/76 across the Cape Fear River and SR 1300 in Wilmington, NC. The bridge has an overall length of 3,033 feet and consists of 32 approach spans of variable length consisting of prestressed concrete girders and steel plate girders with a concrete deck; and a 408' moveable lift span section consisting of a steel truss with open steel grid deck.

**Description of Work**

This work shall consist of furnishing all labor, materials and equipment to make mechanical and electrical repairs as follows:

For Bridge #11 mechanical work consists of replacement of the center lock assemblies including installation of temporary support beams; replacement of live load span locks, auxiliary drive, span drive brakes, and open gearing covers; as well as rehabilitation of the existing air buffers and open gearing frame anchor bolts; and maintaining span balance during construction. Electrical work consists of replacement of all existing electrical equipment, conduits, and wiring including terminal cabinets, auxiliary drive controls, span limit switches, stairway and counterweight pit lighting, and pier panel board.

For Bridge #13 mechanical work consists of replacement of the main and auxiliary counterweight ropes and replacement of the live load bearings.

Contractor shall provide all necessary access; boats, underdeck platforms, scaffolding, ladders, etc.; provide all traffic control (both vehicular and navigational); coordinate all navigation channel work with the US Coast Guard; provide all staging area, material storage, boat storage and boat access; provide environmental controls to limit loss of materials into water and air; jacking equipment, sawing/drilling/chipping equipment; and all else necessary to complete the work.

The contractor shall be responsible for fulfilling all requirements of the NCDOT Standard Specifications for Roads and Structures dated July 2006, except as otherwise specified herein.

**SECURING OF VESSELS**

(10-12-01)

Secure vessels in accordance with Section 107 of the Standard Specifications and the following provision.

When utilizing barges, tugboats or other vessels, take all necessary precautions to ensure that such vessels are securely anchored or moored when not in active operation. Take all necessary measures to ensure that the vessels are operated in a manner that avoids damage to or

unnecessary contact with bridges and other highway structures and attachments. If severe weather conditions are anticipated, or should be anticipated through reasonable monitoring of weather forecasts, take additional measures to protect bridges and other highway structures and attachments from extreme conditions. The Contractor is strictly liable for damages to any bridge or other highway structure or attachment caused by a vessel owned or controlled by the Contractor. The Contractor is also liable to third parties for property damages and loss of revenue caused by vessels under the Contractor's control.

### **COAST GUARD COORDINATION**

(SPECIAL)

At no time during work will the waterway be closed or narrowed to navigation without prior approval from the Coast Guard. The contractor is required to maintain close and regular contact with the Coast Guard, Sector North Carolina to keep them informed to activities in the waterway with Joseph Edge at (252)-247-4525 or email [joseph.m.edge@uscg.mil](mailto:joseph.m.edge@uscg.mil). Also must contact the 5<sup>th</sup> Coast Guard District with Bill Brazier at (757) 271-1016 or email at [Bill.H.Brazier@uscg.mil](mailto:Bill.H.Brazier@uscg.mil).

**The Contractor shall bear full responsibility for all required coordination with the Coast Guard. Advance coordination with the Coast Guard for any anticipated disruptions to waterway traffic shall begin within 30 days following award of Contract and prior to commencing on-site activities. Approval for scheduled waterway disruptions shall be initiated approximately 45 days in advance, and confirmed no less than 30 days but no more than 45 days, in advance of the first disruption.**

**Refer to CFR 33 Parts 1 thru 124 for regulations regarding bridge operation (Bridge #11 and #13 are required to open on demand in accordance with the CFR).**

All work shall be conducted so that free navigation of the waterway is not unreasonably interfered with and the present navigable depths are not impaired. Timely notice of any and all events that affect navigation shall be given to the District Commander during the work on the moveable span. The channel shall be promptly cleared of all obstructions placed therein or caused by the contractor.

#### **Informal Commitments Made thru USCG Coordination:**

**December 1, 2011 to May 15, 2012**

##### **Bridge #11, Isabel Holmes Bascule Bridge:**

Two 72 hour marine outages will be allowed but not concurrent with the outages for Bridge 13.

##### **Bridge #13, Memorial Lift Bridge:**

Two 72 hour marine outages will be allowed but not concurrent with the outages for Bridge 11.

### **WORK IN, OVER OR ADJACENT TO NAVIGABLE WATERS:**

(SPECIAL)

All work in, over, or adjacent to navigable waters shall be in accordance with the special provisions and conditions contained in the permits obtained by the Department from the U.S. Coast Guard, U.S. Army Corps of Engineers, or other authority having jurisdiction. The work

Coast Guard, U.S. Army Corps of Engineers, or other authority having jurisdiction. The work shall have no adverse effect on navigation of the waterway including traffic flow, navigational depths, and horizontal and vertical clearances without approval from the authorities granting the permits.

The Contractor shall prepare drawings necessary to obtain any permits which may be required for his operations including but not limited to excavation and dumping, constructing wharves, piers, ramps, and other structures connecting to bank or shore, and drawings for constructing falsework, cofferdams, sheeting, temporary bridges, and any other construction within the waterway. Submittals shall show locations of such work with respect to the navigational opening. The Contractor shall coordinate the submittal of drawings with the Engineer.

All construction shall progress and be maintained in a safe and timely manner. Temporary construction facilities shall be removed completely and promptly upon discontinuation of their useful purpose.

The Contractor shall immediately notify the appropriate authorities and take corrective measures as needed when any situation occurs that imposes a threat to the public. He shall also immediately correct any acts or occurrences that contradict or violate any requirements in the plans, special provisions, or permits when corrective measures can be performed in a safe manner. The Contractor shall notify the appropriate authorities when such corrective measures cannot be performed in a safe manner.

All costs incurred by the Contractor in complying with the above requirements shall be included in the prices bid for the various pay items and no additional payment will be made.

## **CRANE SAFETY**

(8-15-05)

Comply with the manufacturer specifications and limitations applicable to the operation of any and all cranes and derricks. Prime contractors, sub-contractors, and fully operated rental companies shall comply with the current Occupational Safety and Health Administration regulations (OSHA).

Submit all items listed below to the Engineer prior to beginning crane operations involving critical lifts. A critical lift is defined as any lift that exceeds 75 percent of the manufacturer's crane chart capacity for the radius at which the load will be lifted or requires the use of more than one crane. Changes in personnel or equipment must be reported to the Engineer and all applicable items listed below must be updated and submitted prior to continuing with crane operations.

### **Crane Safety Submittal List**

**Competent Person:** Provide the name and qualifications of the "Competent Person" responsible for crane safety and lifting operations. The named competent person will have the responsibility and authority to stop any work activity due to safety concerns.

**Riggers:** Provide the qualifications and experience of the persons responsible for rigging operations. Qualifications and experience should include, but not be limited to, weight calculations, center of gravity determinations, selection and inspection of sling and rigging equipment, and safe rigging practices.

**Crane Inspections:** Inspection records for all cranes shall be current and readily accessible for review upon request.

**Certifications:** By July 1, 2006, crane operators performing critical lifts shall be certified by NC CCO (National Commission for the Certification of Crane Operators), or satisfactorily complete the Carolinas AGC's Professional Crane Operator's Proficiency Program. Other approved nationally accredited programs will be considered upon request. All crane operators shall also have a current CDL medical card. Submit a list of anticipated critical lifts and corresponding crane operator(s). Include current certification for the type of crane operated (small hydraulic, large hydraulic, small lattice, large lattice) and medical evaluations for each operator.

## **LAW ENFORCEMENT**

**SPECIAL**

### **Description**

Furnish law enforcement officers and marked law enforcement vehicles to direct traffic in accordance with the contract.

### **Construction Methods**

Use uniformed law enforcement officers and marked law enforcement vehicles equipped with lights mounted on top of the vehicle and law enforcement vehicle emblems to direct or control traffic as required by the plans or by the Engineer.

### **Measurement and Payment**

*Law Enforcement* will be measured and paid for in the actual number of hours that each law enforcement officer is provided during the life of the project as approved by the Engineer. There will be no direct payment for marked law enforcement vehicles as they are considered incidental to the pay item.

Payment will be made under:

**Pay Item**  
Law Enforcement

**Pay Unit**  
*Hour*



CONSTRUCTION SPECIAL PROVISIONS AND BID ITEMS  
 FOR  
 MECHANICAL AND ELECTRICAL REPAIRS TO THE  
**NORTHEAST CAPE FEAR RIVER BASCULE BRIDGE**  
**and**  
**CAPE FEAR MEMORIAL LIFT BRIDGE**

WILMINGTON, NORTH CAROLINA

Prepared For:

State of North Carolina  
 Department of Transportation

Prepared By:

Modjeski and Masters, Inc.  
 100 Sterling Parkway, Suite 302  
 Mechanicsburg, PA 17050

March 2011



Section A - General Special Provisions

- Section A-1 Working Drawings and Submittals
- Section A-2 As-Built Documentation
- Section A-3 Guarantee
- Section A-4 Maintaining Bridge Operation
- Section A-5 General Requirements for Bridge Electrical Work
- Section A-6 Wiring Methods and Materials
- Section A-7 Grounding and Bonding

Section B - Bascule Bridge Special Provisions

- Section B-1 Maintaining Bascule Span Balance
- Section B-2 Miscellaneous Bascule Bridge Mechanical Work
- Section B-3 Miscellaneous Bascule Bridge Electrical Work
- Section B-4 Bascule Bridge Electrical Equipment

Section C - Memorial Lift Bridge Special Provisions

- Section C-1 Maintaining Lift Span Balance
- Section C-2 Live Load Bearing Rehabilitation
- Section C-3 Main and Auxiliary Counterweight Rope Replacement

Bid Item List:

- Miscellaneous Bascule Bridge Mechanical Work
- Miscellaneous Bascule Bridge Electrical Work
- Memorial Lift Bridge Live Load Bearing Rehabilitation
- Memorial Lift Bridge Main and Auxiliary Counterweight Rope Replacement

**ELECTRICAL AND MECHANICAL REPAIR SPECIAL PROVISIONS****SECTION A-1**  
**WORKING DRAWINGS AND SUBMITTALS****1. SCOPE**

- (A) This section covers all working drawings and submittals for all work related to this project.
- (B) Refer to the additional specific requirements for certain submittal items given elsewhere in these Contract Documents.
- (C) Satisfactory completion of all of the requirements of this Section shall be regarded as equal in importance to all other work performed as part of this project, and shall be prosecuted, executed, coordinated, and in all respects dealt with as such.
- (D) The Contractor shall draw the attention of all sub-contractors, fabricators, vendors, suppliers, and other parties providing materials, labor, and/or other services for this project to the requirements of this Section.

**2. DEFINITIONS**

- (A) As used in the Specifications for this project, the term "submittals" shall be understood to include all working drawings and other items required by these Contract Documents to be submitted by the Contractor to the Engineer for review, examination, and/or record.

**3. REQUIRED SUBMITTALS**

- (A) Prior to purchasing any materials or performing any work, the Contractor shall submit, for approval, shop drawings, erection and installation drawings and details, manufacturer's drawings, catalog cuts, and/or similar literature. Such submittal items are required for all work related to this project, and for all materials and products to be furnished as a part thereof.
- (B) Submittals are required for all work in order to establish to the satisfaction of the Engineer that the work being provided is in conformance with the requirements and intents of the Contract Documents, and to enable proper fabrication and installation of all work.
- (C) The Contract Documents are intended only to depict the general intent of this contract; they are not of sufficient detail to be used in lieu of shop drawings, erection and installation drawings, layout drawings, and other working drawings. All required additional detail development shall be provided at no additional cost.
- (D) Catalog cut and product specification sheets shall be provided for all standard or semi-standard purchased items. Certified drawings for standard or semi-standard purchased items shall be provided when required by these Contract Documents or when requested by the Engineer.
- (E) Material test certificates shall be provided for raw materials when requested by the Engineer or otherwise required by these Contract Documents.
- (F) Additional submittal items shall be provided as may be required elsewhere by these Contract Documents.
- (G) All submittal items shall be approved by the Engineer prior to purchase, fabrication, or installation of the product(s) depicted. Submittals that have not been approved, or require correction, shall

be resubmitted until such time as they are acceptable to the Engineer. This procedure shall not be considered a cause for delay or additional payment. The Contractor shall bear all costs or damages that may result from the ordering or fabrication of any products prior to the acceptance of all related submittals.

(H) Structural Work

1. Submittals for steel structures, including metal handrails, shall include shop drawings, erection and installation drawings, stress sheets, and other working drawings showing details, dimensions, sizes of units, and other information necessary for the fabrication and installation of metal work.
2. Submittals for concrete structures and prestressed concrete members shall include prestressing strand detail drawings and elongation calculations, falsework drawings, bracing plan and detail drawings, form work drawings, masonry drawings, lay reinforcing steel drawings, and other working drawings showing details, dimensions, sizes of units, and other information necessary for the fabrication and installation of concrete work.. Reinforcing steel working drawings shall include bar lists, bending diagrams, and such additional details and diagrams as may be necessary to show clearly the location of the bars in the structure. Bar lists shall show the computed weight of the bars. Bar lists shown in the plans shall be checked by the Contractor and he shall be responsible for the correctness of those bar lists should he decide to use them in lieu of preparing his own.
3. Additional submittals shall be provided as may be required elsewhere in these Contract Documents.

(I) Temporary Work

1. The Contractor shall prepare such working drawings, including camber diagrams, as are necessary to show in detail the temporary work methods of permanent construction he proposes to use. Such working drawings shall be signed and sealed by a Professional Engineer licensed in the appropriate discipline by the State of North Carolina.
2. In order to satisfy the Engineer that the plans and methods he proposes using in constructing the work will furnish a completed project in strict accordance with the Contract Documents, within the time limits required, the Contractor shall submit such plans to the Engineer for examination (not approval). Such examination of drawings by the Engineer shall not relieve the Contractor of any of his responsibility for correctness, for the strength and sufficiency of falsework, equipment, sheeting, bracing, cofferdams, or other construction of temporary work designed by him, nor the accurate and complete execution of all work in strict accordance with the Contract Documents.
3. Erection drawings shall show in detail or shall clearly describe temporary structures, falsework, and general features and capacities of erection equipment.

(J) Electrical Work

1. Submittals for electrical work shall include shop and working drawings, layout drawings, wiring diagrams, catalog cut and specification sheets, installation details, test procedures and results, and other items as necessary for the fabrication and installation of electrical work, and as may be required by these Contract Documents.

(K) Bridge Machinery Work

1. Submittals for machinery work shall include shop and working drawings, layout drawings, catalog cut and specification sheets, installation details, test procedures and results, and

other items as necessary for the fabrication and installation of machinery work, and as may be required by these Contract Documents.

2. Certified drawings shall be submitted for approval prior to purchase of all standard or semi-standard machinery components including, but not limited to: motors, brakes, reducers, couplings, turned bolts, bearings, and similar items.

(L) Other Work

1. Submittals for incidental, miscellaneous, and other work shall include shop and working drawings, installation and erection drawings, catalog cut and specification sheets, and other items as necessary for the fabrication and installation of the work, and as may be required by these Contract Documents.

**4. ADVANCE APPROVAL FOR ORDERING OF RAW MATERIALS**

- (A) In order to expedite delivery of raw materials prior to acceptance of the related shop drawings, the Contractor may request, in writing, approval from the Engineer to order raw materials of the correct type for later fabrication from approved shop drawings.
- (B) Such approval by the Engineer shall be valid only if provided in writing (verbal authorization is not acceptable) and shall not relieve the Contractor from responsibility for compliance with all requirements of these Contract Documents.
- (C) The Contractor is hereby cautioned that the Engineer is under no obligation to grant such advance approval, and that refusal to grant such approval shall not be considered cause for delay or additional payment.

**5. PRELIMINARY SUBMITTALS**

- (A) In order to expedite the submittal review process, the Contractor may request, in writing, approval from the Engineer to submit preliminary submittals for examination. Approval for submission of preliminary submittals shall be exclusively at the discretion of the Engineer, and refusal of such approval shall not be considered cause for delay or additional payment.
- (B) Preliminary submittals shall conform in every respect to the applicable requirements of this Section and the rest of the Contract Documents, except that information yet to be determined (dimensions, ratings, etc.) may be omitted. However, any missing information shall be clearly indicated on the submittal. Preliminary submittals shall be clearly identified with "PRELIMINARY SUBMITTAL FOR EXAMINATION ONLY. NOT FOR FINAL REVIEW, APPROVAL, OR CONSTRUCTION." in minimum 1/4 inch high bold red letters permanently marked on all sheets of the submittal item (this marking shall be permitted to be placed only on the cover sheet required elsewhere in this Section for catalog cut sheets and similar standard product literature).
- (C) Preliminary submittals shall be submitted separately from other submittals for review, approval, and/or examination.
- (D) Preliminary submittals will be examined only, as opposed to reviewed and approved. This examination will be for compliance with the requirements of the Contract Documents and for conformance with the overall design concept, insofar as such an examination is possible with the information provided in the submittal; examination will not be conducted with the same rigor or thoroughness as a review for approval. This examination is intended only to establish that the Contractor is proceeding properly in preparation of the submittal item. This examination, and any comments and/or corrections provided to the Contractor as a result of this examination, shall not be considered binding upon the Engineer and shall in no way restrict the comments provided, and/or actions taken, by the Engineer during any subsequent review for approval of the same

item.

- (E) See the provisions for "Submittals For Examination Only" given elsewhere in this Section.

## **6. GENERAL REQUIREMENTS FOR SUBMITTALS**

- (A) Submittal items shall be grouped and submitted according to logical groupings in order to facilitate review. Specific requirements for submittal groupings may also be given elsewhere in these specifications. Where a group of items are required by these Specifications to be submitted together, any submission which is missing required information may be rejected without consideration.
- (B) All submittals shall be in English. United States (English) standard units of measure shall be used except where necessary to match units of measure used in the Contract Documents.
- (C) All drawings shall be furnished with a clear white background, be numbered, include a revision block, include a minimum 3 inch by 3 inch block for the Engineer's approval stamp, and clearly indicate the current revision date of the drawing. Each drawing shall clearly indicate the originating party.
- (D) All drawings shall include scales. Where reduced, or enlarged, copies of drawings are submitted, they shall be clearly marked as such. Each drawing shall be clearly marked with the current revision date.
- (E) Drawings shall not be larger than 36 inches by 24 inches, nor smaller than 11 inches by 8.5 inches. The preferred sizes shall be 34 inches by 22 inches and 17 inches by 11 inches. Other submittal items shall be either 11 inches by 8.5 inches or 17 inches by 11 inches.
- (F) All catalog cuts, brochures or other literature submitted shall be manufacturer's latest issue in current use.
- (G) All information on all submittals shall be neat and clearly legible. Those submittals which are not neat and clearly legible will not be accepted.
- (H) All items submitted without proper marking and identification will not be reviewed by the Engineer, but will be returned for proper marking as required.
- (I) Once a submittal item has been approved, any proposed deviation from the information depicted thereon shall be submitted as revisions for the Engineer's approval prior to implementation of the proposed deviation. All drawings affected by such deviations shall be revised by the Contractor and resubmitted for re-approval, if necessary.
- (J) All submittals shall clearly show dimensions and pertinent ratings, and be marked to explicitly identify the intended use of each component on this project. Where a submittal includes a table, listing, or group of similar items with different catalog numbers and/or options, the specific product(s) being proposed shall be clearly marked.
- (K) All submittals shall clearly and explicitly depict all information required to permit the Engineer to determine if the item(s) in question satisfy the requirements of the Contract Documents.
- (L) The Engineer is not responsible for locating or securing any information that is not readily available. Accordingly, to ensure that sufficient information is available, the Contractor must furnish as a part of submittals all descriptive material (such as cuts, illustrations, drawings, or other information) necessary to establish exactly what product is being proposed, and to allow the Engineer to determine whether a proposed product satisfies the requirements of the Contract Documents.

- (M) Where a specific manufacturer and/or model is specified for a component, and the Contractor proposes a different manufacturer and/or model as an equal replacement, the Contractor may require back-up calculations in order to positively establish that the proposed item is equal to the specified item and is acceptable for use.
- (N) If the Contractor proposes to modify a product so as to make it conform to the requirements of the Contract Documents, the Contractor shall include in the required submittals a clear description of such proposed modifications and clearly mark any descriptive material to show the proposed modifications.
- (O) Any proposed variance from the Contract Documents shall be clearly identified.
- (P) Catalog cut sheets, shop drawings showing overall views of a component (as opposed to drawings showing only detail views), and similar submittals shall clearly identify the weight(s) of the component(s) depicted. Where a number of individual electrical and/or mechanical components are to be combined into a single unit, the weight of the combined unit may be identified in lieu of the weights of the individual components. Additional information regarding component weights shall be provided when requested by the Engineer.
- (Q) All submittals shall indicate the manufacturer's delivery time for the item after receipt of approval by the Engineer. Shipping time to the project site shall also be indicated for items with transit times greater than one week, with transit times which are critical to the project schedule, and/or which require unusual shipping arrangements.
- (R) Submittals which do not comply with the requirements of this Section will be returned without consideration.
- (S) Time lost because of submission by the Contractor of incorrect or incomplete submittals will not be cause for extension of the specified contract period.

## **7. COVER SHEET FOR STANDARD PRODUCT LITERATURE**

- (A) The following shall apply to all catalog cut sheets, brochures, and similar standard product literature.
- (B) For individually submitted catalog cut sheets, each sheet, or set of several sheets all pertaining to the same item, shall be provided with a cover sheet. Cover sheet shall clearly list the submittal item title, the manufacturer's name, the complete model name and/or number, the number of sheets in the cut sheet set, and similar relevant information. The cover sheet shall also include a minimum 3 inch by 3 inch block for the Engineer's approval stamp, and clearly indicate the current revision date of the submittal. The cover sheet shall be stapled to the front of the catalog cut sheet(s) it pertains to. Note that this cover sheet is separate from the submittal cover letter described elsewhere in this section.
- (C) Where a number of items are to be shop assembled into a complete assembly or sub-system, the catalog cut sheets for all of the items in the assembly or sub-system may be submitted bound together with a single cover sheet listing the information required above for each item. However, in such a case, the items bound together will be treated as a single submittal item and approved or rejected as a unit.

## **8. CALCULATIONS**

- (A) All required calculations shall be signed and sealed by a Professional Engineer holding a valid license, in the appropriate discipline, to practice in the State of North Carolina.

- (B) Calculations shall be complete and show all information, including assumptions and references, required to permit re-creation by an independent engineer.

## **9. SUBMITTAL QUALITY CONTROL**

- (A) All submittal items required by these Contract Documents shall be regarded as part of the work items to which they relate, and shall be of the highest quality and acceptable in all respects.
- (B) Prior to transmittal, all submittals shall be thoroughly checked by Contractor to ensure conformity with the requirements of these Contract Documents. In addition, the Contractor shall be certain that any equipment he proposes to furnish and/or install will fit and functionally operate within the designated available space. Clearances shall be functional, as specified, and shall take into account all applicable Codes, regulations, and similar requirements, and shall permit suitable access for routine operation and maintenance.
- (C) The Contractor shall coordinate and review all submittals of all trades and subcontractors for accuracy, compliance with the requirements of the Contract Documents, compatibility with all new and existing work of all trades, and coordination with other submittal items. A statement to this effect shall be affixed to all submittal items or placed on the submittal cover letter required elsewhere in this Section, along with a list of the submittals that have been reviewed for compatibility and coordination.

## **10. CONTRACTOR RESPONSIBLE FOR SUBMITTAL QUALITY CONTROL**

- (A) Quality control of submittal items shall be solely the responsibility of the Contractor. The Contractor shall ensure that all submittals satisfy the requirements presented in these Contract Documents, and bear full responsibility for all costs and damages associated with, and/or resulting from, failure to provide submittals which conform to such requirements. Submittals which do not conform to the requirements relating to format, neatness, accuracy, completeness etc. presented in these Contract Documents will be returned without consideration.
- (B) Reviews of submittal items by the Engineer are intended to establish that the materials and work depicted are acceptable, not to serve as quality control for the submittals themselves. The Contractor shall conduct a complete and careful review of all submittal items prior to their submission. Such a review shall include, but not necessarily be limited to, the items listed below, shall consider all portions of all submittal items, and shall be conducted by personnel who are familiar with the project and properly qualified to understand the information depicted in the submittal.
1. Accuracy of content.
  2. Consistency with submittal items for related and/or adjacent materials and/or work.
  3. Compatibility with related and/or adjacent materials and/or work.
  4. Formatting and presentation according to the requirements of these Contract Documents.
  5. Typographical accuracy.
  6. Drafting accuracy.
  7. Completeness of required information.
  8. Accuracy of cross references, both within a submittal item and between multiple submittal items.
  9. Compatibility of interfaces between components.
  10. Clear identification of all variances from the requirements of these Contract Documents.
  11. Overall conformity with the requirements for submittals given in these Contract Documents.
- (C) The Contractor shall be fully responsible for the accuracy of all submittals, including submittals which have been approved by the Engineer, and shall bear full responsibility for all costs and

damages associated with, and/or resulting from, any errors within submittals.

## **11. SCHEDULING**

- (A) Sufficient time shall be allowed for initial review, correction and resubmission, and final review of all submittals. The time allowed for review and approval shall be in accordance with the *Standard Specifications*. The Contractor shall clearly identify the requested return date for each item at the time of its submittal.
- (B) Submittal and checking time is included in total time for completion of all work.
- (C) At the beginning of the project, a schedule shall be submitted of the items of materials and equipment for which submittals are required. For each required submittal, the date shall be given for intended submission of the submittal to Engineer for review, and the date required for its return to avoid delay in any activity beyond the scheduled start date.

## **12. DELIVERY**

- (A) Six copies of all submittals shall be delivered to the location designated by the Engineer. The Engineer may optionally require that the six required copies be divided into two sets for delivery to two different locations.
- (B) Submittal items, properly checked before submission, shall be delivered in a timely manner to allow review prior to ordering or fabrication. As far as practical, drawings shall be submitted in installments or divisions so as to avoid any unnecessary concentration of checking by the Engineer.
- (C) Submittal items shall be packaged so as to prevent damage during shipping. Submittal items which are significantly damaged during shipping shall be replaced at no additional cost.
- (D) The Contractor shall follow up requests for approval, if not acknowledged within the anticipated and/or scheduled time, to avoid loss of submittals in shipping or in handling.

## **13. ENGINEER'S REVIEW**

- (A) The Engineer will review submittal items for compliance with the requirements of the Contract Documents and for conformance with the overall design concept. (Design concept relates to the final, in-place installation of material and equipment as part of a functioning whole project in accordance with the requirements and intents of these Contract Documents.)
- (B) After the Engineer's review is completed, one "mark-up" copy of each submittal item will be returned to the Contractor. The "mark-up" copy will be marked with the approval status, as outlined below, and any comments and/or corrections resulting from the Engineer's review.
- (C) The approval status of submittals will be determined by the Engineer as follows.
  - 1. "APPROVED" - The Engineer's review found no objectionable deviations and it conforms to the design concept. Record copies (see below) may be distributed, and work may proceed.
  - 2. "APPROVED AS NOTED" - The Engineer's review found no major deviations from the contract requirements. Minor discrepancies or deficiencies were noted onto the drawing or submittal. Purchase of materials and/or fabrication may proceed if the Contractor complies with the Engineer's comments. Corrected copies are required for re-submittal, and approval, prior to distribution of record copies (see below) or installation.



3. "RETURNED FOR CORRECTIONS" - The Engineer found significant discrepancies or deficiencies such that the submittal/shop drawing shall be corrected to comply with the Contract Documents and/or the Engineer's comments, and re-submitted for approval. Submittals which have not been approved shall be corrected and resubmitted until such time as the submittal is acceptable to the Engineer. No purchase of material, fabrication, installation, or related work is authorized.
- (D) When the Engineer determines that the review comments on a submittal item are few enough that it is unnecessary to return a "mark-up" copy of the submittal, a letter or similar correspondence indicating the comments and approval status for the submittal may be provided in lieu of the "mark-up" copy.
- (E) All comments and/or approval status determinations by the Engineer are unofficial unless written, either in the form of a "mark-up" copy of a submittal or a written correspondence. Under no circumstances shall verbal comments regarding any submittal item be considered official.
- (F) After approval of submittal items by the Engineer, no changes shall be made without resubmission, and all changes or revisions shall be clearly marked and dated. Working copies of submittals shall not be issued for use until after the submittals have been approved, and the date of approval shall be clearly marked on all working copies. Acceptance of material and work will be subject to the final approved submittals.
- (G) Under no circumstances shall the Engineer's review be considered to waive any of the provisions or requirements of these Contract Documents, nor release the Contractor from responsibility for the corrections of submittals and/or for errors in details which may interfere with erection and installation. Nor shall review and/or approval of submittal items relieve the Contractor from furnishing materials and products of proper dimensions, quantity, quality, and from the responsibility for their correct installation and for the proper operational performance intended.

#### **14. SUBMITTALS FOR EXAMINATION ONLY**

- (A) These Contract Documents may also require certain items to be submitted for examination only, as opposed to review and approval. Such items will be examined only to the extent and/or for the purposes stated by these Contract Documents; they will not be reviewed in the same manner as items submitted for approval.
- (B) After examination, the Engineer will return one "mark-up" copy marked either "EXAMINED" or "EXAMINED AS NOTED", as appropriate. Comments resulting from the Engineers examination may or may not be included with the returned "mark-up" copy.
- (C) Under no circumstances shall the Engineer's examination be considered to waive any of the provisions or requirements of these Contract Documents, nor release the Contractor from responsibility for the corrections of submittals and/or for errors in details which may interfere with erection and installation. Nor shall such examination relieve the Contractor from furnishing materials and products of proper dimensions, quantity, quality, and from the responsibility for their correct installation and for the proper operational performance intended.

#### **15. DISTRIBUTION OF "MARK-UP" SUBMITTALS**

- (A) The Engineer will return only one "mark-up" copy of each submittal item. It shall be the Contractor's responsibility to make additional copies of returned submittals as he may require. Distribution of final approved drawings, manufacturer's drawings and catalog cuts to sub-contractors and suppliers shall be the responsibility of the Contractor.

**16. DISTRIBUTION OF RECORD COPIES**

- (A) After a submittal item has been granted full approval by the Engineer (marked "APPROVED"), the Contractor shall furnish and deliver four record copies of the item.
- (B) Items which were returned "APPROVED AS NOTED" shall have all comments and/or corrections incorporated, and be re-submitted for final approval prior to distribution of the record copies.
- (C) Each copy of each item shall be clearly marked with "RECORD COPY OF APPROVED ITEM", the item tracking number, and the approval date.
- (D) The Contractor shall also provide, at no additional cost, electronic versions of record copies when requested by the Engineer. Files shall be provided on standard Compact Discs and shall conform to the requirements for electronic versions of as-built documentation given elsewhere in these Specifications. Number of copies to be provided shall be as directed by the Engineer, but will not exceed four.
- (E) These final approved copies of submittals are in addition to, and not in place of or part of, the as-built documentation required elsewhere in these Specifications.

**17. RECORD COPIES KEPT ON SITE**

- (A) The Contractor shall maintain, on site, at least one record copy of all final approved submittals.
- (B) Record copies of approved submittals shall be stored in such a manner as to prevent damage due to dirt, water, sunlight, insects, rodents, etc., and shall be continuously available for the Engineer's inspection.
- (C) These on site copies of approved submittals are in addition to, and not in place of or part of, the on site as-built documentation required elsewhere in this Section.

**18. SUBMITTAL TRACKING**

- (A) For the purposes of tracking items throughout the entire submission process, each submittal item (shop drawing, catalog cut, installation detail, calculation set, etc.) shall be assigned a unique tracking number by the Contractor. Where a single catalog cut is comprised of several physical sheets, one tracking number shall be assigned for all sheets. Calculation sets, bound sets of multiple catalog cut sheets, and similar items containing multiple physical sheets which are all related shall be assigned one tracking number for each item. All other submittals, including shop drawing sets comprised of multiple physical sheets, shall have an individual tracking number assigned to each sheet. Once an item has been assigned a tracking number, it shall remain the same for all subsequent revisions and resubmissions of the item.
- (B) The Contractor shall clearly mark all submittal items with the following information: project name, tracking number, title, contract plan equipment schedule item number (where applicable), and submission number. This information shall be typewritten, or legibly handwritten, on the front of each sheet of a submittal item. Additionally, submittal items which are comprised of multiple physical sheets which are all related to a common tracking number shall be marked with the page number and the total number of pages. Submittal items which are not prepared as required by these Specifications will be returned unchecked.
- (C) Each submittal shall also be assigned a unique, descriptive title. Titles shall not be repeated, either within a single submission or between multiple submissions. Titles shall be descriptive of the function of the item(s) depicted and shall not, to the extent practicable, utilize a manufacturer's part or model name or number, or a trade name. (For example, use "Liquidtight Flexible Metal Conduit", not "Sealtite".) Once an item has been assigned a title, it shall remain

the same for all subsequent revisions and resubmissions of the item.

## **19. SUBMITTAL COVER LETTER**

- (A) All submissions shall include a cover letter, signed by an authorized representative of the Contractor, identifying the submission and its contents.
- (B) Each cover letter shall be assigned a unique and sequential transmittal number. (Note that this transmittal number is different from the tracking number assigned to each individual submittal item.)
- (C) The cover letter shall list the following information for each submittal item:
  - 1. Item tracking number.
  - 2. Submission number. For items which are being re-submitted, the previous transmittal number shall be indicated.
  - 3. Title and description. Where a single item is comprised of multiple physical pages, the total number of pages shall be noted. Any item designated as a long lead-time, or similar critical path, item shall be clearly identified as such.
  - 4. Number of copies.
  - 5. Name of party (Contractor, sub-contractor, vendor, manufacturer, system integrator, etc.) responsible for originating the item.
  - 6. A list of the submittals that have been reviewed for compatibility and coordination.
  - 7. Purpose of submission (for approval, information only, etc.).
  - 8. The requested return date.
- (D) Where copies of a submission are sent to multiple parties, a properly addressed cover letter shall accompany each copy. In such a case each cover letter shall bear the same transmittal number, and shall clearly identify the other parties receiving copies of the submission.
- (E) A sample submittal cover letter is attached to the end of this section. This sample letter is provided for illustrative purposes only, but the actual letter format shall be substantially the same as that shown.

## **20. REQUEST FOR INFORMATION AND CORRESPONDENCE TRACKING**

- (A) Each Request for Information (RFI), or similar correspondence, shall be clearly marked with a tracking number similar to those required for submittal items.
- (B) Each RFI shall cover only one distinct item and/or question.

## **21. RESTRICTIONS ON USE, REPRODUCTION, AND/OR DISTRIBUTION**

- (A) The term "documentation", as used in this section, includes submittal items, as-built documentation, operation and maintenance manuals, and all other similar items required by these Contract Documents, or provided for this project by, or through, the Contractor.
- (B) No restrictions shall be placed on the reasonable use, reproduction, and/or distribution of any documentation by the Department, the Department's designated representative(s), the Engineer, and/or the Engineer's designated representative(s) for the purposes of this project.
- (C) All documentation shall be considered to be incidental to the materials, products, and/or work they are concerned with, and therefore shall become the unrestricted property, in perpetuity, of the Department upon completion and final acceptance of the project.
- (D) The Contractor shall bear full responsibility for assuring compliance with these requirements,

including obtaining permission for use of any copyrighted material, and for any compensation required by, and/or damages sought by, parties preparing or providing documentation which may result from compliance with these requirements.

**22. MEASUREMENT AND PAYMENT**

- (A) There will be no measurement or direct payment for submittals and working drawings. Associated costs shall be included in the prices bid for the various other items requiring submittals.
- (B) Delivery and/or approval of required submittals shall not be considered to be a basis for partial payment against any item.

**END OF SECTION**

**SUBMITTAL COVER LETTER**

PROJECT.	TRANSMITTAL NUMBER:
	DATE:

TO:	FROM:
-----	-------

ITEM NUMBER	SUBMISSION NUMBER	TITLE AND DESCRIPTION	COPIES	ORIGINATING PARTY	ITEMS REVIEWED FOR COMPATIBILITY	SUBMITTED FOR	REQUESTED RETURN DATE

REMARKS:

**I HEREBY DECLARE THAT THESE ITEMS HAVE BEEN REVIEWED FOR ACCURACY, COMPLIANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS, COMPATIBILITY WITH ALL NEW AND EXISTING MATERIALS AND WORK OF ALL TRADES, AND COORDINATION WITH OTHER SUBMITTAL ITEMS.**

\_\_\_\_\_  
*(typed name of person signing)*

**SECTION A-2**  
**AS-BUILT DOCUMENTATION**

**1. SCOPE**

- (A) This section covers all as-built documentation for all work related to this project.

**2. GENERAL REQUIREMENTS FOR AS-BUILT DOCUMENTATION**

- (A) Satisfactory completion of all of the requirements of this section shall be regarded as equal in importance to all other work performed as part of this project, and shall be prosecuted, executed, coordinated, and in all respects dealt with as such.
- (B) All as-built documentation shall be turned over to the Engineer prior to the completion of the project. The overall project will not be granted final acceptance, until all required as-built documentation has been furnished and accepted.
- (C) All as-built documentation which is required by these contract documents to be submitted to the Engineer, for any reason, shall be subject to the same requirements for all other submittals given elsewhere in these specifications.

**3. FIELD COPIES**

- (A) The Contractor shall maintain, on site, full size sets of contract plans, shop drawings, erection and installation drawings, layout drawings, and similar drawings and tabulations, marked up with changes and revisions in red to reflect the as-built or as-installed condition. Note that this on site as-built documentation is in addition to, and not in place of or part of, the on site copies of approved submittal items required elsewhere by these specifications.
- (B) As-built documentation shall be updated weekly, such that no changes or deviations are more than one week old without being correctly recorded.
- (C) The Contractor shall also maintain a written log of all as-built changes. Log shall be typewritten or maintained on a computer, and clearly indicate the affected item (plan sheet, shop drawing, etc.), the revision date, the person making the revision, and a brief description of the revision. This log shall be updated weekly, and submitted to the Engineer, for information only, each week after being updated.
- (D) All as-built documentation shall be stored in such a manner as to prevent damage due to dirt, water, sunlight, insects, rodents, etc., and shall be continuously available for the Engineer's inspection.

**4. FINAL RECORD COPIES**

- (A) Final copies of all as-built documentation shall be neat, clean, and easily readable. Drawings shall preferably be updated via CAD, but may be updated by hand where the Engineer agrees that updating via CAD is not practical.
- (B) As-built versions of contract plans, catalog cut sheets, shop drawings, installation and layout drawings, and similar items shall be provided irregardless of whether or not the original versions contain as-built changes. All as-built documentation items shall be clearly identified as such.

- (C) In cases where plans are effectively replaced by the Contractor's shop and/or installation drawings, such as for control logic drawings, such contract plans may, with the explicit permission of the Engineer, not be required to be updated with specific as-built changes. In such cases, the as-built versions of the affected plans shall be updated with a clear statement indicating that they do not reflect the as-built condition and referring to the appropriate as-built shop and/or installation drawings. Any case in which the Engineer does not allow plans to be updated in this manner shall not be considered cause for delay or additional payment.
- (D) Final copies of all as-built documentation shall be clearly marked with the phrase "AS BUILT" in minimum 1/4 inch high bold or block text, along with the revision date in smaller text. This marking shall appear on every individual sheet of drawings, and on the first page of multi-page catalog cut sheets and similar items.
- (E) As-built versions of all contract plans, shop drawings, erection drawings, materials tabulations, and similar items shall be provided on both paper and reproduction quality Mylar.
  - (1) Number of copies shall be as follows.
    - 1. Mylar: two copies.
    - 2. Paper: six copies.
  - (2) Paper shall be matte white 20 pound engineering quality engineering bond (minimum 3.5 mils thickness). Mylar shall be engineering quality matte (minimum 4 mils thickness).
- (F) Drawings shall be plotted at their original full size so that all scales are accurate.

## **5. REVIEW AND APPROVAL OF FINAL RECORD COPIES**

- (A) The Contractor shall submit to the Engineer preliminary copies of all as-built documentation for review and approval prior to delivery of the final record copies. These preliminary copies may be printed on plain paper (vellum copies are not required), but shall otherwise be equal in every respect to the final record copies.
- (B) The preliminary copies will be reviewed by the Engineer for completeness, general accuracy, and compliance with the requirements for as-built documentation given in these contract documents. Upon approval of the preliminary copies, the Contractor shall deliver the final record copies.

## **6. MEASUREMENT AND PAYMENT**

- (A) There will be no measurement or direct payment for as-built documentation. Associated costs shall be included in the prices bid for the various items of work.
- (B) Delivery and/or approval of required as-built documentation shall not be considered to be a basis for partial payment against any item. However, the overall project will not be granted final acceptance until all required as-built documentation has been furnished and accepted.

**END OF SECTION**

**SECTION A-3**  
**GUARANTEE**

**1. GUARANTEE OF MATERIALS AND WORKMANSHIP**

- (A) By executing the contract for this project, the Contractor agrees to guarantee all work against defects due to materials and/or workmanship for one full calendar year from the date of final acceptance of the work covered.
- (B) The Contractor shall remedy, in a timely manner, at his own expense, and to the complete satisfaction of the Department, any and all such defects which are discovered during the guarantee period.
- (C) The guarantee shall remain in full effect regardless of the status of payments to the Contractor or disposition, including termination, of the contract for this project.
- (D) The guarantee shall in no way limit the Contractor's liability for defects due to failure to comply with the contract documents, including any defects which may be discovered after expiration of the guarantee period.
- (E) Should the Contractor fail to remedy any defects within a timely manner, the Department may elect to have such defects corrected by others and bill the Contractor for the full cost thereof.
- (F) The Contractor shall reimburse the Department for any and all court costs, attorney's fees, and similar costs encountered by the Department in the course of enforcing the guarantee.

**2. MEASUREMENT AND PAYMENT**

- (A) The guarantee required by this section, and any work caused thereby or related thereto, is considered incidental to the work covered by the guarantee and will not be separately measured or paid for. All associated costs shall be included in the prices bid for the items covered.

**END OF SECTION**



**SECTION A-4**  
**MAINTAINING BRIDGE OPERATIONS**

**1. SCOPE**

- (A) This section covers maintaining normal bridge operations and coordinating any disruptions thereto, including required coordination for disruptions to waterway traffic, as related to this project.

**2. GENERAL REQUIREMENTS**

- (A) The bridge shall remain available to roadway traffic at all times except as provided in the Traffic control Plans.
- (B) The Contractor shall maintain span balance throughout the course of the project.
- (C) Normal bridge operation shall be maintained at all times, and the Contractor's activities shall not cause the bridge to be inoperable, except for those limited periods of allowed waterway disruption as described elsewhere herein (see Waterway Disruptions and Coast Guard Coordination).
- (D) As used in this section, the phrase "normal bridge operation", and similar phrases, shall be understood to signify all of the following.
1. That all bridge operating systems, sub-systems, and components are operating as intended and in the same manner as they did prior to the beginning of the project.
  2. That no special procedures or equipments are required in order to operate any bridge systems, sub-systems, or components.
  3. That the lift span is capable of being raised to allow the passage of marine traffic, upon request and without intentional delay, at normal speed via the normal drive system.
- (E) Should the Contractor's activities result in any of the roadway traffic controls (signals, warning gates, and barrier gates) being inoperable, the Contractor shall provide appropriate temporary measures (temporary signals, flaggers, "crash trucks", etc.) as may be dictated by the Department in order to safely close the roadway to traffic for operation of the lift span. Any such measures shall be provided at no additional cost to the Department.
- (F) The Contractor shall bear full responsibility for all fines, fees, and damages resulting from non-compliance with the requirements of this section, United States Coast Guard regulations and requirements, and/or any other applicable local, state, or federal laws and regulations. The Contractor shall immediately reimburse the Department for any fines, fees, and damages assessed against the Department due to the Contractor's activities.

**3. SEQUENCE OF CONSTRUCTION**

- (A) The Contractor shall be responsible for developing a written sequence of construction, which shall take into account all required work. The Contractor's written sequence of construction shall provide sufficient detail to permit the Department to determine if the sequence complies with the requirements of the Contract Documents, and to ensure coordination between work items.
- (B) The Contractor shall submit the written sequence of construction to the Department, which shall take into account the actual waterway disruptions allowed by the Coast Guard. The actual sequence of construction must be approved by the Department prior to commencing on-site activities. However, such review and approval shall in no way relieve the Contractor of full responsibility for performing all work in accordance with the requirements of the Contract

Documents. The Contractor shall bear full responsibility for the accuracy and practicality of the actual sequence of construction, and agrees to hold blameless the Department, and/or the Department's designated representative(s), for any mistakes, inconsistencies, etc. within the approved sequence. Any difficulties, damages, fines, etc. which may result from usage of the approved sequence of construction shall be the sole responsibility of the Contractor, and shall not be considered cause for delay or additional payment.

#### **4. WATERWAY DISRUPTIONS AND COAST GUARD COORDINATION**

- (A) The Contractor is hereby notified that, while the requirements of this section related to allowed waterway disruptions have been informally coordinated with the United States Coast Guard in advance, formal approval by the Coast Guard for waterway disruptions will be determined at the time of the Contractor's request(s). Where such requirements are given, explicitly or implicitly, they are provided solely to illustrate anticipated Coast Guard requirements and to assist in bidding. The actual waterway disruptions allowed will be fully at the discretion of the Coast Guard. The Department shall not be held responsible for any requirements, stipulations, limitations, etc. related to waterway disruptions as imposed by the Coast Guard which conflict with the requirements of the Contract Documents. Any such conflict shall not be considered cause for delay or additional payment.
- (B) The Contractor shall bear full responsibility for all required coordination with the Coast Guard. Advance coordination with the Coast Guard for any anticipated disruptions to waterway traffic shall begin within 30 days following award of Contract and prior to commencing on-site activities. Approval for scheduled waterway disruptions shall be initiated approximately 45 days in advance, and confirmed no less than 30 days but no more than 45 days, in advance of the first disruption.
- (C) All waterway disruption periods must be separated by continuous periods of no disruption, the length of which shall be as directed by the Coast Guard.

Note: that actual waterway disruptions shall be as coordinated with, and approved by, the Coast Guard as stated above and may vary depending upon waterway usage at the time of the proposed disruptions.

- (D) The Contractor shall work continuously (around the clock in multiple shifts) during any waterway disruption and re-open the waterway as soon as the work necessitating the disruption is completed.

#### **5. MEASUREMENT AND PAYMENT**

- (A) There will be no measurement or direct payment for compliance with this section. Associated costs shall be included in the prices bid for the various work items.

**END OF SECTION**

**SECTION A-5**  
**GENERAL REQUIREMENTS FOR BRIDGE ELECTRICAL WORK**

**1. SCOPE**

- (A) This section covers all products, labor, services, incidentals, and related work necessary to furnish, install, test, and put into permanent service all electrical work as shown on the plans and described in the Specifications.
- (B) This section, along with the following sections, comprise the Special Provisions for electrical work. The provisions and requirements of all sections of these electrical Special Provisions shall apply fully and equally to all electrical work and to all contractors performing electrical work. The provisions and requirements of this section are hereby incorporated into the sections listed below by this reference, and shall have the same force and effect as if printed in full in each of the sections listed.
1. Section A-6 – Wiring Methods and Materials
  2. Section A-7 – Grounding and Bonding
  3. Section B-3 – Miscellaneous Bascule Bridge Electrical Work
  4. Section B-4 – Bascule Bridge Electrical Equipment
- (C) Reference is also made to the following sections.
1. Section A-1 – Working Drawings and Submittals
  2. Section A-2 – As-Built Documentation
  3. Section A-3 – Guarantee
  4. Section A-4 – Maintenance of Bridge Operations
- (D) The contractor is expected to deliver a complete, functional, reliable, and safe installation which fully satisfies the requirements, both explicit and implicit, and intents of the contract documents.
- (E) Any work shown and/or described in any portion of the contract documents shall be executed as if shown and/or described in all portions of the contract documents.
- (F) Any work which is not shown and/or described in the contract documents, but is nevertheless necessary in order to properly carry out the intent thereof, shall be executed in its entirety as if it were specifically shown and/or described therein.

**2. GENERAL PROVISIONS**

- (A) Unless specifically noted otherwise in these contract documents, the Contractor shall bear full responsibility, at no additional payment, for all costs, damages, etc. related to compliance with this section and those sections which incorporate this section by reference.
- (B) Where terms such as "include" are used in identifying items belonging to a group, such identification shall be understood to be non-exhaustive and shall not in any way limit the applicable items to those explicitly identified.
- (C) Use of terms such as "furnish" or "provide" shall be understood to include acquisition, delivery to the project site, and installation of the identified item(s). Installation shall include physical installation, electrical and mechanical hook-ups, testing and adjustment, and generally making the identified item(s) fully operable in accordance with the requirements and intents of these contract documents.

- (D) Use of terms such as "required" or "necessary" shall be understood to include all of the following: as required by the contract documents; as stipulated by the Engineer; as required by applicable laws, regulations, and/or codes; as needed for correct, safe, and reliable operation.
- (E) Use of terms such as "approved" or "accepted" shall be understood to solely refer to approval by the Engineer as satisfying the requirements of the contract documents and acceptable for use and/or execution, except where a different meaning is made clear by the context of use.
- (F) Where terms such as "appropriate", or similar subjective terms, are used, the determination of appropriateness shall be solely at the discretion of the Engineer, the exercise of which shall not be considered cause for delay or additional payment.
- (G) The terms "products" and "materials" may be used interchangeably, and shall both generally be understood to include all raw materials, standard and custom manufactured products, equipment, devices and related appurtenances required to be furnished for the specified work.
- (H) Where these Special Provisions provide a list of acceptable alternatives for a product and/or method, it shall be understood as if the list were followed by the phrase "unless otherwise shown on the plans".
- (I) The term "contract documents" shall be understood to refer to the plans, Standard Specifications, Special Provisions, and all agreements, addenda, and additional documents which comprise the contract for this project.
- (J) The term "Prime Contractor" shall be understood to refer to the Contractor who is primarily liable for the acceptable completion of the overall project.
- (K) The term "Electrical Contractor" shall be understood to refer to the sub-contractor who, apart from the Prime Contractor, is primarily responsible for performing the electrical work. This is the Prime Contractor if no separate sub-contractor is used for the electrical work.

### **3. REFERENCED PUBLICATIONS AND STANDARDS**

- (A) Unless otherwise noted, the version of referenced standards or publications is the version in effect at the bid opening time for this contract.
- (B) The following publications form a part of these Special Provisions by this reference, and shall have the same force and effect as if printed herewith in full.
  - 1. AASHTO LRFD Movable Highway Bridge Design Specifications
  - 2. NECA 1 – Standard Practice for Good Workmanship in Electrical Contracting
  - 3. NETA Acceptance Testing Specifications
  - 4. NFPA 70 – National Electrical Code
  - 5. North Carolina Electrical Code
  - 6. North Carolina Department of Transportation Standard Specifications for Roads and Structures
  - 7. All applicable state and local codes.
- (C) Additionally, all work shall comply with all additional requirements of the Authorities Having Jurisdiction. It shall be the responsibility of the Contractor to contact the proper Authorities prior to beginning work in order to determine all requirements, as well as to maintain relevant communications with such Authorities throughout construction.

**4. QUALIFICATIONS OF CONTRACTORS, VENDORS, AND MANUFACTURERS**

- (A) The contract documents assume that all contractors and/or sub-contractors undertaking electrical work related to this project are properly qualified, skilled, and experienced in the type of work involved. It is similarly assumed that all vendors and manufacturers selected by the Contractor to provide products for this project are properly qualified, skilled, and experienced in the fabrication and/or manufacturer of the products involved.

The Contractor shall make no excuse for failure to satisfy the requirements of the contract documents based on lack of qualifications, skills, or experience of any contractor, sub-contractor, vendor, and/or manufacturer.

(B) Electrical Contractor

1. The Electrical Contractor shall be properly licensed by the State of North Carolina, and be primarily and regularly engaged in the installation and service of industrial electrical power distribution and control systems.
2. The Electrical Contractor shall employ on site supervisory personnel who are licensed electricians experienced in the installation and maintenance of industrial electrical power distribution and control systems.
3. The Electrical Contractor shall have been in the business of installing and servicing industrial electrical power distribution and control systems for at least ten continuous years as of the bid date.
4. In lieu of sub-contracting the electrical work to a separate Electrical Contractor, Prime Contractor personnel satisfying all of the above requirements may perform electrical work.

(C) General Vendors and Manufacturers

1. Vendors and/or manufacturers for electrical systems, sub-systems, and/or products, other than the control system, shall be primarily and regularly engaged in providing the items for which they are responsible.
2. Vendors and/or manufacturers for electrical systems, sub-systems, and/or products shall have been the business of providing the items for which they are responsible for at least 5 continuous years as of the bid date.
3. Additional qualification requirements for vendors and/or manufacturers shall be as given elsewhere in these Special Provisions.

4. Vendors and/or manufacturers for electrical systems, sub-systems, and/or products, other than the control system, need not be identified along with the bid documents unless such identification is required elsewhere in the contract document.

However, the Engineer may at any time request documentation demonstrating that a particular vendor or manufacturer satisfies the applicable qualification requirements of the contract documents. Any such request must be fulfilled to the complete satisfaction of the Engineer, including satisfaction of all applicable requirements. Failure to fulfill such a request to the satisfaction of the Engineer may be considered cause for the Engineer to order a halt to any work, without consideration for additional payment or delay, which is related to and/or affected by the vendor or manufacturer in question.

## **5. CONTROL OF WORK AND MATERIALS**

### **(A) Character of Work**

1. It is the intent, under this contract to secure high class workmanship in all respects, and that the finished work be workmanlike and acceptable in every detail.
2. In addition to the specific requirements given by the contract documents, all work shall comply with the following.
  - a. All work must properly perform its intended function in a reliable manner.
  - b. All work must be of substantial character such that it is not likely, in the Engineer's judgment, to become subject to premature failure during the course of normal service, including normal wear and tear.
  - c. All work must not pose any unusual and/or unreasonable danger to persons and/or property. All work must not be likely, in the Engineer's judgment, to expose persons and/or property to any unusual and/or unreasonable danger as a result of normal service, including normal wear and tear.
  - d. All work must be aesthetically acceptable in every way, including neatness and cleanliness.

### **(B) Quality Control**

1. The Contractor shall bear full responsibility for all coordination of features, ratings, etc. of products as may be required to provide complete, operational, reliable and safe system(s) and sub-system(s) in accordance with the requirements and intents of these contract documents.
2. The Contractor shall bear full responsibility for all coordination necessary to perform all work, including, but not be limited to, coordination with and/or between suppliers, vendors, sub-contractors, and trades.
3. All details shown on the plans are typical and apply to all similar locations, or as otherwise indicated. All dimensions and details shall be verified at the site before proceeding with any work, purchasing any items, or fabrication of any custom components. The Contractor shall bear all costs and/or damages which may result from the ordering or fabrication of any items or materials prior to such verifications.
4. The Engineer may request that the Contractor furnish product samples in order to assist the Engineer in determining the acceptability of a proposed product or procedure. Such samples shall be furnished by the Contractor at no additional cost, and will be returned at or before the end of the project.

5. The Engineer may request that the Contractor furnish standards, reference materials, and/or similar publications in order to assist the Engineer in determining the acceptability of a proposed product, procedure, or test result. Such publications shall be furnished by the Contractor at no additional cost, and will be returned at or before the end of the project.
6. All items shall be handled, applied or installed in strict accordance with manufacturer's recommendations and instructions and with these Special Provisions.

(C) Familiarity with Contract Requirements and Examination of Plans

1. It is the responsibility of the Contractor, prior to submission of a bid, to fully determine the nature and location of the work, the character, quality and quantity of the materials which will be required, the nature of equipment and facilities needed preliminary to and during the performance of the work, the general and local conditions, and of all other matters which can in any way affect the work for this project. Failure to comply with this requirements shall not relieve the Contractor from responsibility for completion of all specified work, and shall not be considered cause for delay or additional payment.
2. Do not acquire dimensions by scale measuring of the contract plans except where a scale is explicitly indicated. Do not acquire dimensions of existing features by scale measuring of the contract plans.
3. Any reference drawings included with the plans are provided as-is and may not reflect the actual current conditions at the job site. The Owner makes no claim as to the accuracy of any reference drawings. The Contractor shall bear full responsibility for field verification of all critical dimensions.
4. The Contractor shall bring to the attention of the Engineer for clarification any apparent typographical or drafting error in the plans and/or these Special Provisions. Typographical and/or drafting errors, discovered or undiscovered, shall not relieve the Contractor from responsibility for satisfactory completion of all specified work in accordance with the intent of these contract documents, and shall not be considered cause for additional payment.

(D) Harmony And Coordination Of Contract Documents

1. The contract documents, including any referenced publications, are intended to form a cohesive and consistent whole.
2. These Special Provisions shall in no way be interpreted as voiding any applicable provision or requirement contained in any other portion of the contract documents, including those intended to be generally applicable to all work regardless of type or trade, except that in the case of an irreconcilable conflict the Engineer shall determine which provision(s) and/or requirement(s) take precedence. Otherwise, the Contractor shall make every effort to comply with all applicable provisions and requirements.
3. The contractor shall immediately bring to the attention of the Engineer any conflict between or within the contract documents and/or referenced publications.
4. Resolution of any conflicts between or within the contract documents and/or referenced publications shall be at the discretion of the Engineer. The existence and/or resolution of such conflicts shall not be considered cause for delay or additional payment.
5. Dimensions shown on plans, unless obviously incorrect, shall take precedence over measurement by scale. Larger scale and/or detail plans shall take precedence over smaller scale and/or general plans.

(E) Field Measurements

1. Before ordering any materials or fabricating any items, the Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.
2. All field measurements which are critical to the fabrication of new items shall be verified before submission of shop drawings for such items. Field measurements noted on shop drawings shall be clearly differentiated from other dimensions.
3. The Owner and/or Engineer will not, as a part of shop drawings review, bear responsibility for verification of any field measurements made by the Contractor. Review of shop drawings by the Owner and/or Engineer does not in any way relieve the Contractor from responsibility for the accuracy of field measurements.
4. The Contractor shall bear full responsibility for any errors which may result from inaccuracy of field measurements.

(F) Brand Name Products and Substitutions

1. Identification by "brand name" shall be understood to indicate identification by manufacturer name and/or model name or number.
2. The identification of products, both on the plans and in these Special Provisions, by brand name or equal description is intended to be descriptive, but not restrictive, and is to indicate the characteristics, performance, and quality of products that are satisfactory. Except when noted otherwise, the Contractor may propose "equal" products for consideration by the Engineer. Such "equal" products may be used only if the Engineer determines that the proposed product satisfies the requirements identified in the contract documents, is acceptable for the intended use, and is substantially equal in characteristics, performance, and quality to the specified product.
3. The Engineer may disqualify any proposed "equal" product which in his past experience and/or judgment is of poor quality and/or not likely to perform reliably in the application under consideration.
4. Where a product is identified by brand name, that brand name product was used as the design basis. Where the Contractor proposes to use an approved "equal" product, even if such a substitution is approved by the Engineer, the Contractor shall assume all responsibility for its proper installation and fit into the system and shall bear sole responsibility for any resultant extra work, including products, labor, and related costs.
5. The Contractor shall bear full responsibility for supplying to the Engineer all information required for the Engineer to determine the acceptability of a proposed "equal" product or procedure. The Engineer may request additional information, beyond what is explicitly required by these contract documents, to assist in determination of acceptability.
6. Determination of the acceptability of a proposed "equal" product shall be solely at the discretion of the Engineer. Rejection of a proposed "equal" product shall not be considered cause for delay or additional payment.
7. Because of the continuously changing nature of commercially manufactured products, neither the Owner nor the Engineer warrant that any identified brand names are available, accurate, and/or satisfy all requirements of the contract documents. The Contractor shall bear full and final responsibility for selection of products which satisfy all identified requirements. In case of any discrepancy, or other conflict, between the salient



requirements identified in the contract documents and products identified by brand name, the salient requirements shall govern. Any such conflict, or other discrepancy, shall not be considered cause for delay or additional payment.

(G) Inspection Of Materials And Workmanship

1. All products and work, including fabrication, erection, and/or installation procedures, are subject to inspection and testing by the Engineer at all times. If any products and/or installations are found to be defective it shall be the Contractor's responsibility to coordinate repair or replacement at no additional cost.
2. Under no circumstances shall any inspection and/or test by the Engineer or his duly authorized representative, or any approval granted as a result thereof, relieve the Contractor from responsibility for full compliance with the requirements of these contract documents.
3. Where inspections or tests are to be made at the point of manufacture or fabrication, the Contractor shall in all cases give ample notice to the Engineer to permit such inspection and tests to be performed before shipment is made.
4. The Contractor shall make all work and products physically accessible to the Engineer for inspection and testing at all times. Walkways, platforms, ladders, and specialized equipment required for convenient and safe access to areas of work shall be provided by the Contractor. The Contractor shall provide all tools and labor to remove and replace covers, disassemble and reassemble equipment or structural features, etc. as may be directed by the Engineer to facilitate inspection and testing by the Engineer.
5. The Contractor shall keep the Engineer informed regarding the progress of work and provide the Engineer with reasonable advance notice of milestones during construction when inspection and/or testing by the Engineer may be required. The Contractor shall also coordinate construction activities to allow access to all work by the Engineer, as well as provide the time required by the Engineer to perform all inspection and testing. If, in the Engineer's judgment, the requirements of this paragraph are not being complied with, the Engineer may order the Contractor to halt work to allow for inspection and testing to take place. Any such disruption to work shall not be considered cause for delay or additional payment.
6. The Contractor shall furnish all facilities for the inspection of products and workmanship at the point of manufacture or fabrication, and inspectors shall be allowed free access to the necessary parts of the premises.
7. The Contractor shall be charged with any additional cost of inspection when material and workmanship are not ready at the time inspection is requested by the Contractor.
8. The Contractor shall furnish, promptly and without additional charge, all samples and specimens that are herein specified or that may be required by the Engineer to be taken or prepared in the field, and shall furnish labor and assistance, testing machines, tools and equipment necessary to prepare the samples and specimens as directed by the Engineer. Samples and specimens which the Engineer shall designate to be sent to the testing laboratories shall be shipped by the Contractor, as directed by the Engineer, at the Contractor's expense.
9. For any materials not covered by a designed specification of some specified organization, appropriate methods of testing and inspection to be outlined or designated by the Engineer shall be followed.

10. All samples for analyses and tests shall be taken in such manner as to be truly representative of the entire lot under test and shall not be worked in any way to alter the quality before testing. Where expressly permitted by the Engineer in the case of materials taken from stock or for use in minor parts, certified analyses and tests of the manufacturer furnished in triplicate may be accepted in lieu of tests prescribed herein. In case the records of physical and chemical tests of stock material are not available, a reasonable number of tests shall be furnished to the Engineer free of charge as required by the Engineer to satisfy himself as to its quality.
  11. Inspection and tests of fabricated parts and manufactured articles shall be made by such methods and at such times as to insure compliance with the specification in all respects.
  12. Any material may be rejected if, in the opinion of the Engineer, service records indicate that it is unsound or otherwise unsatisfactory.
  13. The Contractor shall furnish the Engineer with as many copies of purchase orders to subcontractors, suppliers or manufacturers as the Engineer may direct.
  14. All machining and preparation of test samples, required by the A.S.T.M. or other specification and cited as standard for this contract, shall be done by the Contractor at his own expense, except as otherwise specified herein.
  15. Should the preparation of the material be at far or inaccessible points or should it be divided into unreasonably small quantities, or widely distributed to an unreasonable extent, or should the percentage of rejected material be unreasonably large, the additional cost of extra inspection resulting therefore shall be borne by the Contractor, the Engineer being sole judge of what is to be deemed extra inspection.
  16. The Engineer shall have full power to reject any and all material or work which fails to meet the terms of the contract documents and such material or work shall be promptly repaired, or removed and replaced with new, as may be directed by the Engineer. All material or work which develops defects during the life of the contract either before or after installation shall be removed and replaced notwithstanding that it may have passed the prescribed inspection and tests.
  17. The Contractor shall immediately correct any imperfect work which may be discovered before final acceptance of the project at no additional cost. The fact that any such work may have been inspected shall not relieve the Contractor of any of his obligations to perform proper and satisfactory work, as herein specified, and all work which, during its progress, may become damaged from any cause or fails for any reason to satisfy the requirements of the contract documents, shall be removed and replaced by good and satisfactory work by the Contractor without any additional cost to the Owner and such work shall be subject to the approval of the Engineer.
  18. The Contractor shall furnish, at no additional cost, all labor and assistance necessary for the Engineer or his duly authorized representative to make such inspection and tests of workmanship as specified herein or as directed by the Engineer.
  19. These requirements shall apply equally to all work and products at the project site, in a shop, and in off-site storage.
- (H) Acceptance of Work
1. Acceptance of all work is at the sole discretion of the Owner and the Engineer.

2. The Contractor shall perform all tests and operational demonstrations, and fully cooperate with all inspections, required by the Owner and Engineer for the purpose of determining that all work satisfies the requirements of the contract documents. Such tests, demonstrations, and inspections shall be at no additional cost.
3. While individual systems and/or sub-systems may be granted preliminary acceptance during the course of construction, final overall acceptance of all work will not be granted until such time as the Owner and Engineer are satisfied that all work fully satisfies the requirements of the contract documents. Any preliminary acceptance granted prior to final acceptance shall in no way restrict the Owner's right to require further adjustment prior to final acceptance, nor shall it relieve the Contractor of responsibility for full compliance with the requirements of the contract documents.
4. The Contractor is hereby notified that the Engineer is in no way obligated to grant preliminary acceptance to any portion of the electrical work. Denial of any request to grant preliminary acceptance shall not be considered cause for additional payment or delay.
5. Acceptance of any work, either partial or full, shall not relieve the Contractor for full and final responsibility for compliance with the contract documents, and shall in no way be interpreted as limiting the Contractor's liability for defects in the work due to failure to comply with the contract documents, including any defects discovered after acceptance of the work.

## **6. SUBMITTALS**

- (A) The contract documents are intended only to depict the general intent of this contract; they are not of sufficient detail to be used in lieu of required submittals. All required additional detail development shall be provided at no additional cost.
- (B) The Contractor's Electrical Engineer shall coordinate and supervise the preparation of all electrical submittals, and fully review and check all submittal items, including those originally prepared by all sub-contractors and vendors, prior to submission for compliance with the requirements of the contract documents, compatibility with all new and existing work, and coordination with other submittal items.
- (C) Submittals shall comply with Section A-1 – Working Drawings and Submittals.
- (D) Product Submittals
  1. Brochures, catalog cut and specification sheets, and other product literature for all standard or semi-standard products.
  2. Certified drawings for standard or semi-standard products when requested by the Engineer, or as otherwise required by the contract documents. Submit certified drawings shall be provided for all motors not provided as an integral component of a piece of standard or semi-standard equipment by the manufacturer of that equipment. Certified drawings shall clearly depict all critical dimensions, as well as all electrical and mechanical ratings. Where motors are provided with special modifications (encoders, extended shafts, etc.), these modifications shall be reflected on the certified drawings. Manufacturer's standard catalog drawings are not acceptable in place of certified drawings.
  3. Material test certificates for raw materials when requested by the Engineer, or as otherwise required by the contract documents.

4. Product submittals shall be provided for all products proposed for installation, even if the proposed products are identical to those specified by the contract documents.
5. Each set of product submittal information shall cover only one distinct product.

(E) Working Drawings

1. Shop and assembly drawings for fabricated items and assemblies.
2. Layout, erection, and installation drawings and details.
  - a. Layout and installation drawings shall be developed to show proposed locations, dimensions, and clearances to floors, walls, ceilings, structural members, mechanical components, and other nearby objects and equipment. Drawings need not necessarily be to scale, but items must be shown in their proper relative positions and be dimensioned. Drawings shall explicitly show National Electrical Code required "working" and "dedicated equipment" spaces about electrical equipment. Drawings shall clearly show the Contractor's proposed method of attachment, mounting details, specific hardware, any and all holes to be drilled or cut in structural steel or masonry, etc. Mounting detail drawings may be in the form of hand drawn details on 8 1/2 x 11 inch or 11 x 17 inch sheets where appropriate, but must be clearly titled and include a drawing number.
  - b. Layout and installation drawings shall be submitted for approval prior to performing the work in question.
  - c. If layout and installation drawings are not submitted for approval prior to performing related work, or the submitted drawings are in any way incomplete or deficient (omitted items, inaccurate scale or dimensions, etc.), the Engineer may require the Contractor to relocate any affected electrical equipment which is installed in violation of National Electrical Code "working" or "dedicated equipment" spaces or which the Engineer determines is installed in an inappropriate location. Such relocation, and/or any related remedial work, shall not be considered cause for delay or additional payment.
3. Conduit, raceway, and cable tray layout drawings and details.
  - a. Conduit and raceway layout diagrams shall show each raceway utilized, with all wire numbers installed therein, in tabular or spreadsheet format. Spare conductors shall also be assigned wire numbers. Different symbols shall be used to clearly distinguish between underground, concrete encased, in-wall, and exposed conduits, as well as cable trays, flexible cables, wireways, junction boxes, terminal cabinets, equipment, and enclosures.
  - b. Drawings shall be fully coordinated with the all wiring diagrams, tabulations, and shop drawings.
4. Wiring diagrams and tabulation.
  - a. Multi-line wiring diagrams shall be submitted for approval prior to installation of raceways and wiring. Diagrams shall show all circuit phase, neutral, and grounding conductors. All conductors shall be identified on the diagrams by wire numbers that match the same respective conductors or connections shown on other diagrams and shop drawings. Wiring diagrams shall clearly indicate the size and type of all conductors.

- b. Wiring diagrams are not intended to be to scale, but shall show all equipment, terminal cabinets, splices, etc. Items shall be shown in their approximate geographic orientation to each other to the extent practical.
  - c. Wiring diagrams shall show locations of all conductor splices and connections, including equipment hook-ups, and indicate the proposed splice or connection method.
  - d. Conductor tabulations shall be provided and clearly indicate all wire numbers passing through or terminating in each raceway, box, cabinet, and equipment enclosures. All raceways, boxes, cabinets, and equipment enclosures shall be included on the tabulations. Tabulations shall include device served and function of each conductor. Spare conductors shall also be assigned wire numbers and listed.
5. Nameplates for electrical equipment, including proposed text. The text of nameplates which are part of a product depicted on a shop drawing shall be clearly shown on that shop drawing.

- (F) Submit testing procedures and results as required.
- (G) Submit all additional information as may be described elsewhere in the contract documents, or as otherwise required by the Engineer in order to determine the acceptability of proposed products and/or work.

## **7. PRODUCT WARRANTIES**

- (A) All product warranty certificates, and similar warranty information, shall be stored at a single location on the project site and be turned over to the Owner prior to final acceptance of the project.
- (B) Warranty information shall be clearly marked to identify the components covered and allow cross referencing back to the as-built contract and shop drawings.
- (C) Where registration is necessary as a condition of warranty coverage, warranties shall be registered to the Owner.

## **8. PRODUCTS AND EXECUTION**

- (A) All electrical work shall be performed by electricians and helpers who are trained and experienced in the installation and maintenance of industrial electrical power and control systems. Specialty technicians shall be trained and experienced in the type of work they are performing. All electrical work shall be supervised by properly qualified supervisory personnel (see requirements for Contractor qualifications and the Contractor's Electrical Engineer given elsewhere in these Special Provisions).
- (B) All mechanical, structural, or other such work related to electrical work shall be performed by persons who are properly trained, qualified, and experienced in the type of work being performed.
- (C) All electrical work shall conform to the requirements of the contract documents, the National Electrical Code, and any applicable federal, state, and local laws and/or regulations.

In no way shall these contract documents be interpreted as requiring a violation of the National Electrical Code (NEC), or any other applicable federal, state, or local laws and/or regulations. In

any case of dispute between the contract documents and the NEC, preference shall be given to the more stringent requirements. The Engineer shall immediately be informed of any such dispute.

- (D) All work shall be neat and workmanlike per NECA 1.
- (E) The Contractor shall bear full responsibility for the completion of all work in a professional and safe manner.
- (F) The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Engineer of any discrepancy before performing any work.
- (G) Unless specifically indicated otherwise, products, tools, and equipment used for electrical work shall be standard items of manufacturers regularly engaged in the manufacture of such items.
- (H) In addition to the items explicitly shown on the plans and described in these Special Provisions, the Contractor shall be responsible for providing all miscellaneous products, tools, equipment, and labor necessary for providing a complete, operational, reliable and safe system(s) and sub-system(s) in accordance with the requirements and intents of these contract documents.
- (I) Unless specifically noted otherwise, all electrical equipment locations, conduit and raceway routings, etc. shown on the plans are schematic in nature and may not reflect actual dimensions and/or locations. The Contractor shall verify all relevant dimensions prior to performing any work, and shall bear full responsibility for compliance with National Electrical Code (NEC) required clearances (i.e. "Working Space", "Dedicated Equipment Space", etc.). The Engineer shall immediately be informed of any conflict between equipment locations shown on the plans and NEC required clearances. In the case of any such conflict, the equipment in question shall be relocated, or similar remedial action taken, as may be directed by the Engineer and at no additional cost.
- (J) All details shown on the plans are typical and apply to all similar locations, or as otherwise indicated. All dimensions and details shall be verified at the site before proceeding with any work, purchasing any items, or fabrication of any custom components. The Contractor shall bear all costs and/or damages which may result from the ordering or fabrication of any items or materials prior to such verifications.
- (K) Manually operable devices shall not be mounted less than 2 feet or more than 6 feet above the finished floor as measured to the center of the handle, button, or similar operator. Mounting heights for various other devices shall be as indicated, or as given in Chapter 11 of NECA 1 where no height is indicated.
- (L) The manufacturer(s) of all products covered shall have been primarily and regularly engaged in the manufacture of such products for a continuous period of at least ten years as of the bid date. When requested by the Engineer, documentation demonstrating compliance with this requirement shall be submitted.
- (M) To the extent practical, and unless otherwise indicated, all like products shall be by the same manufacturer.
- (N) Install all products in accordance with their manufacturers' recommendations and the requirements of the NEC and these contract documents.
- (O) Physically install all products in a secure manner as indicated and as required to provide a reliable installation.
- (P) Inspect and test all installed products for correct installation, performance, and workmanship.

- (Q) Torque all terminals and other current carrying connections per the manufacturer's recommendations using calibrated tools.
- (R) Nameplates and warning labels shall be provided for all equipment, cabinets, boxes, etc. in accordance with the requirements given elsewhere in these Special Provisions.
- (S) All conductors shall be labeled in accordance with the requirements given elsewhere in these Special Provisions.

## **9. MISCELLANEOUS PRODUCTS**

- (A) In addition to the products explicitly indicated, it shall be the responsibility of the Contractor to provide all additional items required to provide a complete bridge electrical power and control system. Such items include, but are not limited to: miscellaneous conductors and jumpers, conductor lugs and terminals, raceways and fittings, boxes and enclosures, fasteners, and miscellaneous mounting hardware.

## **10. COORDINATION OF INTERFACES**

- (A) The Contractor shall be responsible for ensuring proper interfacing between electrical systems, and/or sub-systems, and the bridge operating machinery, the bridge structure, and miscellaneous equipment.

## **11. DELIVERY, STORAGE, AND HANDLING**

- (A) All products shall be delivered to the site in accordance with the approved sequence of construction. All products shall be properly protected until installation, including during shipment and storage.
- (B) Prior to shipment from the manufacturer's and/or fabricator's plant or plants, the Contractor shall prepare all products for shipment. All large, bulky and/or heavy items shall be securely mounted on skids or pallets of ample size and strength to facilitate loading and unloading. All small parts shall be boxed in sturdy wood or heavy corrugated paperboard boxes. A packing list enclosed in a moisture-proof envelope and indicating the contents of each such box shall be securely attached to the outside of the container. The skid/pallet mounting and boxing shall be done in a manner that will prevent damage to the equipment during loading, shipment, unloading, storage and any associated and/or subsequent handling. Weatherproof covers shall be provided during shipment to protect any and all items shipped in open railway cars, trucks, or barges. Any eyebolts, special slings, strongbacks, skidding attachments or other devices used in loading the equipment at the manufacturer's and/or fabricator's plant or plants shall be furnished for unloading and handling at the destination.
- (C) Products shall be stored so as to permit easy access for inspection and identification, and be protected from the ground by the use of pallets, platforms or other means. Products shall not be stored in a manner that would cause distortion or damage.
- (D) All large units shall have lifting eye bolts or lifting holes properly sized for safe working loads and located to provide a balanced lift.

**12. EXISTING FACILITIES**

- (A) The Contractor shall verify the locations of all existing facilities, both above ground and below ground, and exercise extreme care during construction to not damage existing facilities. Any damage to existing facilities resulting from the Contractor's activities shall be repaired by the Contractor, to the satisfaction of the owner of the facility, at no additional cost.
- (B) The Contractor shall trace, locate, identify, and tag all existing equipment and conductors which are to remain or be moved and put back into service. Any damage to equipment and/or conductors which are to remain or be moved and put back into service resulting from the Contractor's activities shall be repaired by the Contractor, to the satisfaction of the Engineer, at no additional cost.

**13. PROTECTION OF WORK**

- (A) The Contractor shall at all times protect and preserve all materials, supplies, and equipment of every description (including property which may be furnished or already owned by the Owner) and all work performed.
- (B) All reasonable requests of the Engineer to enclose or specially protect such property shall be complied with.
- (C) If, as determined by the Engineer, material, equipment, supplies, and work performed are not adequately protected by the Contractor, such property may be protected by the Owner and the cost thereof may be charged to, or deducted from any payments due to, the Contractor.

**14. TEMPORARY PROVISIONS**

- (A) The Contractor shall bear full responsibility for providing all temporary provisions as may be required to accomplish all work and permit continued operation and use of existing equipment and facilities during prosecution of such work.
- (B) The Contractor shall maintain, throughout the course of the project, temporary navigation lighting as may be required by the United States Coast Guard. The Contractor shall be responsible for coordinating temporary navigation lighting requirements with the Coast Guard.
- (C) Unless specifically noted otherwise, all temporary provisions required by these contract documents shall be provided at no additional cost.

**15. CLEANING AND MAINTENANCE**

- (A) The Contractor shall keep the project premises, and adjoining premises, clean from excess material, debris, and rubbish caused by Contractor's operations at all times.
- (B) The Contractor shall clean the project premises prior to final acceptance. Cleaning shall include, but not be limited to, the following.
  - 1. Removal of excess materials, debris, and rubbish.
  - 2. Removal of grease, oil, paint, and similar materials from the surfaces of installed materials and equipment.
  - 3. Touch-up painting as may be required to repair damage to the finishes of installed materials and equipment.
  - 4. The Contractor shall maintain all work during construction and until the work is finally accepted. All costs of such maintenance shall be included in the unit prices bid for the various items; no additional payment will be made for materials, labor, or incidental costs related to any such maintenance.



**16. TESTING AND ADJUSTMENTS**

- (A) The Contractor shall be responsible for performing all testing, inspections, and any resulting corrective work as may be necessary in order to ensure that all work is functioning properly, and as otherwise required elsewhere in these Special Provisions.
- (B) All testing, inspections, and demonstrations, and any resulting remedial work, will be deemed solely the responsibility of the Contractor and will not be considered cause for delay or additional payment.
- (C) Procedures and equipment used for the testing required by these Special Provisions shall be in accordance with manufacturer's recommendations, NETA Acceptance Testing Standards, any other applicable industry standards, and be appropriate for the specific test being performed. Voltmeters, ammeters, etc. shall be true RMS type. Where recording instruments are required, they shall be three phase, strip chart or computer based type. All tools and instruments shall be specifically designed for measuring the quantity in question and be maintained in properly calibrated condition.
- (D) Prior to energizing any circuit or connection of any piece of equipment to any circuit, the following tests shall be performed.
1. Measure the supply voltage and phase rotation and verify that both are correct for the equipment installed.
  2. Verify that all conductors and current carrying parts of equipment are continuous, free of shorts, opens, or unintentional grounds, and that all conductors are properly terminated.
- (E) In addition to the required quantitative tests, the Contractor shall also be responsible for performing all qualitative inspections which may be required to ensure that all electrical work is properly executed. Such inspections shall include, but not be limited to, the following.
1. Visual inspection of all electrical connections.
  2. Visual inspection of all raceway, conductor, device, and equipment installations.
  3. Verifying proper operation of all operating mechanisms and mechanical interlocks.
  4. Verifying proper tightening of mechanical lugs and terminals.
  5. Inspection of all hardware connections.
- (F) All portions of the electrical work, both individually and as a whole, shall be subjected to operational, as installed, testing. Such testing shall be as required to establish that the item(s) under test meet all specified requirements and are operating in a reliable manner. The Contractor shall also be prepared to conduct any additional miscellaneous operational demonstrations as may be requested by the Engineer to establish that a given product, system, or subsystem meets all specified requirements and is operating in a reliable manner.
- (G) For all test results which fall outside the stated acceptable values or conditions or the Engineer finds unacceptable, the Contractor shall investigate the cause of the failure, take appropriate corrective actions, and repeat the test(s). This procedure shall be repeated until such time as all test results are deemed acceptable by the Engineer.

**17. MEASUREMENT AND PAYMENT**

- (A) Work covered by this section is incidental to the various items of electrical work, and will not be separately measured or paid for. All costs associated with this section shall be included in the prices bid for the various items of electrical work, as appropriate.

**END OF SECTION**

**SECTION A-6**  
**WIRING METHODS AND MATERIALS**

**1. SCOPE**

- (A) This section covers all products, labor, services, incidentals, and related work necessary to furnish, install, test, and put into permanent service all general wiring as shown on the plans and described herein.
- (B) This section is a component of the electrical Special Provisions. The provisions and requirements of Section A-5 – General Requirements for Bridge Electrical Work are hereby incorporated into this section by this reference, and shall have the same force and effect as if printed here in full.

**2. SUBMITTALS**

- (A) All submittals as required by Section A-5 – General Requirements for Bridge Electrical Work.

**3. GENERAL REQUIREMENTS**

- (A) All conductors shall be labeled in accordance with the requirements given elsewhere in these Special Provisions.
- (B) All wire and cables shall be fully insulated with stranded copper conductors. Solid and/or aluminum conductors shall not be used.
- (C) Conductors with green colored insulation shall be used only for grounding conductors. The re-identification of conductors with green colored insulation, such as with colored tape, is not permitted.
- (D) All branch and feeder circuits requiring a neutral shall be supplied with a dedicated neutral conductor. Neutrals shall not be shared by two or more phase conductors, except where all conductors are serving a single piece of equipment, or for multiwire branch circuits serving lighting loads where indicated.
- (E) Coordinate all wire and cable requirements with manufacturers of equipment served.
- (F) Wiring, where practical, shall be bundled and run neatly, plumb or level, parallel to edges of cabinets, or at right angles.
- (G) Care shall be exercised in the handling and installation of wire and cable to avoid damage to conductors, insulation, jackets, armor, etc. Wire or cable which is found to be damaged shall be replaced at no additional cost.
- (H) Unless specifically indicated otherwise, conduit and cable entrances in damp and wet locations shall be made only in the bottom of cabinets and/or enclosures.
- (I) To the extent practical, maintain at least one foot separation between power wiring and communication and/or instrumentation cables.
- (J) Conduits, cable trays, cable armor, boxes and other raceways shall be installed such that they are electrically continuous from end to end. Bonding jumpers and related hardware shall be provided at expansion fittings and elsewhere as necessary to ensure electrical continuity.
- (K) Except where specifically noted otherwise, insulated throat bonding bushings or bonding nuts shall be provided wherever conduits or metal armored cables enter metal boxes or enclosures.

Bonding bushings and bonding nuts shall be connected to the equipment grounding conductor installed in the conduit or cable. Boxes, cabinets, and enclosures shall be bonded directly, not just through the conduit(s) and or connector(s), to each equipment grounding conductor. This connection may be made by a jumper tapped to the main equipment grounding conductor(s).

- (L) Provide riser supports for vertical conduits as required by the NEC. Riser supports shall consist of stainless steel mesh cable grips mounted inside a pull box or similar enclosure. Secure cable grip mesh to at top and bottom with stainless steel hose clamps. In-conduit type supports shall not be used.
- (M) Provide conduit expansion fittings as indicated, at all structural expansion joints, as required to comply with the NEC, and as required to provide a complete and reliable installation.
- (N) Install metal conduit and tubing in accordance with the Steel Tube Institute of North America's Guidelines for Installing Steel Conduit / Tubing.
- (O) Make bends in rigid conduit with tools which are specifically designed for bending the type and size of conduit in question. Exercise care when bending conduit to maintain proper internal diameter and wall thickness.
- (P) All conduits, cables, conductors, and terminal blocks shall be labeled. See the specific requirements given elsewhere in this section.
- (Q) Prior to energizing any circuit for the first time:
  1. Verify that all conductors are continuous and free of shorts, opens, and/or unintentional grounds.
  2. Physically inspect accessible portions of the wire and/or cable for signs of damage.
  3. Verify that all circuit conductors are properly terminated and that all connections are tight. Use calibrated torque wrenches, screw drivers, and/or similar tools to verify proper mechanical connection torque levels in accordance with NETA Acceptance Testing Specifications and/or the manufacturer's recommendations.

#### **4. WIRING METHODS**

- (A) Only the wiring methods specifically indicated on the plans are permitted.

#### **5. CONDUCTORS FOR GENERAL WIRING**

- (A) UL Listed Type XHHW-2, except that UL Listed Type MTW, THWN, or similar moisture and heat resistant insulation shall be permitted for use inside factory assembled control panels. Rated 600 volts.
- (B) Shall satisfy the requirements of ICEA S-95-658 / NEMA WC-70, and the National Electrical Code.
- (C) Conductor sizes as indicated, as required for the equipment served, and as required elsewhere in this section.
- (D) Suitable for use in wet locations, oil resistant. Where installed in cable tray, or otherwise exposed to sunlight, shall be rated as sunlight resistant.
- (E) Soft annealed copper conductors per ASTM B3, stranded per ASTM B8 Class B.
- (F) Size of conductors permanently marked on insulation.
- (G) Shall be as manufactured by Encore Wire, Southwire, Okonite, or approved equal.

## **6. SPECIALTY CABLE**

- (A) Specialty cables shall be provided as required for the equipment and/or systems served. Conductor sizes, counts, and similar characteristics shall be as recommended by the manufacturer of the equipment and/or system served.
- (B) Insulation shall be rated at least 300 volts. Where installed in the same raceway, cable tray, or enclosure with power and/or lighting circuits, or where otherwise required by the NEC, insulation shall be rated at least 600 volts.
- (C) Outer jacket shall be sunlight and oil resistant.
- (D) Where required by the Engineer due to the installation method and/or environment, cable shall be rated for direct burial.

## **7. LOW VOLTAGE SPLICES, TERMINALS, AND TERMINAL BLOCKS**

- (A) Provide all splices, taps, connectors, terminals, terminal blocks, and related appurtenances as required to provide a complete installation.
- (B) Conductors shall not be spliced, except under one of the following conditions.
  - 1. When making final connection to luminaires, receptacles, or similar devices.
  - 2. When making field connection(s) to equipment which is factory supplied with hook-up leads.
  - 3. Where specifically indicated otherwise.
  - 4. With the permission of, and as prescribed by, the Engineer when absolutely required by conditions of installation.
- (C) Splices and/or taps made in conductors 10 AWG and smaller for making final connection to luminaires, receptacles, or similar devices may be made with insulated, set-screw type connectors (Ideal Models 10, 11, or 22, or approved equal). Set-screw connectors shall be provided with a flame retardant insulating shell and wrapped with vinyl electrical tape after installation.
- (E) All other splices and/or taps shall be made on heavy duty, insulated, screw type terminal blocks mounted in terminal cabinets. Terminal blocks shall have no more than two conductors per terminal.
- (F) Splices and/or taps made at equipment or in locations which do not permit the use of terminal blocks may be made with crimp or mechanical type connectors with the Engineers permission. Splices made with crimp or mechanical type connectors shall be insulated with rubber and vinyl tape, or an insulating cover specifically designed for use with the connector, after installation. The Engineer may requires the use of special splices or splice kits to address specific application considerations.
- (G) Terminal Blocks and Power Distribution Blocks
  - 1. Terminal blocks and power distribution blocks shall be heavy duty, UL Listed or Recognized, rated 600 volts and 90 Celsius, suitable for use with copper conductors, NEMA style, barrier type, tin plated copper or aluminum, Valox or phenolic insulated, either terminal screws or mechanical box lugs.

2. Terminal blocks in control system cabinets may be as described elsewhere in these Special Provisions.
3. Mount terminal blocks with stainless steel bolts or machine screws.
4. Provide engraved labels for all terminals.
5. Terminal blocks and power distribution blocks shall be as manufactured by Marathon Special Products, ILSCO, or approved equal.

(H) Crimp Type Lugs, Terminals, and Connectors

1. Crimp type lugs, terminals, and connectors shall be UL listed for 600 volts and 90 Celsius, for use with copper conductors, and manufactured from electro-tin plated copper or aluminum.
2. Lugs and connectors for conductors 8 AWG and larger shall be one-piece, seamless design.
3. Terminals shall be ring or flanged-fork type.
4. Terminals and connectors for conductors 10 AWG and smaller shall be provided with integral nylon insulating sleeves and brass sleeve insulation grips.
5. Crimp type lugs, terminals, and connectors shall be as manufactured by 3M, ILSCO, or approved equal.

(I) Mechanical Type Lugs and Connectors

1. Mechanical type lugs and connectors shall be set-screw type, UL listed for 600 volts and 90 Celsius, for use with copper conductors, and manufactured from electro-tin plated copper or aluminum.
2. Torque all mechanical lugs and connectors per the manufacturer's recommendations using calibrated tools.
3. Mechanical type lugs and connectors shall be as manufactured by ILSCO, or approved equal.

(J) Insulating Tape and Taping

1. Rubber tape shall be highly conformable, linerless Ethylene Propylene Rubber, high voltage (suitable for use up to 69 kV), self bonding insulating tape. Minimum 30 mils thick. Shall be rated 90 Celsius continuous and 130 Celsius short term. Scotch (3M) 130C, or approved equal.
2. Vinyl tape shall be UL Listed, premium grade, all weather, flame retardant, self bonding vinyl electrical tape. Shall be UV (per UL 510), abrasion, corrosion, alkaline, and acid resistant. Minimum 7 mils thick. Shall be rated 105 Celsius continuous. Scotch (3M) Super 33+ or Super 88, or approved equal.
3. For splices without integral insulating sleeves, tightly apply a minimum of one half-lapped layer of rubber tape, tacky side up, over entire splice and extending onto the conductor insulation at least one tape width on both sides of splice. Apply a minimum of two half-

lapped layers of vinyl tape completely over rubber tape and extending onto conductor insulation past ends of rubber tape.

4. For splices which are provided with integral insulating sleeves, apply a minimum of two half-lapped layers of vinyl tape completely over splice and extending onto conductor insulation past ends of splice.
- (K) Provide special splices and splice kits, with all required accessories and appurtenances, as shown on the plans, as required elsewhere in these Special Provisions, or as required by the Engineer to address specific application considerations for splices allowed by special permission.

## **8. CONDUCTOR IDENTIFICATION**

- (A) All conductors and terminal blocks shall be permanently labeled at every terminal or connection, splice, and tap. Each conductor shall be assigned an identifying number (including spares), and shall be assigned only one number throughout the entire electrical or control system. Identification numbers shall be coordinated for consistency and accuracy with numbers shown on the contract plans, and on the Contractor's approved wiring diagrams and shop drawings, field wiring diagrams, and any other diagrams containing the same respective conductor.
- (B) Conductor labels shall be machine printed, water and smudge resistant. Hand written labels are not acceptable. Labels shall be snap-on, slide-on, or heatshrink type. Adhesive type labels are not acceptable.
- (C) Terminal blocks labels shall be engraved plastic.

## **9. RIGID METAL CONDUIT (RMC) – STEEL**

- (A) UL Listed, threaded rigid metal conduit. Manufactured from high-strength steel and hot-dip galvanized inside and out per ANSI C80.1.
- (B) Size shall be as indicated and as required. Minimum size shall be 3/4 inch.
- (C) Threads shall be 3/4-inch taper NPT. Factory cut threads shall be galvanized after cutting.
- (D) Field cuts to conduit shall be made square and reamed to remove burrs. Field cut threads shall have same length, dimensions, and taper as factory-cut threads. Clean field cut threads with an appropriate degreasing solvent after cutting and coat with zinc-rich cold galvanizing compound. Any area on the interior of the conduit which has been disturbed by reaming shall be similarly treated.
- (E) Shall be as manufactured by Allied Tube and Conduit, or approved equal.

## **10. RIGID METAL CONDUIT (RMC) – PLASTIC COATED STEEL**

- (A) UL Listed, threaded rigid metal conduit. Manufactured from high-strength steel and hot-dip galvanized inside and out per ANSI C80.1.
- (B) Size shall be as indicated and as required. Minimum size shall be 3/4 inch.
- (C) Exterior coating shall be UV resistant PVC, minimum 40 mils thick. The adhesion of the PVC coating to the conduit shall be greater than the strength of the coating itself. Overall conduit shall be UL listed with the PVC coating as the primary corrosion protection and the underlying galvanized coating as supplemental protection. Conduit shall be ETL verified to the Intertek ETL Semko High Temperature H2O PVC coating adhesion test procedure for 200 hours.

- (D) Shall comply with the requirements of NEMA RN1.
- (E) Independent certified test results shall be available to confirm coating adhesion under the following conditions.
  1. Conduit immersed in boiling water with a minimum mean time to adhesion failure of 200 hours per ASTM D870.
  2. Conduit and conduit exposure to 65 Celsius and 95% relative humidity with a minimum mean time to failure of 30 days per ASTM D1151.
  3. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test per ASTM D3359.
  4. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone per ASTM D1308.
  5. The exterior coating bond shall be confirmed using the methods described in Section 3.8 of NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1 of NEMA RN1.
- (F) Interior coating shall be urethane, minimum 2 mils in thickness.
- (G) Threads shall be 3/4-inch taper NPT. Factory cut threads shall be galvanized after cutting.
- (H) Field cuts to conduit shall be made square and reamed to remove burrs. Field cut threads shall have same length, dimensions, and taper as factory-cut threads. Clean field cut threads with an appropriate degreasing solvent after cutting and coat with a touch-up compound as recommended by the conduit manufacturer. Any area on the interior of the conduit which has been disturbed by reaming shall be similarly treated.
- (I) Plastic coated rigid metal conduit shall be installed using tools and methods which will not cause damage to the PVC coating. Any areas on the exterior of the conduit which have been damaged during installation shall be coated with an exterior patching compound as recommended by the conduit manufacturer.
- (J) All installers of PVC coated conduit shall be certified by the conduit manufacturer. Written documentation of such certification shall be provided to the Engineer.
- (K) Shall be Robroy Industries Plasti-Bond REDH2OT, or approved equal.

#### **11. LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)**

- (A) UL Listed, continuous, flexible galvanized steel conduit made liquidtight by covering with an oil, chemical, sunlight, weather resistant, and liquidtight polyvinyl chloride cover.
- (B) Size shall be as indicated and as required. Minimum size shall be 3/4 inch, except that 1/2 inch may be used for connections to luminaires, and at other locations where specifically identified.
- (C) Suitable for use in exposed and concealed locations from -46 to +105 Celsius.
- (D) Shall be ANAMET Electrical Anaconda Sealtite Type HTUA, or approved equal.

#### **12. RIGID NON-METALLIC CONDUIT (RNC)**

- (A) UL Listed, nonthreaded, standard wall (Schedule 40), rigid polyvinyl chloride (PVC) conduit.
- (B) Size shall be as indicated and as required. Minimum size shall be 3/4 inch.
- (C) Weather, chemical, and sunlight resistant.



- (D) Suitable for use underground, above ground, and in concrete.
- (E) Shall comply with the requirements of NEMA TC2 and UL 651.
- (F) Shall be as manufactured by Carlon, or approved equal.

**13. LIQUIDTIGHT FLEXIBLE NON-METALLIC CONDUIT (LFNC)**

- (A) UL Listed, continuous, flexible non-metallic conduit. Oil, chemical, sunlight, and weather resistant.
- (B) Size shall be as indicated and as required. Minimum size shall be 3/4 inch, except that 1/2 inch may be used for connections to luminaires, and at other locations where specifically identified.
- (C) Shall be Carlon Carflex, or approved equal.

**14. CONDUIT COUPLINGS, UNIONS, AND FITTINGS**

- (A) Conduit couplings, unions, and fittings shall be UL Listed and specifically designed for use with the type of conduit in question.
- (B) Non-threaded couplings and/or unions (i.e. "split couplings") shall not be used in wet locations. Set-screw type coupling and/or unions shall not be used.
- (C) In damp and wet locations, conduit entrances to boxes and/or enclosures which do not have integral threaded hubs shall be made with watertight hubs (i.e. "Myers Hubs"). Hubs shall be UL Listed, watertight, grounding (with lug), threaded type. Hubs shall be provided with sealing gaskets to preserve the NEMA enclosure rating of the boxes and/or enclosures they are used with.
- (D) In dry locations only, conduit entrances to boxes and/or enclosures which do not have integral threaded hubs may be made with sealing type steel locknuts and grounding bushings with lugs (rigid and flexible conduits).
- (E) In dry locations only, conduit entrances to sheet steel outlet, device, and junction boxes installed in concealed areas (such as inside walls and above ceilings) may be made with standard steel locknuts and insulating bushings.
- (F) Conduit couplings, unions, and fittings for use with plastic coated rigid metal conduit shall be galvanized steel, or galvanized iron alloy, with overall plastic coating. Plastic coating shall satisfy the requirements for coating for plastic coated rigid metal conduit given elsewhere in this section.
- (G) Conduit couplings, unions, and fittings for rigid nonmetallic conduit shall be PVC and satisfy the requirements for rigid nonmetallic conduit given elsewhere in this section.
- (H) Fittings for flexible conduit shall be watertight, threaded type, with integral insulating bushings.
- (I) In dry and damp locations, fittings for flexible conduit shall be galvanized steel. In wet locations, fittings for flexible conduit shall be galvanized steel with overall plastic coating. Plastic coating shall satisfy the requirements for coating for plastic coated rigid metal conduit given elsewhere in this section. Fittings for use with non-metallic flexible conduit shall be non-metallic.
- (J) Fittings shall be provided with sealing gaskets to preserve the NEMA enclosure rating of the boxes and/or enclosures they are used with.

- (K) Shall be as manufactured by O-Z/Gedney, Cooper Crouse-Hinds, Robroy Industries, Carlon, or approved equal.

## **15. CONDUIT BODIES**

- (A) UL Listed, with threaded hubs and integral bushings. Conduit bodies shall be as follows, unless explicitly indicated otherwise.
1. Where plastic coated rigid steel conduit is required or otherwise used.
    - a. Plastic coated cast iron alloy with plastic coated iron alloy or stainless steel cover.
  2. For use with non-metallic conduit.
    - a. PVC
  3. Other locations.
    - a. Any permitted in (1) above.
    - b. Galvanized cast iron alloy with iron alloy cover or stainless steel.
- (B) Plastic coating shall satisfy the requirements for coating for plastic coated rigid metal conduit given elsewhere in this section.
- (C) All covers shall be screw-in type; clip-in or other wedge type covers shall not be used. Cover screws shall be stainless steel.
- (E) Shall be as manufactured by O-Z/Gedney, Cooper Crouse-Hinds, Robroy Industries, or approved equal.

## **16. CONDUIT AND CABLE SUPPORTS**

- (A) Support rigid conduits near each elbow and within 18 inches of each box, enclosure, conduit body, or similar termination, and at regular intervals not to exceed 6 feet.
- (B) Support flexible conduits near each elbow and within 12 inches of each box, enclosure, conduit body, or similar termination, and at regular intervals not to exceed 3 feet, except where flexibility is required.
- (C) Support cables, other than flexible cables, not installed in raceways within 12 inches of each box, enclosure, or conduit body, and at regular intervals not to exceed 3 feet.
- (D) Support flexible cables within 12 inches of each box, enclosure, or conduit body.
- (E) Support cables installed in cable trays as required elsewhere in this section.
- (F) Provide additional supports as indicated and as required to provide a complete, reliable installation.

(G) Support types and attachment methods shall be as indicated. Where not explicitly shown on the plans, support types and attachment methods shall be as follows or as otherwise directed by the Engineer.

1. Inside the Control House
  - a. Any method permitted in (2) below.
  - b. Galvanized malleable iron mechanical type clamps (i.e. "Right Angle", "Parallel", and "Edge" type).
  - c. Galvanized or stainless steel one hole straps or hangers.
2. For use with non-metallic conduit
  - a. PVC
3. All Other Locations
  - a. Galvanized malleable iron one-hole clamps with clamp backs
  - b. Stainless steel U-bolts with fabricated brackets
  - c. Stainless steel U-bolts with trapeze hangers.

(H) Clamps and U-bolts installed in wet locations, or otherwise used with plastic coated rigid metal conduit, shall be plastic coated. Plastic coating shall satisfy the requirements for coating for plastic coated rigid metal conduit given elsewhere in this section.

(I) Fabricated brackets for conduit supports shall be hot-dip galvanized steel or stainless steel.

(J) Trapeze hangers shall be constructed from hot-dip galvanized steel or stainless steel angle or channel and stainless steel threaded rod.

(K) Spring steel, clip type supports shall not be used.

(L) Shall be as manufactured by O-Z/Gedney, Cooper Crouse-Hinds, Robroy Industries, or approved equal.

## **17. OUTLET AND DEVICE BOXES**

(A) Outlet and device boxes and covers shall be UL Listed and appropriate for the intended use. Boxes shall be as follows, unless explicitly indicated otherwise.

1. Where plastic coated rigid steel conduit is required or otherwise used.
  - a. Plastic coated cast iron alloy
2. For use with non-metallic conduit
  - a. PVC
3. Other Locations.
  - a. Any permitted in (1) above.
  - b. Galvanized cast iron alloy.

- (B) Cast iron alloy boxes shall be galvanized with threaded hubs, integral bushings, and internal ground screws.
- (C) Plastic coating shall satisfy the requirements for coating for plastic coated rigid metal conduit given elsewhere in this section.
- (D) Sheet steel boxes shall be galvanized and provided with pre-punches knockouts.
- (E) Outlet and device boxes shall include external mounting ears where required to permit secure mounting of the box without compromising its integrity.
- (F) Provide appropriate covers. Material of blank cover shall match material of box. Covers for cast iron boxes shall be gasketed and use stainless steel fasteners. Cover plates for use with wiring devices shall be as required elsewhere in these Special Provisions.
- (G) Outlet and device boxes shall be as manufactured by O-Z/Gedney, Cooper Crouse-Hinds, Robroy Industries, or approved equal. Box covers and device cover plates shall be as manufactured by O-Z/Gedney, Cooper Crouse-Hinds, Robroy Industries, Hubbell, or approved equal.

### **18. PULL BOXES, JUNCTION BOXES, AND TERMINAL CABINETS**

- (A) Junction boxes, pull boxes, and terminal cabinets shall be UL Listed, appropriate for the intended use, and conform to the requirements of NEMA 250 and UL 50.
- (B) Unless specifically indicated otherwise, junction boxes, pull boxes, and terminal cabinets shall be as follows.
  - a. All Locations
    - i. NEMA 4X Type 316 stainless steel with stainless steel, or similarly corrosion resistant, hinges and/or hardware.
    - ii. NEMA 4 hot-dip galvanized cast iron with stainless steel, or similarly corrosion resistant, hinges and/or hardware.
  - b. NEMA 4 cast aluminum with stainless steel, or similarly corrosion resistant, hinges and/or hardware.
    - i. Damp or Dry Locations
    - ii. NEMA 12 steel with corrosion resistant finish inside and out and corrosion resistant hinges and/or hardware.
- (C) Boxes and cabinets installed in wet or damp locations shall be provided with drains. See the requirements for conduit system drains given elsewhere in this section.
- (D) Boxes and cabinets shall be sized as indicated, as required by the NEC, and as appropriate for the conductors or equipment served.
- (E) Terminal cabinets shall include aluminum or steel internal mounting panels with corrosion resistant finishes, heavy duty terminal blocks for wire terminations, and uninsulated ground bars. Terminal blocks shall comply with the requirements given elsewhere in these Special Provisions.
- (F) Boxes and cabinets which contain terminal blocks for more than one type of circuit (power, control, instrumentation and communication, etc.) shall include suitable dividers in accordance with NEC requirements.

- (G) Terminal cabinets, and pull and junction boxes with large and/or heavy doors, shall have hinged doors. Boxes and cabinets with hinged doors shall include bonding jumpers between the door(s) and the box or cabinet body.
- (H) Where appropriate, outlet and device boxes satisfying the requirements given elsewhere in this section may be used as junction and/or pull boxes.
- (I) Install boxes and cabinets plumb and level. Anchor cabinets securely as indicated and as required to provide a dependable installation.
- (J) Isolate aluminum boxes and cabinets from concrete and dissimilar metals with neoprene shims. Do not install aluminum boxes and cabinets in contact with the ground. Isolate boxes and cabinets which are not stainless steel from unpainted and/or "weathering" steel with neoprene shims.
- (K) Junction boxes, pull boxes, and terminal cabinets shall be as manufactured by O-Z/Gedney, Cooper Crouse-Hinds, Hammond Manufacturing, Hoffman, or approved equal.

## **19. CONDUIT AND CABLE PENETRATIONS**

- (A) Provide penetrations for conduits and cables as shown on the plans, and as otherwise required for proper installation of conduits and cables.
- (B) Where specific penetration methods and/or details are not shown on the plans, penetrations shall comply with the following.
  - 1. Between dry and damp or wet areas: environmentally sealed penetrations.
  - 2. Between other areas: standard sleeved penetrations.
- (C) Environmentally Sealed Penetrations
  - 1. Penetration sealing system providing air, dust, and water tight seal using rubber seal(s) in stainless steel (Type 316) compression frame(s).
  - 2. As manufactured by Roxtec (G frame with RM modules, R frame with RM modules, or RS seal), or approved equal.
- (D) Standard Sleeved Penetrations
  - 1. Pipe sleeve, secured in place with epoxy adhesive. Sleeves for penetrations in concrete or masonry shall be UV resistant Schedule 40 PVC. Sleeves for penetrations in all other types of construction shall be hot-dip galvanized Schedule 40 steel pipe. Inside diameter of sleeves shall be not less than 1/2 inch larger than the outside diameter of the conduit or cable to be installed in the sleeve.
  - 2. After installation of conduit or cable, the penetration shall be sealed with expanding foam insulation.
- (E) Following installation, restore floors, walls and ceilings with materials equal to the original construction and finish to match surrounding surfaces. Materials used shall be subject to the approval of the Engineer for appropriateness.
- (F) Penetrations in concrete shall be repaired with either non-shrink grout or silicone caulk. The Engineer will advise the Contractor regarding the method to be used at each penetration location.

**20. CONDUIT SYSTEM DRAINS****(A) Boxes and Enclosures**

1. A combination drain/breather shall be installed in all boxes and enclosures installed in wet locations, and as otherwise indicated.
2. Drain/breathers shall be capable of passing 25 cc of water per minute and 0.1 cubic feet of air per minute at atmospheric pressure. Stainless steel body with 1/2 inch male external thread. Crouse-Hinds ECD18 "Combination", or approved equal.
3. Drain/breathers shall be installed in the bottom wall of the box or enclosure.

**(B) Conduits**

1. All conduit runs installed in wet or damp locations shall be arranged to drain. Conduit runs between dry locations and wet or damp locations shall be arranged to drain away from the dry location and toward the wet or damp location.
2. Conduit drain fittings shall be installed at the low point(s) of all conduit runs in wet and damp locations.
3. Conduits shall preferably be arranged to drain away from boxes and enclosures in wet and damp locations. Where this is not practical, a drain fitting as described below shall be installed immediately adjacent to the box or enclosure.
4. Conduit drain fitting shall consist of a conduit body and screened drain. The screened drain shall be installed down to permit proper drainage and help prevent water ingress through the drain. Drain body shall be copper-free aluminum, and screen shall be stainless steel. Crouse-Hinds CD Series, or approved equal. Apply an anti-oxidant and anti-seizing compound (Ideal Noalox, or equal) to the threads of the drain before installing in the conduit body.

**21. MEASUREMENT AND PAYMENT**

- (A) Work covered by this section is incidental to the various items of electrical work, and will not be separately measured or paid for. All costs associated with this section shall be included in the prices bid for the various items of electrical work, as appropriate.

**END OF SECTION**

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**SECTION A-7**  
**GROUNDING AND BONDING**

**1. SCOPE**

- (A) This section covers all products, labor, services, incidentals, and related work necessary to furnish, install, test, and put into permanent service all electrical grounding and bonding as shown on the plans and described herein.
- (B) This section is a component of the electrical Special Provisions. The provisions and requirements of Section A-5 – General Requirements for Bridge Electrical Work are hereby incorporated into this section by this reference, and shall have the same force and effect as if printed here in full.

**2. SUBMITTALS**

- (A) All submittals as required by Section A-5 – General Requirements for Bridge Electrical Work.

**3. GENERAL REQUIREMENTS**

- (A) All grounding and bonding shall be in accordance with NEC Article 250.
- (B) All raceways and multi-conductor cable shall include at least one equipment grounding (bonding) conductor. Raceways and metallic cable armor/sheaths shall not be used as the sole grounding or bonding conductor for any circuit.

**4. TRANSFORMER GROUNDING AND BONDING**

- (A) Equipment grounding conductors shall be provided for all feeder circuits to transformers and bonded to the transformer enclosure and/or ground bus.
- (B) Transformer secondaries shall be solidly grounded. Secondary bonding jumpers shall generally be located at the transformer, but may be made at the first overcurrent protective device with the permission of the Engineer when connection at the transformer is impractical.
- (C) Grounding electrodes shall generally be the nearest substantial structural steel member. Alternate grounding electrodes may be used with the permission of the Engineer where connection to a suitable structural member is impractical.
- (D) The grounding electrode conductors shall be bare or insulated soft annealed copper per ASTM B3, stranded per ASTM B8 Class B. Conductors shall be sized as indicated and as required by the NEC. The equipment grounding conductors shall be continuous and unspliced from end to end. Grounding electrode conductors shall be protected from physical damage by installation in rigid nonmetallic conduit. Conduit shall extend from the main bonding jumper location to the grounding electrode.
- (E) When secondary bonding jumpers are installed at the transformer, a line side equipment bonding jumper shall be provided and routed with the circuit conductors from the transformer ground bar to the ground bar at the first overcurrent device.

**5. EQUIPMENT GROUNDING AND BONDING**

- (A) All conduits and cables, except for conduits and cables containing only service conductors (line side of main bonding jumper) shall contain at least one equipment grounding conductor. Equipment grounding conductor(s) shall be insulated soft annealed copper per ASTM B3,

stranded per ASTM B8 Class B. Equipment grounding conductor(s) shall be sized as indicated, as required by the NEC, and as recommended by the manufacturer(s) of the equipment served.

- (B) Where equipment grounding conductors are required to be increased in size to comply with the NEC, it shall be permissible to splice the large conductor to a smaller conductor to facilitate final connection to the equipment served. The smaller conductor shall not be smaller than required by NEC 250.122. The splice shall be made in a convenient location in the immediate vicinity of the equipment served (motor local disconnect switch, junction box or terminal cabinet, equipment enclosure, etc.). The Engineer may require the addition of an additional box for making such a splice where a suitable box or enclosure is not located sufficiently close to the equipment served.
- (C) Conduits, cable trays, cable armor, boxes and other raceways shall be installed such that they are electrically continuous from end to end. Bonding bushing, fittings, lugs, jumpers, and related hardware shall be provided as indicated and as necessary to provide a complete electrically continuous installation.
- (D) Except where specifically indicated otherwise, insulated throat bonding bushings or bonding nuts shall be provided wherever conduits or metal armored cables enter metal boxes or enclosures. Bonding bushings and bonding nuts shall be connected to the equipment grounding conductor installed in the conduit or cable. Boxes, cabinets, and enclosures shall be bonded directly, not just through the conduit(s) and or connector(s), to each equipment grounding conductor. This connection may be made by a jumper tapped to the main equipment grounding conductor(s).
- (E) All electrical equipment shall be solidly connected to the equipment grounding conductor serving that equipment.
- (F) The ground buses of all panelboards, switchboards, switchgear, motor control centers, and similar equipment shall be bonded to the nearest substantial structural steel member. Bonding jumpers shall conform to the requirements for equipment grounding conductors given elsewhere in this section, and shall be sized equal to the equipment grounding conductors serving the equipment. Installation of the bonding jumper shall conform to the requirements for grounding electrode conductors given in the NEC.
- (G) Terminal cabinets shall be provided with uninsulated ground bars for terminating and bonding together all equipment grounding conductors.
- (H) Where bolted connections are used for connection equipment grounding conductors to equipment, the area around the connection shall be cleaned down to bare metal prior to making the connection. Touch-up paint the area after the connection is made.
- (I) Equipment grounding conductors shall not be spliced except as follows.
  - 1. To tie multiple conductors together in junction boxes, pull boxes, terminal cabinets, or similar equipment enclosures.
  - 2. When connecting a large conductor to a smaller conductor for making final connection to equipment as permitted elsewhere in this section.
  - 3. When making taps for connection to boxes or enclosures as permitted elsewhere in these Special Provisions.
  - 4. When making taps for connection to luminaires, light switches, receptacles, and similar devices.
  - 5. Where specifically indicated otherwise.



- 6. With the permission of, and as prescribed by, the Engineer when absolutely required by conditions of installation.

Splices and taps for equipment grounding conductors shall be made with heavy duty crimp or mechanical type connectors, or by exothermic weld.

- (J) Equipment grounding conductor connections to equipment shall be made with appropriate crimp or mechanical type lugs. Ground bars shall include set-screws for conductor connections, or utilize bolted connections to crimp or mechanical type lugs.

**6. MEASUREMENT AND PAYMENT**

- (A) Work covered by this section is incidental to the various items of electrical work, and will not be separately measured or paid for. All costs associated with this section shall be included in the prices bid for the various items of electrical work, as appropriate.

**END OF SECTION**

**SECTION B-1**  
**MAINTAINING BASCULE SPAN BALANCE**

**1. SCOPE**

- (A) The Contractor shall be responsible for all labor and material necessary to maintain the proper balance condition throughout construction and to adjust bridge balance by adding or removing the necessary existing balance blocks in the counterweight pockets to properly balance each of the two bascule leaves,. At the conclusion of all work on the bascule span, the balance condition shall again be determined by the Engineer with adjustments required to bring the balance condition to within the required balance range.
- (B) This section is a component of the Bascule Bridge Special Provisions. The provisions and requirements of Section A – General Special Provisions are hereby incorporated into this section by this reference, and shall have the same force and effect as if printed here in full.

**2. MATERIALS**

- (A) Additional balance weights for installation in the counterweight pockets shall be furnished by the Contractor, and shall be 100 pounds each, all of the same weight, to match the existing balance bars. The existing balance bars are 1 ¾" x 1 ¾" x 9'-6" ASTM A36 Steel with a ¼" diameter eye bolt in the top end for ease of handling. Steel balance weights shall be painted with an approved rust inhibitor.

**3. BALANCE CONDITION**

- (A) The existing bridge balance conditions, and the final (after all work completed) balance conditions shall be determined by the strain gauge method.

**4. REQUIRED BALANCE RANGE**

- (A) During construction, the acceptable balance condition shall be 1,500 to 6,000 pounds downward reaction at the tip of each bascule leaf in the fully closed position. The center of gravity of each bascule leaf shall be located at an angle between -20 and 30 degrees from the horizontal, with the trunnion as the vertex while the leaf is in the fully closed position. Balance conditions shall be strictly maintained within above stated range during all construction activities.
- (B) The Contractor shall provide balance calculations for all additions and removals of components and materials to and from the bascule leaves and counterweights, as further described elsewhere herein. Such calculations shall be submitted to the Engineer for each operation that involved any alterations to the weight or balance of the bascule span.
- (C) When weight adjustments are necessary to maintain the balance conditions, weight shall be added to or removed from the counterweight pockets in accordance with the approved calculations. The bridge balance conditions shall be adjusted the same day that construction activities result in any alteration of the bridge balance, and prior to any openings for waterway traffic. At no time shall any brakes or span locks be released or disengaged, respectively, until bridge balance has been properly restored to the stated acceptable balance range.
- (D) Temporary equipment and tools shall be removed from the bascule span prior to each bridge operation, and therefore need not be included in the balance considerations as long as they are located on the waterway side of the trunnions.

- (E) For bidding purposes, the Contractor shall assume that a total of 35,000 pounds of additional balance bars must be added to the bascule span counterweight pockets (total for the project) to achieve the recommended balance range on both bascule leaves.
- (F) At completion of the project, acceptable balance condition shall be 2,000 to 4,000 pounds downward reaction at the tip of each bascule leaf in the fully closed position. The center of gravity of each bascule leaf shall be located at an angle between 5 and 25 degrees above the horizontal, with the trunnion as the vertex while the leaf is in the fully closed position. Adjustment of the final balance condition shall be as directed by the Engineer.

## **5. CONSTRUCTION DETAILS**

- (A) The Contractor shall perform detailed balance calculations. The balance calculations shall be performed by a Professional Engineer licensed in the State of North Carolina. The calculations shall account for the detailed weight of all materials removed and added as part of this project and their locations (horizontal and vertical) referenced from the center of the trunnion. The recorded weights shall be precise and accurate, accounting for all material including fill plates, welds, bolts, washers, nuts and any other components removed, added or replaced on the bascule leaves and counterweights as part of this project.
- (B) Calculations shall be submitted on spreadsheets showing the material callout, weight, moment arm dimensions in the horizontal, vertical and transverse directions and the resulting horizontal, vertical and transverse moments. Weight removed shall be accounted for on a separate sheet from the weight added or replaced. A summary balance table shall be developed. The summary tables shall show the chronological staging of the balance and proposed imbalances throughout the duration of construction. The calculations shall also account for the placement of the new balance blocks, and the removal or repositioning of existing balance blocks. A narrative shall be included with the outline of the proposed construction sequence, the duration of the unbalance and all other aspects of the work. This information shall be coordinated with the Contractor's scheduling requirements and shall be submitted to the Engineer for approval. The weights for the new work shall be included on the shop drawings for each component. The calculations and spreadsheet shall be updated daily by the Contractor and submitted to the Engineer throughout construction.

## **6. MEASUREMENT AND PAYMENT**

- (A) ADDITIONAL BALANCE BARS (BASCULE SPAN) shall be measured by the pound furnished and installed, and paid for at the contract unit price, per pound. Payment will be made according to the actual quantity of weight added as directed by the Engineer in the field to maintain satisfactory balance conditions.
- (B) There will be no separate measurement and payment for maintaining the span balance condition. This work is considered to be an integral part of the overall mechanical work, and the costs thereof shall be included in the price bid for other mechanical work items.

**END OF SECTION**

**SECTION B-2**  
**MISCELLANEOUS BASCULE BRIDGE MECHANICAL WORK**

**1. SCOPE**

- (A) This section covers all products, labor, services, incidentals, and related work necessary to furnish, install, test, and put into permanent service all miscellaneous mechanical work as shown on the plans and described herein. The installation and adjustment of all machinery shall be by millwrights experienced in this class or work.
- (B) This section is a component of the Bascule Bridge Special Provisions. The provisions and requirements of Section A – General Special Provisions are hereby incorporated into this section by this reference, and shall have the same force and effect as if printed here in full.

**2. REFERENCES**

The issue date of references included in these project specifications and Contract plans need not be more current than provided by the latest Change Notice to this specification. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The latest revisions only shall be used for all references.

**AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)**

AASHTO                      LRFD Movable Highway Bridge Design Specifications, 2<sup>nd</sup> Edition, 2007

**AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)**

AGMA 2000-A88              Gear Classification and Inspection Handbook

AGMA 6010-F97              Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives

AGMA 2001-C95              Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth

**AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)**

ANSI B 1.1                      Screw Threads

ANSI B 4.1                      Preferred Limits and Fits for Cylindrical Parts

ANSI B 17.1                      Keys and Keyseats

ANSI B 18.3                      Socket, Cap, Shoulder and Set Screws (Inch Series)

ANSI B 18.21.1                  Helical Lock Washers

ANSI B 46.1                      Surface Texture

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

ASTM A 36                      Carbon Structural Steel

ASTM A 108                      Steel Bars, Carbon, Cold Finished, Standard Quality

ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip
ASTM A 276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A 291	Carbon and Alloy Steel Forgings for Pinions and Gears
ASTM A 311	Stress Relieved Cold Drawn Carbon Steel Bars Subject to Mechanical Property Requirements
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 449	Quenched and Tempered Steel Bolts and Studs
ASTM A 490	Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 563	Carbon and Alloy Steel Nuts
ASTM A 572	High-Strength Low-Alloy Columbian-Vanadium Steel of Structural Quality
ASTM A 574	Alloy Steel Socket Head Cap Screws
ASTM A 582	Stainless Steel Bars, Cold Finished
ASTM A 588	High-Strength Low Alloy Structural Steel with 50,000 psi Minimum Yield Point to 4 Inches Thick
ASTM A 668	Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 852	Quenched and Tempered Low-Alloy Structural Steel Plate
ASTM B 22	Bronze Castings for Bridges and Turntables
ASTM B 438	Standard Specification for Sintered Bronze Bearings (Oil-Impregnated)
ASTM F 436	Hardened Steel Washers
ASTM F 593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F 594	Stainless Steel Nuts

**AMERICAN WELDING SOCIETY (AWS)**

AWS D1.1	Structural Welding Code – Steel
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**NATIONAL LUBRICATING GREASE INSTITUTE (NLGI)**

NLGI 1	Tabulation of Various Greases
NLGI 2	Tabulation of Various Greases

**3. QUALITY ASSURANCE**

Inspection: Materials and fabrication procedures are subject to inspection and testing in the mill, shop and field by the Engineer. Such inspections and tests, if performed, will not relieve the Contractor of the

responsibility for providing materials and fabrication procedures in compliance with specified requirements.

- (A) Design of Items and Connections: All details shown on the Contract Drawings are typical and apply to similar conditions unless otherwise indicated. Dimensions and details in the Contract Plans are for Bid-Purposes only and shall be verified via field measurements and erection-design layouts by the Contractor before proceeding with any work, obtaining final approval of any Shop Drawings by the Engineer, and to avoid causing subsequent delay in work.
- (B) The Engineer shall be notified immediately for clarification whenever any portion of the work appears unclear or not accurately defined.
- (C) Certified Test Reports: As used herein, certified test reports refer to reports of tests conducted on previously manufactured materials or equipment which are purported to be identical to that proposed for this application.
- (D) Mill/Factory Tests: As used herein, mill or factory tests refer to tests required to be performed on the actual materials or equipment proposed for this application. Results of the tests shall be submitted in accordance with the provisions of this Contract.

#### **4. SUBMITTALS**

- (A) In addition to the requirements of Section A-1 – Working Drawings and Submittals, the Contractor shall submit:
  1. Mill test reports or certified test reports for all metals used
  2. A complete list of all proposed new or rehabilitated machinery items which require lubrication. The list shall be maintained throughout construction and shall contain the type of lubricant used and the date it was installed by the Contractor. The list shall be given to the Engineer prior to start up and testing of the respective machinery.

#### **5. GENERAL MATERIALS, BRACKETS, AND SUPPORTS**

- (A) Unless specifically indicated otherwise, plates, shapes (angles, channels, etc.), fabricated brackets, and similar items shall ASTM A36, or approved equivalent, steel.
- (B) Where plates, shapes, fabricated brackets, and similar items are identified as aluminum, they shall be 6061-T6, or approved equivalent, unless otherwise noted.
- (C) Unless specifically indicated otherwise, all stainless steel shall be "Marine Grade", such as Type 316. If the Contractor can demonstrate to the satisfaction of the Engineer that Marine Grade stainless steel is not available for the item in question, a lesser grade, such as Type 304, will be considered.
- (D) Fabricated items which are constructed by welding shall be thermally stress relieved after welding and before any additional machining or finishing.
- (E) Fabricated steel items which are to be galvanized shall be hot-dip galvanized after fabrication. Hot-dip galvanizing shall be in accordance with the American Galvanizers Association Suggested Specification for Hot-Dip Galvanizing.
- (F) Welding shall be in accordance with American Welding Society standards appropriate for the material(s) and final product in question.

- (G) Isolate aluminum items from concrete and dissimilar metals with neoprene shims. Do not install aluminum products in contact with the ground.
- (H) Isolate galvanized items from unpainted and/or "weathering" steel with neoprene shims.

## **6. MANUFACTURED ITEMS**

- (A) The Contractor shall submit shop drawings to the Engineer for approval. These shall include complete details, specification of materials, schedules for fabrication and shop assembly, procedures and diagrams showing sequence and details for erection. The Contractor is responsible for providing all field measurements and erection layouts necessary to fully define the details of all fabricated components. Reformatted contract plans, without complete manufacturing and erection information as set forth herein, shall not be considered satisfactory shop drawings.
- (B) Shop drawings with erection-dependent data, required from the Contractor, may be conditionally approved by the Engineer for material allocation or procurement. The Contractor shall be fully responsible for providing final details (e.g. exact shaft lengths) to the supplier for fabrication.
- (C) Variations between the conditionally approved shop drawings and installed components shall be recorded and submitted on the As-Built Drawings.
- (D) Shop drawings for manufactured detail parts shall be given a suitable title to describe the parts detailed thereon. These drawings shall be so complete that parts may be duplicated without reference to patterns, other drawings, or individual shop practice. Each drawing shall be identified by the complete project name and number, and shall include:
  - (E) Dimensions, call-outs and notes to completely define the final form, fit, function, manufacturing process and allowable deviations for each feature of each item.
  - (F) Material specifications for each item including heat treatment, specific hardness and/or mechanical properties requirements when mandated.
  - (G) The surface finish of machined surfaces and toleranced dimensions at all locations for which a specific fit is required. A general tolerance block conforming to the Contract Plans shall be used to define the tolerances of all other dimensions. Fits and finishes shall be the more rigorous of AASHTO or manufacturer specifications.
  - (H) Quantities of all details required for their associated assemblies and quantities of complete assemblies for the entire bridge.
  - (I) Component weights for purchased and manufactured items shall be shown on the same shop drawings as the component details to facilitate material handling planning.

## **7. PURCHASED ITEMS AND ASSEMBLIES**

- (A) Shop drawings for purchased components shall be given a suitable title to describe the parts detailed thereon and shall include:
  - (B) Complete data on the design and construction of all detail components furnished as part of the machinery under this Contract as presented herein.
  - (C) All proprietary items shall be shown in outline on shop drawings and shall include:

1. Complete assembly diagrams shall be provided for proprietary components that show each part contained within the item and its corresponding manufacturer's part number. The diagrams shall be sufficient to enable complete disassembly and re-assembly of the subject component and enable the definition and procurement of proper spare/replacement parts.
2. In the event that any part is modified in any manner from the way it is described or delivered by its original manufacturer, the Contractor shall deliver a drawing which details each modification, and the part shall be assigned a unique part number to assure procurement of proper spare/replacement parts.

(D) Certified external dimensions and clearances affecting interfaces or installations.

1. Gross weight.
2. Capacity and normal operating ratings.

(E) Method, recommended type and quantity of lubrication, including location and type of fittings and provisions for adding, draining and checking the level of each lubricant employed.

(F) Inspection openings, seals, and vents.

(G) Complete shop bills of materials shall be included for all machinery parts. If the bills are not shown on the shop drawings, prints of the bills shall be furnished for approval in the same manner as specified for the drawings.

(H) Complete assembly and erection drawings shall be furnished. These drawings shall provide identification, and essential locating dimensions for each part or assembly with respect to the bridge or foundation.

(I) Shop drawings, which have not been approved or require correction, shall be resubmitted until they are approved by the Engineer. This approval-procedure shall not be considered a cause for delay. The Contractor shall bear all costs or damages which may result from the ordering or fabrication of any materials prior to the acceptance of the shop drawings. As a means of expediting delivery prior to acceptance of the shop drawings, the Contractor may request in writing from the Engineer, approval to order raw materials of the correct type for later fabrication from accepted shop drawings. Such approval by the Engineer shall be in writing. After acceptance of the shop drawings, the Contractor shall supply the Engineer with additional copies of the accepted drawings as may be required.

(J) Material certifications and component test reports shall be submitted for approval as required by the standards.

## **8. MATERIALS**

(A) Materials and components shall conform to the drawings and referenced standards.

(B) Hardness shall be tested and reported for details with required hardness values.

(C) No item shall be fabricated without sufficient advance notice given to the Engineer to permit inspection.

(D) The Contractor shall furnish all facilities and provide for the free access at the plant or shop for the inspection of material and workmanship.

(E) Acceptance of a material or item shall not preclude subsequent rejection if defects are found later.



- (F) The Contractor shall furnish the Engineer with of copies of purchase orders as requested.
- (G) Unless otherwise provided, the Contractor shall furnish without charge test specimens required herein, all labor, testing machines, tools and equipment necessary to prepare the specimens and to make the physical tests and analyses. Two copies of test reports and chemical analyses shall be furnished to the Engineer.

## **9. MANUFACTURER'S RECOMMENDATIONS**

When installation procedures for an item or component are required to be in accordance with the recommendation of the manufacturer, printed copies of the recommendations shall be furnished to the Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

## **10. STANDARD PRODUCTS**

- (A) Materials and equipment shall essentially be standard, current production, cataloged products of established manufacturers, and have at least two years of satisfactory commercial or industrial use prior to bid opening.
- (B) Where two units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer.
- (C) Each major assembled component shall have a conspicuous, durable, permanently affixed nameplate that includes at least the following information: the manufacturer's name, address, the component model number, serial number, rated capacity and pertinent factory setting(s). The nameplate of the distributing agent will not be acceptable.
- (D) Copies of nameplates and/or equipment tags shall be furnished as part of the shop drawing and included in the Operation and Maintenance Manual for future reference on all machinery.
- (E) Materials of equal or greater strength and corrosion resistance than shown on the design drawings can be proposed and are subject to approval by the Engineer.
- (F) Electrodes for welding shall comply with AWS Code.
- (G) Heavy hexagonal head structural bolts, heavy hexagonal nuts, and hardened washers shall conform to ASTM A325 Type 1, A563 Grade C, and F436 respectively. ASTM A307 shall not be used.
- (H) Alloy steel hex socket head cap screws shall comply with ASTM A574. Stainless Steel hex socket head cap screws shall be Type 304 or 316, with a minimum tensile strength of 75,000 psi, and shall meet or exceed ASTM F593, Alloy Group 1 or 2, Condition CW, unless otherwise specified. Dimensions shall conform to ANSI B18.3.
- (I) Stainless steel for fasteners, threaded rods, pins, and dowels, where specified, shall be Type 304 or 316 Stainless Steel, with a minimum tensile strength of 75,000 psi and shall meet or exceed ASTM F593, Alloy Group 1 or 2, Condition CW, unless otherwise specified. Stainless steel for hex nuts shall be Type 304 or 316, with a minimum tensile strength of 75,000 psi and shall meet or exceed ASTM F594, Alloy Group 1 or 2, Condition CW, unless otherwise specified. Stainless Steel washers where specified shall be Type 304 or 316. Stainless steel shim material shall be ASTM A167, Type 302/304.

- (J) Equipment covers and guards, unless specified otherwise, shall be a minimum 10 gauge stainless steel conforming to ASTM A167, Type 316, welded at corners, adequately stiffened and held rigidly in place. Covers and guards shall be provided wherever necessary for safety of maintenance or other personnel and to protect components from the elements.
- (K) Unspecified steel plate for details and weldments shall conform to ASTM A572 Grade 50, except for minor weldments, brackets, and pedestals for electrical components which may be ASTM A36 structural steel.

## 11. DETAILS AND WORKMANSHIP

- (A) The machinery shall be finished, assembled, and adjusted in an approved manner using best shop practice. The limits of accuracy which are to be observed in machining all parts, and the allowances for all metal fits shall be placed on the Shop Drawings.
- (B) Where surface finishes are indicated, the symbols used shall conform to ANSI B46.1, "Surface Texture". Roughness specified is the maximum value, and any smoother finish will be satisfactory. Compliance with specified surface will be determined by trained sense of feel and by visual inspection of the work compared to "Standard Roughness Comparisons" in accordance with the provisions of ANSI B46.1. Values of roughness width and waviness are not specified, but shall be consistent with the general type of finish specified by the roughness height. Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable will be cause for rejection.
- (C) Unspecified surface finishes shall conform to AASHTO, Paragraph 2.5.17. Mating surfaces shall be machined to provide even, true bearing. Surfaces with rotating or sliding contact shall be highly polished and finished true to the given dimensions.

Surface finishes are given as the roughness height in micro-inches.

<u>Part</u>	<u>Fit</u>	<u>Finish</u>
Machinery base on steel	—	250
Machinery base on masonry	—	500
Shaft journals	RC6	8
Journal bushings	RC6	16
Split bushing in base	LC1	125
Solid bushing in base (to 1/4" wall)	FN1	63
Solid bushing in base (over 1/4" wall)	FN2	63
Hubs on shafts (to 2" bore)	FN2	32
Hubs on shafts (over 2" bore)	FN2	63
Turned bolts in finished holes	LC6	63
Sliding bearings	RC6	32
Keys and keyways (top and bottom)	LC4	63
Keys and keyways (sides)	FN2	63
Machinery parts in fixed contact	—	125
Teeth of open spur gears,		
Under 1 inch circular pitch	—	32
1 inch to 1 3/4 inch circular pitch	—	63
over 1 3/4 inch circular pitch	—	125

The above fits for cylindrical parts shall also apply to the major dimensions of non-cylindrical parts.

- (D) So far as practical, all work shall be laid out to secure proper matching of adjoining unfinished surfaces. Large discrepancies between adjoining unfinished surfaces, shall be remedied to realize

proper alignment. Depressions or holes not affecting the strength or function of the parts may be filled in a manner approved by the Engineer.

## **12. MECHANICAL COMPONENT REQUIREMENTS**

- (A) **Shafting, Pins, Keys, Keyways, and Set Screws:** Rounds and shafts shall be true, straight and free from flaws, piping, laps, seams, or cracks. All shafts shall have finished ends with a 60 degree lathe center with a clearance hole at the exact center of the shaft. Stepped shafts shall have fillets finished smoothly to adjacent surfaces without tool marks or scratches. Surface finish for fillets shall have a maximum roughness of 63 micro-inch according to ANSI B46.1, unless a finer finish is required. Unless otherwise specified, shafting shall be ASTM A108 Cold Finished Steel with a minimum tensile strength of 75,000 psi and a minimum yield strength of 60,000 psi.
- (B) All forged shafts shall be reduced to size from a single bloom or ingot until perfect homogeneity is secured. The blooms or ingots, from which shafts or pins are to be made, shall have a cross-sectional area at least three times that required after finishing. No forging shall be done at less than red-heat. Forged rounds for shafts and pins shall be true, straight, and free from any defect. Unless otherwise specified, forged shafting shall be ASTM A 291 Alloy Steel with a minimum tensile strength of 80,000 psi and a minimum yield strength of 60,000 psi.
- (C) All shafts and pins shall be accurately finished, round, smooth, and straight; and when turned to different diameters, they shall have rounded fillets at all shoulders. Each shaft or pin having a uniform diameter of 8 inches or more and each shaft or pin having several diameters, of which the smallest is 8 inches or more, shall be bored lengthwise through the center to a diameter approximately one fifth the smallest diameter. The wall of the center bore shall be examined for cracks and fissures. Shafts and pins exhibiting defects will not be accepted. Shafts that are bored with an inspection hole shall have the ends prepared for the attachment of a centering device equivalent to the lathe center. All such devices shall be furnished as part of the work.
- (D) All journal bearing areas on shafts and pins shall be accurately turned, ground, and polished with no trace of tool marks or scratches on the journal surface or adjoining shoulder fillets. The journal bearing area shall have an 8 micro-inch finish, unless otherwise specified in the plans. Journal diameters shall be finished to the limits of an ANSI Class RC6 running fit, unless otherwise noted. Bearing seats on shafts with rolling element bearings, shall have a surface finish of 63 micro-inch, unless otherwise specified by the bearing manufacturer. Fit of rolling element bearing I.D. and shaft shall be as specified by the bearing manufacturer.
- (E) Keys shall be machined for a FN2 side fit and an LC4 fit on top and bottom with keyways in shafts and hubs and a 63 microinch finish. Keyway corners and key chamfers shall be cut with the fillet radius and chamfer as suggested by ANSI B17.1. All keys shall be effectively held in place, preferably by setting them into closed-end keyways milled into the shaft. The ends of all such keys shall be cut square, or rounded to a half circle equal to the width of the key. Keyways shall not extend into any bearing. Keys shall preferably not extend past the end of the hub of the keyed element. If two keys are used, they shall be located 120 degrees apart.
- (F) Unless otherwise specified herein or on the drawings, keys shall be made from cold-finished carbon steel squares or flats that meet the requirements of ASTM A311, Class A, with a minimum tensile strength of 75,000 psi, and minimum yield strength of 75,000 psi, or equal or greater strength alternative.
- (G) Set screws shall not be substituted for keys for transmitting torsion; they may be used only for holding keys or light parts in place. They shall be safety-type headless set screws with cup points set in counterbored seats. Unless otherwise ordered, they shall be secured in place by use of self-locking threads.

### 13. CENTER LOCK REPLACEMENT

The existing center lock components shall be completely removed and replaced with new center lock components as detailed in the Contract Drawings. Power and control wiring are presented in the Electrical Section. There shall be two center lock assemblies total. There are no significant roadway traffic closures scheduled for this work. A temporary center lock assembly is detailed on the contract drawings and shall be installed and adjusted before removal of any existing center lock guides, receivers or lock bars. The existing live load shoes shall be adjusted by installing or removing shims to provide contact at both sides of each live load assembly. This adjustment shall be coordinated with the roadway profile and each live load adjustment shall be submitted for approval by the NCDOT representative. No adjustment shall be made until approval is granted.

- (A) The lock bar assembly shall include the motor with brake, enclosed right angle reducer, couplings, limit switches, crank shaft bearings, crank shaft, and an auxiliary removable hand wheel. The crank shaft is connected to a turnbuckle which drives the lock bar. The center lock guides are mounted on the girder web with the drive components.
- (B) The motor shall have an extended rear shaft with square end to accept a hand crank for emergency operation. A cover over the rear shaft extension shall contain an interlocking micro-switch so that the motor will not operate electrically with the cover removed. The motor brake shall have a manual release which only works during hand crank operation, and will reset when the cover is replaced. A drill attachment for a ½" drill shall also be provided for manual operation.
- (C) Center lock mounting bases, guides, and support weldments shall conform to the plans. Weldments shall be stress relieved by heat prior to finish machining. Bearing material for guides and receiver bracket shall be ASTM B22 UNS NO. C863000 bronze with lubrication grooves and passages. See Contract Drawings for details.
- (D) Each center lock assembly, with all guides, and electrical connections thereto shall be erected and assembled on the span. Full size stainless steel shims shall be used to adjust to correct position, alignment and elevation. Lock assemblies shall be erected with undersized holes and fasteners, and when adjusted shall be drilled and reamed for turned bolts to be installed.

### 14. LIVE LOAD SPAN LOCK REPLACEMENT

The existing live load span lock components shall be completely removed and replaced with new live load span lock components as detailed in the Contract Drawings. Power and control wiring are presented in the Electrical Section. There shall be two live load span lock assemblies per leaf, four assemblies total.

- (A) The lock bar assembly shall include the actuator with brake, limit switches, crank shaft bearings, auxiliary removable hand wheel, guides and supports. The actuator is connected directly to the lock bar.
- (B) The actuator shall have a rod speed of 1.9 in/sec and a stroke of 15.7 inches. The motor shall be TENV with thermal protection. Thrust overload control shall be provided by a power monitoring relay. The actuator shall have overstroke protection such that the over travel of the actuator shall not damage any portion of the actuator assembly.
- (C) The motor shall have provision to accept a hand crank for emergency operation. The assembly shall have a disengagement system and control interlock switch to prevent electrical operation of the motor with the hand crank installed. A drill attachment for a ½" drill shall also be provided for manual operation.

- (D) Live load span lock mounting bases, guides, and support weldments shall conform to the plans. Weldments shall be stress relieved by heat prior to finish machining. See Contract Drawings for details.
- (E) Each live load span lock assembly, with all guides, and electrical connections thereto shall be erected and assembled on the pier wall. Full size stainless steel shims shall be used to adjust to correct position, alignment and elevation. Lock assemblies shall be erected with undersized holes and fasteners, and when adjusted shall be drilled and reamed for turned bolts to be installed.

## 15. AUXILIARY DRIVE REPLACEMENT

The existing auxiliary drive shall be completely removed and replaced with a new auxiliary drive. The new auxiliary span drive shall consist of an auxiliary gear-motor, a manually operated clutch gear coupling, a new pinion shaft and pinion, a new gear which is mounted on the existing drive shaft, supporting bearings, pedestals, keys, anchor bolts, shims and other assembly hardware necessary to complete the installation, and properly align all components and the new auxiliary drive pinion to the new auxiliary drive gear. A new gear cover shall be fabricated to cover the auxiliary gearing. There shall be one new auxiliary span drive assembly per leaf, two total.

- (A) Auxiliary Shaft Bearings: Anti-friction, pillow-block bearings shall be self-aligning. Bearings shall be the product of a manufacturer of established reputation who has had bearings of comparable size of the same materials and type in successful service for at least 10 years. Bearings on each shaft shall be arranged so that the shaft is restrained in the axial direction (fixed) on one end and free to move axially (float) in the other.
- (B) Auxiliary Pinion and Gear: The Contractor shall submit to the Engineer for approval, a detailed assembly and alignment procedure for the pinion/gear mesh.
  1. The teeth of all gears shall be cut from solid rims or blanks. The sides and peripheries of all gears and pinions shall be finished, and the pitch circle for the gear and pinion shall be scribed on both sides not less than 0.02 inches deep, with a V-pointed tool. The working surfaces of all gear teeth shall be true to the proper outline, accurately spaced on the true pitch circle, exceptionally smooth, and free from plane or milling-cutter ridges. Cutter burrs shall be removed from all edges of the teeth, and the top edges of all teeth shall be rounded to 1/32 inch radius.
  2. Except as otherwise provided herein or on the drawings, all gears shall be cut and mounted to meet requirements for accuracy of the ANSI/AGMA Standard 2000-A88 (or more recent edition), Gear Classification and Inspection Handbook. The AGMA quality number shall be stated on the applicable shop drawings. Open gearing shall conform to minimum AGMA Quality No. 7. Gearing in enclosed gear reducers shall conform to AGMA Quality No. 9 or higher.
  3. The auxiliary gearing shall have a cover to protect personnel from injury during operation. The cover shall be fabricated from 10 gauge stainless steel and have two hinged access doors to facilitate easy inspection and lubrication of the gearing. The new pillow block bearings shall be outside the cover. See Contract Drawings for details.
- (C) Auxiliary Gearmotor: The auxiliary drive shall consist of a 10 hp, 1750 rpm, 480V, 3- phase motor attached to an enclosed foot mounted reducer, with a 41.87:1 ratio, and an output speed of 42+/- RPM, Model K97DV132M4 SEW-Eurodrive or approved equal, and mounted to a new welded pedestal which is anchored to the new auxiliary drive support detailed in the Contract Drawings. The gearmotor output shall be rated at 15,200 lb-in torque with an AGMA service factor of 2.5.

- (D) Auxiliary Disconnect Coupling: The gear-motor output shaft shall be connected to a new auxiliary pinion input shaft via a disconnect gear coupling, with manual lever actuation.
1. The disconnect gear coupling shall be a FALK 1025G72 disconnect coupling, or approved equal, with a custom hand operated shifter mechanism, necessary to engage or disengage the coupling by shifting the outer sleeve. The long hub is mounted to the gear-motor output shaft. There is a 0.188" gap between the shaft ends in the coupling. The short hub is mounted to the new auxiliary pinion shaft.
  2. The shifter mechanism shall be able to be locked in either the engaged or disengaged position. The mechanism shall be fabricated as detailed in the Contract Drawings.
  3. The shifter mechanism shall trip a limit switch when the coupling is in the engaged position. This will allow for the use of the auxiliary drive motor. Refer to the Electrical Specifications for information on this limit switch.
- (E) Auxiliary Pinion Shaft: Rounds and shafts shall be true, straight and free from flaws, piping, laps, seams, or cracks. All shafts shall have finished ends with a 60-degree lathe center. Stepped shafts shall have fillets finished smoothly to adjacent surfaces without tool marks or scratches. Material certifications shall be submitted. Surface finish for fillets shall have a maximum roughness of 63 microinch according to ANSI B 46.1 unless a finer finish is required. The Contractor shall obtain and submit independent verification of dimensions by a qualified inspection firm for approval.

## **16. OPEN GEARING COVER REPLACEMENT**

The existing open gearing covers shall be removed and replaced with new covers. The new covers shall be fabricated from 1/4" aluminum plate, 6061-T6, unless otherwise specified on the Contract Drawings. All mounting hardware shall be Type 304 or 316 Stainless Steel. There shall be two open gearing covers per leaf, four covers total. See Contract Drawings for details.

## **17. SPAN DRIVE BRAKE REPLACEMENT**

The existing span brakes shall be removed and replaced with "drop-in" replacement brakes. Brakes shall be of the drum type. The brakes shall be furnished complete with an electrically driven AC thruster type actuator. There shall be four brakes replaced per leaf, eight brakes total.

Brakes MUST be manufactured to be a direct drop in for the present GE9516 brake, as well as being of mill duty quality of the type 300M series mill duty shoe brake as designed by Mondel.

All brakes shall be from the same manufacturer and must have a minimum of 10 years supplying brakes to the movable bridge industry.

Brakes shall be an AC thruster type drum brake, spring set and electrically released.

Brakes shall be AIST torque rated for 800 ft-lbs. and factory set to a torque value of 450 ft-lbs.

Brakes shall be furnished with an auto equalization assembly designed to ensure that the shoes maintain equal alignment, positive and equal braking action and equal lining wear.

Brakes shall be furnished with corrosion resistant hardware.

Brake shoes shall consist of a molded, non-asbestos type brake shoe lining that is bonded to the shoe holder.

All main pivot points on the brake shall be equipped with a bolted type antifriction composite bushing assembly. This assembly is to be comprised of an outer race component made from a composite material containing a self lubricating surface coating on the bore and a precision machined nitrided steel inner race. Spherical needle type bearings are not acceptable. Pin and clip type connections are not acceptable.

The brakes shall be furnished completely assembled and must be supplied with the Eldro type thrustor model "Ed" actuator. No other actuator type or manufacturer will be accepted.

The Eldro type "Ed" actuators shall be supplied with a 230/460 Volt, 3 phase, 60 HZ, totally enclosed, squirrel cage ball bearing motor with moisture proof windings, and conduit box. The thrustor motor shall be of ample capacity for the intended application. The rated stalled thrust of each thrustor shall be not less than 135 percent of the thrust actually required to release the brake with the torque adjusted to the continuous rated value. Brakes are to set automatically when for any reason power is removed from the thrustor motor.

The oil used in the Eldro type "Ed" thrustor -operating chamber shall be hydraulic oil specifically recommended by the thrustor manufacturer for low temperature operation. It shall have a free operating temperature range between 13 degrees below zero and 122 degrees above zero Fahrenheit. Throughout this temperature range there shall not be any material change of operating characteristics.

All Eldro type "Ed" thrustor shipped, either mounted or as a spare, must be filled with hydraulic fluid at the factory prior to shipment. All thrustor must meet IP65 standards. External thrustor material shall be Aluminum for light weight and corrosion protection. Thrustor motors shall be rated for inverter duty operation. The electric driving motor shall be in a separate dry section of the thrustor, and air cooled. Motors immersed in oil are not acceptable.

Each Eldro type "Ed" thrustor shall have the capability of being supplied with an independent time delay valve adjustable between 0 and 5 seconds for setting the brake. Only an internal time delay valve constructed of stainless steel is acceptable. Adjustment must be infinitesimally adjustable between the minimum and maximum settings. These adjustments must be allowable with the brake in full service. A single time delay for both setting and releasing is not acceptable.

Brake shoes must be easily replaced from either side of the brake without disassembling the brake. All torque adjustments should not have to be reconfigured after replacing the brake shoes.

Each brake shall be provided with a manual release lever and a device for holding the brake in the released position. The hand release attachment shall be mounted permanently on the brakes and be arranged so that the brake can be released easily and quickly without the use of apparatus not permanently attached to the brakes. This hand release shall not affect any torque setting or brake adjustment.

The hand release shall be capable of being released without removing the brake cover. The mechanism shall latch in both the released and non active positions. It shall provide at a minimum, 90% of the power release stroke and not inhibit the working stroke of the actuator when fully retracted.

Each brake shall contain three (3) lever type limit switches for use in control and indicating circuits. These limit switches will indicate brake electrically released, brake set and brake manually released. All limit switches shall be NEMA rated and have two N.O. and two N.C. contacts.

Each brake shall be furnished with an external torque spring. This shall provide stepless torques adjustment down to 40% of the maximum brake torque. The actual setting must be visible from a calibrated torque indicator provided on the torque spring assembly.

Brake Enclosures

Each brake shall have a NEMA 3R outdoor rated enclosure constructed of 304 stainless steel, painted steel is not acceptable. The enclosures shall have three (3) shaft slots, one for the latching hand release and two for the machine/motor shafts as per the drawings.

Brake Wheels

The existing brake wheels shall be reused with the new drum brakes.

Manufacturers

The brakes and enclosures are based on Mondel Engineering's mill duty brake (MBTE series); AISTNEMA rated brake design as manufactured by Magnetek, Mondel Brake Products.

**18. AIR BUFFER REHABILITATION**

- (A) The existing air buffer assemblies shall be removed and rehabilitated to proper working condition as detailed in the Contract Drawings. This rehabilitation shall include removal and replacement of all filters, gages, piping and fittings. All replacement components shall be stainless steel and rated to 1500 PSI. The rehabilitation shall also include polishing and honing of the cylinder bore, replacement of the piston rings, replacement of the piston rod bushings, and the proper cleaning and repainting of all assemblies. There shall be two air buffers rehabilitated per leaf, four buffers total.
- (B) A new by-pass valve assembly shall be installed on each air buffer assembly. This by-pass valve assembly shall include the addition of a needle valve for pressure adjustment and a tapped hole which is positioned such that the hole is completely clear of the lower piston ring with 1/2" of stroke left before seating of span +/- 1/8".
- (C) Fit: The bore of the cylinders shall be honed and polished to a true cylinder with a tolerance of plus 0.002, minus 0.000 inch from the specified diameter. The rings shall be lapped into their grooves in the pistons and all traces of the lapping abrasive shall be removed by steam cleaning. The surfaces of pistons and piston rings adjacent to or in contact with the cylinder walls shall be honed and polished. The piston rods shall be accurately turned, honed, and polished. All fittings, lines, and valves are to be rated at 1500 psi minimum.
- (D) Assembly: Each cylinder shall be provided with tapped oiling holes and pipe plugs for sealing the oiling holes. Each cylinder shall be equipped with a filtered air inlet, pressure relief valve, and a check valve as shown on the Contract drawings. All piping shall be mounted such that any water in the lines will drain to the needle valve drain installed. All fittings, piping, valves, and gages to be for outdoor duty, corrosion resistant, and stainless steel. Secure mounting of all piping to be accomplished with vibration absorbing mounting clamps.
- (E) Installation: each completely assembled cylinder with piston shall be tested for tightness. The fit of the piston rings shall be so accurate that the compressed air will sustain the weight of the cylinder for not less than 6 minutes with a relative movement between the cylinder and pistons not greater than the normal working stroke which is 2 inches less than the maximum piston travel.
- (F) Prior to assembly: each finished cylinder shall be given a hydraulic pressure test of 850 psi. The lower end of each cylinder shall be closed for this test by a suitable steel plate which will withstand the test pressure without appreciable deformation. Each cylinder shall show no leakage while subjected to the test pressure for a period of 30 minutes.
- (G) Adjusting the Air Buffer Outlet Valve: Normally, the leaf shall be under full electrical control when seating on the live load bearings. The electrical control system and brakes shall furnish the negative torque for seating, as well as the positive torque for driving to maintain the predetermined velocity in all positions with or without the buffers operating. The air buffers shall function



as energy absorbing devices for emergency or for reducing overhauling under severe unbalance due to snow, ice, or other causes. The air release rate from the buffers shall be adjusted to a minimum value determined experimentally as the air buffer build-up pressure with the positive driving torque of the motors, proceeding as follows:

1. Complete any required balancing adjustments of the bascule leaf with no wind or other extraneous loads.
2. Freshly lubricate the trunnions and machinery.
3. Close the bascule leaf to air buffer range (about 8° from seated position) at normal velocity.
4. Adjust needle valve at air outlet so that motors are required to exert moderate positive driving torque when the air buffer pressure is at maximum buildup.
5. When an arresting pressure at the above driving torque is determined, a bronze tag shall be attached to the air gauge - needle valve assembly stamped with the following statement: *"Set valve for maximum pressure of \_\_\_ psi during seating"*.
6. The bypass adjustment needle valve should also be adjusted to provide optimum seating contact without rebound due to air buffer pressure. The needle valve opening should be the minimum setting at which no rebound occurs.

Proper adjustment of the buffers shall be the responsibility of the Contractor.

## **19. WELDED PEDESTALS AND BOLSTERS**

Steel for weldments shall be ASTM A588 HSLA steel unless otherwise specified, and always weldable grades as designated by applicable ASTM standards. Welding materials and methods shall conform to the AWS Structural Welding Code D1.1. Where fillet weld size is not specified, use minimum size as given by AWS, based on plate thickness. All weldments shall be stress relieved with heat. Any machining shall be done after weldment is stress relieved.

## **20. HIGH STRENGTH TURNED BOLTS**

- (A) Turned bolts shall be made from a material and have a strength equal to ASTM A325, Type 1. Turned bolts 1½" and larger shall conform to ASTM A449, Type 1. Heavy hexagonal nuts, and hardened washers complying with A563, Grade C, and F436 respectively shall be used with the turned bolts. Locking shall preferably be by use of double nuts.
- (B) The body of the turned bolts shall be finished to 63 microinches or better. Threads for the turned bolts and nuts shall conform to the Unified Thread Standards, coarse thread series with a Class 2A tolerance for bolts and Class 2B tolerance for nuts, in accordance with ANSI B1.1, unless otherwise specified. Turned bolts are designated by their nominal thread size. The turned bolt body shall be 1/16th of an inch larger in diameter than the nominal size specified, and shall have an LC6 fit with reamed holes. Bolt head and nut bearing surfaces shall be flat and square with the axis of the bolt holes and shall be spot faced if necessary. Unless otherwise noted, bolt holes in machinery parts required for connecting to supporting steelwork may be sub-drilled (in the shop) smaller than the turned bolt diameter and shall be reamed together with supporting structural steel either during assembly or at erection, after the parts are correctly assembled and aligned. Positive type locking shall be provided. Double nuts are preferred. Where double nuts are used, heavy hex and jam nuts shall be used. Alternate locking methods shall be submitted to the Engineer for approval.

## 21. HUBS AND BORES

The hubs of all gears and couplings shall be bored concentric with the pitch diameter of gears or with the outside of couplings. All hubs shall have an ANSI Class FN2 medium force fit on the shafts unless otherwise specified. Unless noted otherwise or otherwise recommended by the manufacturer, all other hubs shall have a 63 microinch finish or better for a bore larger than 2 inches.

## 22. SHIMS

Where shown on the drawings, all machinery shims required for leveling and alignment of equipment shall be stainless steel, ASTM A167, Type 302/304, neatly trimmed to the dimensions of the assembled parts and drilled for all bolts that pass through the shims. In general, total shim pack thickness shall be no less than twice the nominal thickness shown on the drawings, and of sufficient varying thicknesses shall be furnished to secure 0.003-inch variations of the shim allowance including one shim equal to the full allowance. Shims shall be placed to provide full contact between machinery and machinery supports. Shims shall be shown in detail on the shop drawings.

## 23. WELDING

Welding called for on these Contract Documents shall comply with AWS D1.1. Welded steel machinery parts shall be given a stress relief heat treatment prior to machining. The Contractor shall submit a schedule of the proposed stress relief heat treatment to the Project Engineer for approval. The schedule shall include a description of the part and an explanation of the proposed heat treatment, including the rate of heating, the soaking temperature, the time at the soaking temperature, the rate of cooling, and the temperature at which the part is to be withdrawn from the chamber. Soaking times of less than one hour will not be approved. Welds for supporting bridge drive machinery, center wedges, balance wheels, and end lift mechanisms shall be 100% inspected by non-destructive methods. Acceptance criteria shall be that described in AWS D1.5 for tension welds in bridges.

All structural welds shall be complete penetration (cp) welds unless otherwise noted or shown on the Contract Plans. No feather edges on weldments. All weldments shall be stress relieved by heat after welding but before final machining.

All welding shall be by certified welders.

Unless otherwise specified, the minimum fillet weld size allowed is shown below:

Material thickness of thicker part joined (inches)	minimum size of fillet weld (inches)**
To 1/2" inclusive	3/16*
over 1/2" to 3/4"	1/4*
over 3/4" to 1 1/2"	5/16*
over 1 1/2" to 2 1/4"	3/8
over 2 1/4" to 6"	1/2

\*single pass weld must be used. The minimum weld shall be a 3/16" fillet weld.

\*\*weld size is determined by the thicker of the two parts joined unless a larger size is required by calculated stress. The weld size need not exceed the thickness of the thinner part joined.

**24. PAINTING**

- (A) Cleaning and painting of machinery surfaces shall generally conform to the NCDOT standard requirements for structural painting and shall be included on the shop drawings. Factory painted machinery items shall be hand tool or solvent cleaned and repainted with the designated paint system for movable and stationary components.
- (B) Prior to fastening new mechanical components (such as weldments and supports) to the existing bridge structural elements, clean and repaint the area on the existing structure which will be in contact with the new component. Cleaning shall be with power tools to SSPC SP11 to remove rust and poor coating. New paint shall be thick epoxy mastic top coat (Carbomastic 15 as manufactured by Carboline, or approved equal). Note that the existing structure paint system may be lead based.
- (C) Machinery surfaces shall be given one prime coat in the shop, a second prime coat and one intermediate coat after machinery and equipment have been installed and a final high gloss finish coat after completion of operating tests. Color for the final coat will be Federal Safety Orange for all moving parts including shafts, couplings, sides of pinion and rack, gears, and brake wheels. Bearing and lubricated surfaces shall not be painted. Color for the final coat of stationary parts shall be Federal Safety Green. The floor access doors in each Machinery House shall receive a final top coat of Federal Safety Green.
- (D) Before application of paint in the shop, surfaces which require painting shall be cleaned of all chips, burrs, dirt, rust, scale, sand, grease, and other extraneous materials by employing methods such as chipping, grinding, wire brushing, solvents, compressed air, and sandblasting. After cleaning, surfaces requiring paint shall be painted with one prime coat and the other bearing or sliding surfaces will be coated with protective lubricants as required above and approved by the Engineer. Nameplates shall be clean and free of paint.
- (E) After the machinery items have been installed in final position on the bridge, all surfaces which require paint shall be cleaned of grease, oil, and loose materials by the use of solvents and compressed air, and all damaged shop prime coated surfaces shall be touched up with the same paint coating. The Contractor shall take special care to avoid painting of machinery bearing and sliding surfaces and to mask and protect from paint all nameplates, legend plates, and escutcheons mounted on machinery.
- (F) After completion of the operating tests and acceptance of the machinery, all oil, grease, dirt, and other foreign matter shall again be cleaned from exposed machinery surfaces. The exposed surfaces shall then be given a third field coat, which shall color-code the machinery to identify fixed and moving parts as indicated above.
- (G) Paint for the final field coat shall be brush applied and shall be compatible with the previous coat and shall be a high-gloss machinery enamel, resistant to weathering and abrasion, conforming to the requirements of the Safety Color Code for Marking Physical Hazards, ANSI 253.1. The machinery enamel shall be a tested product equal to Rust-Oleum Federal Safety Coating. The brand and colors shall be submitted to the Engineer for approval. The Contractor shall place a cautionary sign in the Operator's House and at the entrance to the machinery area of each tower to explain the color code. Details of the sign including text, dimensions, mounting locations, and materials shall be submitted to the Engineer for approval.

**25. LUBRICATION**

- (A) The Contractor shall furnish a lubrication plan for all new or rehabilitated machinery for approval. The plan shall be developed from recommended practice of the machinery manufacturers. The Contractor shall coordinate the lubrication plans for the various machinery elements and minimize the number of different lubricants. The Contractor shall furnish copies of letters from the various

machinery manufacturers endorsing the lubricants which have been finally selected. Lubricants shall be selected for year round exposure at the bridge.

- (B) The Contractor shall provide two lever type lubrication guns with three foot hoses. Fittings shall be located in a protected and convenient position for use and shall be connected to the points requiring lubrication by pipe extensions where necessary. These pipe extensions shall be kept as short as practical and shall be rigidly supported at the fittings and at intermediate points. Pipe shall be 1/4 inch seamless threaded red brass with cast bronze threaded fittings. Fittings on proprietary parts shall be replaced if necessary with fittings that have been selected as standard for the bridge.
- (C) The Contractor shall furnish a lubrication diagram for the machinery in (A) above which shall show all points requiring lubrication, the type of lubricant to be used at each point and the frequency of lubrication. The diagram shall be submitted to the Engineer for approval and the approved diagram shall be mounted in the operator's house and in each tower top machinery room with a suitable and approved frame and glass cover.
- (D) Lubricant compounds furnished shall be as recommended and certified by their manufacturer for the use and requirements called for. Lubricants shall be recommended for use year round with consideration to ambient temperature ranges that will be experienced by the various components. Synthetic lubricants may be proposed, but shall be compatible with all seals and sealing compounds that may be exposed to the lubricant. Contractor shall furnish the Engineer a copy of the certification.

## **26. MEASUREMENT AND PAYMENT**

- (A) Mechanical work required by this section shall be measured as a single item, MISCELLANEOUS BASCULE BRIDGE MECHANICAL WORK, complete and fully functional in place. This price shall include all products, labor, tools, equipment, testing, and incidentals necessary to complete the work in accordance with these contract documents. Payment shall be on the basis of a single lump sum item.

**END OF SECTION**

**SECTION B-3**  
**MISCELLANEOUS BASCULE BRIDGE ELECTRICAL WORK**

**1. SCOPE**

- (A) This section covers all products, labor, services, incidentals, and related work necessary to furnish, install, test, and put into permanent service all miscellaneous electrical work as shown on the plans and described herein.
- (B) This section is a component of the Bascule Bridge Special Provisions. The provisions and requirements of Section A – General Special Provisions are hereby incorporated into this section by this reference, and shall have the same force and effect as if printed here in full.
- (C) Specific items covered by this section include the following.
  - 1. General Materials, Brackets, and Supports
  - 2. Fasteners
  - 3. Metal Framing Strut
  - 4. Equipment Cabinets and Enclosures
  - 5. Equipment Nameplates, Signs, and Labels
  - 6. Cutting, patching, and welding
  - 7. Painting
  - 8. Removals and salvage

**2. SUBMITTALS**

- (A) All submittals as required by Section A-5 – General Requirements for Bridge Electrical Work.
- (B) Nameplates, signs, and labels text, graphics, layouts, and other descriptive characteristics.

**3. GENERAL MATERIALS, BRACKETS, AND SUPPORTS**

- (A) Unless specifically indicated otherwise, plates, shapes (angles, channels, etc.), fabricated brackets, and similar items shall be hot-dip galvanized ASTM A36, or approved equivalent, steel.
- (B) Where plates, shapes, fabricated brackets, and similar items are identified as aluminum, they shall be 6061-T6, or approved equivalent, unless otherwise noted.
- (C) Unless specifically indicated otherwise, all stainless steel shall be "Marine Grade", such as Type 316. If the Contractor can demonstrate to the satisfaction of the Engineer that Marine Grade stainless steel is not available for the item in question, a lesser grade, such as Type 304, will be considered.
- (D) Fabricated items which are constructed by welding shall be thermally stress relieved after welding and before any additional machining or finishing.
- (E) Fabricated steel items which are to be galvanized shall be hot-dip galvanized after fabrication. Hot-dip galvanizing shall be in accordance with the American Galvanizers Association Suggested Specification for Hot-Dip Galvanizing.
- (F) Welding shall be in accordance with American Welding Society standards appropriate for the material(s) and final product in question.
- (G) Isolate aluminum items from concrete and dissimilar with neoprene shims. Do not install aluminum products in contact with the ground.

- (H) Isolate galvanized items from unpainted and/or "weathering" steel with neoprene shims.

#### **4. FASTENERS**

- (A) Unless indicated otherwise for a specific application, all fasteners shall comply with the requirements listed below.
- (B) All bolts, threaded rod, machine screws, nuts, washers, and similar hardware shall be Type 316 stainless steel.
- (C) Concrete anchors shall be either epoxy adhesive type or wedge stud type. Concrete anchors shall be Type 316 stainless steel.
- (D) Screws (wood, sheet metal, self tapping, masonry etc.) shall not be used except where specifically indicated, or with the special permission of the Engineer.
- (E) Beam clamps in dry or damp locations shall be galvanized. Beam clamps in wet locations shall be PVC coated galvanized or stainless steel. All beam clamps shall be provided with locknuts (or utilize threadlocking adhesive) and stainless steel retainer straps (minimum 12 Gauge).
- (F) All bolted connections shall utilize lock washers. Bolted connections which, due to their inherit geometry, do not permit the use of lock washers may utilize an approved threadlocking adhesive or other approved method of vibration proofing.

#### **5. METAL FRAMING STRUT**

- (A) Metal framing strut (Unistrut) and fittings shall be manufactured in accordance with the requirements of the Metal Framing Manufacturers Association.
- (B) Metal framing strut and fittings shall be Type 316 stainless steel.
- (C) Unless specifically indicated otherwise, metal framing strut shall not be used where it is subject to vibration without the explicit written permission of the Engineer on a case by case basis. Where the use of metal framing strut is permitted, the Engineer may require the use of special hardware and/or installation configurations to increase vibration resistance.
- (D) Metal framing strut and fittings shall be as manufactured by Cooper B-Line, Allied Power-Strut, Unistrut Corporation, Thomas and Betts, or approved equal.

#### **6. EQUIPMENT CABINETS AND ENCLOSURES**

- (A) Unless specifically indicated otherwise, cabinets and enclosures for electrical equipment shall comply with the following.
  1. Dry and Damp Locations: NEMA 12 steel with corrosion resistant finish inside and out and corrosion resistant hinges and/or hardware.
  2. Wet Locations: NEMA 4 or 4X Type 316 stainless steel, or welded or cast aluminum, with stainless steel or similarly corrosion resistant hinges and/or hardware.
  3. Cabinets and enclosures containing devices or terminal blocks shall include aluminum or steel internal mounting panels with corrosion resistant finishes.
  4. Cabinets and enclosures shall comply with the requirements of NEMA 250 and UL 50.
  5. Cabinets and enclosures installed in wet or damp locations shall be provided with drains. See the requirements for conduit system drains given elsewhere in these Special Provisions.

- (B) Install cabinets and enclosures plumb and level. Anchor cabinets securely as indicated and as required to provide a dependable installation.
- (C) Unless specifically indicated otherwise, conduit and cable entrances in damp and wet locations shall be made only in the bottom of cabinets and/or enclosures.
- (D) Isolate aluminum cabinets and enclosures from concrete and dissimilar metals with neoprene shims. Do not install aluminum cabinets and enclosures in contact with the ground. Isolate cabinets and enclosures which are not stainless steel from unpainted and/or "weathering" steel with neoprene shims.
- (E) Provide all accessories and miscellaneous hardware required for a complete installation.

## **7. EQUIPMENT NAMEPLATES, SIGNS, AND LABELS**

- (A) Provide nameplates for all electrical equipment.
  - 1. Nameplates shall be engraved plastic laminate. Text shall be minimum 3/16 inch high. General purpose nameplates shall have white text on black background. Nameplates with warning or cautionary text shall have white text on red background.
  - 2. Nameplates shall be securely and dependably attached to equipment with stainless steel machine screws. Screw holes shall be sealed with silicone, or other approved and effective method, to prevent water ingress.
  - 3. Nameplate text shall be coordinated with the as-built plans and shop drawings to clearly identify each piece of equipment. Nameplate text shall include the following.
    - a. Both device designations (e.g. "S-1"), where applicable, and plain English identification of the equipment and its purpose (e.g. "Main Drive Motor Disconnect Switch").
    - b. Where the equipment is fed from and/or the nearest upstream disconnecting means (e.g. "Fed from MCC Bucket 2A").
    - c. The equipment voltage, phase, either full load current or overcurrent protective device rating, as appropriate, and other pertinent characteristics (e.g. "480 Volts, 3 Phase, 15 Amperes Full Load" or "208Y/120 Volts, 3 Phase, 4 Wire, 100 Amperes Main Breaker" or "480 Volts, 3 Phase, 50 Ampere Thermal-Magnetic Breaker").
- (B) Provide electrical hazard warning labels in accordance with NEC 110.16.
- (C) All electrical cabinets and enclosures shall be provided with the appropriate arc flash hazard warning labels indicating the arc flash hazard category in compliance with NFPA 70E and NEC 2008.

## **8. ARC FLASH HAZARD ANALYSIS**

Contractor shall acquire the services of an engineering service qualified in arc flash hazard analyses to perform an analysis of the bridge electrical system to the extent necessary to provide all electrical cabinets and enclosures with the appropriate arc flash hazard warning labels indicating the arc flash hazard category in compliance with NFPA 70E and NEC 2008.

**9. CUTTING, PATCHING, AND WELDING**

- (A) Provide all openings through walls, floors and ceilings, etc. required for the installation of work.
- (B) Following installation and testing, restore floors, walls and ceilings with materials equal to the original construction and finish to match existing surfaces.
- (C) Cutting, patching, and welding shall be performed only by tradesmen familiar with the construction involved.
- (D) Welding shall be performed only by welders certified according to American Welding Society or American Society of Mechanical Engineers standards appropriate for the work being performed.
- (E) Do not cut or drill structural elements (steel or concrete) without explicit written permission from the Engineer.
- (F) Do not weld to structural elements without explicit written permission from the Engineer.
- (G) Field cuts to, or drilled holes in, galvanized materials shall be treated with an approved, zinc rich, cold galvanizing compound prior to installation. Field cuts to, or drilled holes in, painted structural members shall be treated with a rust inhibiting primer. Any over spray which will not be covered by the item to be installed shall be painted to match the surrounding structure.

**10. PAINTING**

- (A) Electrical equipment cabinets and enclosures, surface mounted raceways, and surface mounted boxes in finished areas shall be painted to match the surrounding area.
- (B) Electrical equipment cabinets and enclosures, raceways, and boxes with factory applied finishes shall be "touch-up" painted as required to repair any damage to the factory finish. "Touch-up" painting shall utilize, at minimum, one coat of primer and two coats of finish paint. Primer and paint shall be as supplied or recommended by the manufacturer of the item being painted.

**11. REMOVALS**

- (A) Remove all equipment and/or conductors designated for removal as shown on the plans or otherwise noted in the contract documents.
- (B) Perform all removals in such a manner as to avoid damage to existing equipment and/or conductors which are to remain.
- (C) The Contractor shall give the Owner the option of salvaging all electrical equipment which is to be removed.
- (D) The Contractor shall deliver all equipment which is to be salvaged to the location designated by the Engineer. All equipment which is to be salvaged shall be handled with care at all times to avoid damage.
- (E) All equipment which is to be removed and is not to be salvaged shall become the property of, and be removed from the project site by, the Contractor.
- (F) The Contractor shall bear full responsibility for proper disposal of removed equipment and/or materials in accordance with all applicable regulations.



- (G) Except where specifically noted otherwise, only existing concrete embedded raceways and boxes may be abandoned in place. Existing underground raceways, in-ground boxes, and other equipment shall not be abandoned in place, except where specifically noted otherwise.

Existing concrete embedded raceways which are to be abandoned in place shall have all conductors removed, be ground flush with the concrete, and filled with non-shrink grout.

Existing concrete embedded boxes which are to be abandoned in place shall have all conductors removed and be covered with a new blank galvanized steel cover.

The locations and characteristics of all raceways, boxes, and equipment which are abandoned in place shall be clearly documented on the as-built drawings.

**12. MEASUREMENT AND PAYMENT**

- (A) Electrical work required by this section shall be measured as a single item, MISCELLANEOUS BASCULE BRIDGE ELECTRICAL WORK, complete and fully functional in place. This price shall include all products, labor, tools, equipment, testing, and incidentals necessary to complete the work in accordance with these contract documents. Payment shall be on the basis of a single lump sum item.

**END OF SECTION**

**SECTION B-4**  
**BASCULE BRIDGE ELECTRICAL EQUIPMENT**

**1. SCOPE**

- (A) This section covers all products, labor, services, incidentals, and related work necessary to furnish, install, test, and put into permanent service all electrical equipment as shown on the plans and described herein.
- (B) This section is a component of the Bascule Bridge Special Provisions. The provisions and requirements of Section A – General Special Provisions are hereby incorporated into this section by this reference, and shall have the same force and effect as if printed here in full.

**2. SUBMITTALS**

- (A) All submittals as required by Section A-5 – General Requirements for Bridge Electrical Work.

**3. DISCONNECT SWITCH**

- (A) Disconnect switches shall be UL Listed heavy duty safety switches and comply with the requirements of NEMA KS 1. Ratings shall be as indicated and as required by the circuits and/or equipment served.
- (B) Switches shall be horsepower rated.
- (C) Switches shall utilize quick-make, quick-break contacts. Contacts shall be visible with the door open.
- (D) Enclosure shall be NEMA 4X stainless steel (Type 316) enclosure with external handle. Enclosure shall include provisions for locking the door closed and for locking the external handle in the OFF position.
- (E) Disconnect switches shall be Cutler-Hammer DH, or approved equal.

**4. MINI-POWER CENTER**

- (A) Power center shall be a single UL Listed unit consisting of a panelboard type distribution section, dry type low voltage transformer, and primary and secondary molded case circuit breakers. Ratings shall be as shown on the plans.
- (B) Panelboard Section
  - 1. Distribution section phase, neutral, and ground buses shall be copper or aluminum.
  - 2. Overcurrent protective devices shall be UL Listed molded case and/or miniature circuit breakers having inverse-time and instantaneous tripping characteristics. Breakers shall connect to the panelboard bus by bolting.
  - 3. Number of device spaces shall be as indicated. Blank covers shall be provided for all unused spaces.
  - 4. Provide a typewritten circuit directory, placed in a clear plastic cover inside the door.
- (C) Transformer Section

1. Insulation system shall be 185 Celsius, with maximum 115 Celsius operating temperature rise under full load.
  2. With two 5% below normal full capacity taps.
  3. Unless specifically indicated otherwise, primary shall be delta connected and secondary shall be solidly grounded wye connected. Transformer secondary neutral grounding shall conform to the requirements for grounding and bonding given elsewhere in these special provisions.
- (D) All wiring between the primary breaker and transformer, the secondary breaker and transformer, and the secondary breaker and distribution section shall be factory installed.
- (E) Enclosure shall be NEMA Type 3R steel with corrosion resistant finish.
- (F) Install in accordance with the requirements of NEMA PB 1.1.
- (G) Adjust phase balance and transformer taps as directed by the Engineer.
- (H) Power centers shall be as manufactured by Cutler-Hammer, or approved equal.

#### **5. ROTARY CAM LIMIT SWITCH**

- (A) Heavy duty rotary cam limit switch.
- (B) Single turn.
- (C) Number of cams as indicated on the plans. SPDT switches. Contacts rated 10 amperes at 120 volts AC.
- (D) NEMA 4/4X stainless steel (Type 316) housing.
- (E) Rear shaft extension.
- (F) Cams adjustable at any position of input shaft. No special cams required for any setting from 4 degrees to 356 degrees.
- (G) Operable from 0 to 500 RPM, and -50 to +185 Fahrenheit.
- (H) 0.6 inch-pounds operating torque per cam.
- (I) Rated for 50 pounds end thrust and 500 pound radial load.
- (J) Repeatability of +/-0.25 degree, or better.
- (K) Gemco 1980, or approved equal.

#### **6. AUXILIARY DRIVE CONTROLS**

- (A) All components shall be UL Listed and as shown on the plans. Additional characteristics shall be as described herein.
- (B) Cabinet
1. UL Listed heavy duty disconnect enclosure.

2. NEMA 4X stainless steel, 14 gauge body and door. Continuous hinge.
3. Dimensions as shown on the plans.
4. Door latching system interlocked with main breaker external operating handle.
5. As manufactured by Hoffman, or approved equal.

(C) Main Breaker

1. UL Listed molded case circuit breaker. Thermal magnetic tripping, with characteristics per UL 489 / NEMA AB 1. Ratings as shown on the plans.
2. Minimum 14,000 amperes short circuit rating at 480 volts.
3. Operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free, with a single common handle for all poles. Automatic tripping shall be clearly indicated by the handle position, or similar visual means.
4. With at least one spare electrically isolated auxiliary contact.
5. As manufactured by Cutler-Hammer, or approved equal.

(D) Starter

1. UL Listed full voltage, NEMA style, electromechanical type motor starter. Ratings as shown on the plans.
2. Field replaceable, double break, silver alloy contacts.
3. With at least one spare electrically isolated auxiliary contact.
4. Manual reset, melting alloy overload relay.
5. Reversing contactors and starters shall be mechanically and electrically interlocked.
6. As manufactured by Cutler-Hammer, or approved equal.

(E) Pendant Station

1. UL Listed heavy duty compact pendant pushbutton station.
2. NEMA 4X non-metallic housing.
3. Two pushbuttons, mechanically interlocked.
4. Hubbell CPB21, or approved equal.

(F) Pendant Station Plug and Receptacle

1. UL Listed, matching, multipin receptacle and plug.
2. Spring loaded silver-nickel contacts.
3. Polyester housing rated NEMA 4X.

4. 600 volts AC, 5 amperes.
  5. Receptacle equipped with a flip open cover. Plug and receptacle shall be held together by a latching pawl when engaged.
  6. As manufactured by Meltric, or approved equal.
- (G) The auxiliary drive controls shall be shop assembled by an experienced controls shop.

## **7. VAPORTIGHT LUMINAIRE**

- (A) UL Listed (1598), enclosed and gasketed incandescent luminaire. Ratings as shown on the plans.
- (B) Luminaires shall be suitable for use in indoor and outdoor applications, and in corrosive environments; rated NEMA 3 and 4X.
- (C) Body material shall be 30% glass filled thermoplastic polyester, with molded threads which will not "freeze". Material shall meet UL 94-V-O for flame retardancy.
- (D) Luminaires shall be supplied with glass globes, polyester guards, and matching mounting hardware.
- (E) Luminaires shall be suitable for use with 90 Celsius supply wire.
- (F) Vaportight Luminaires shall be Hubbell Industrial Lighting NV Series, or approved equal.

## **8. COUNTERWEIGHT PIT FLOODLIGHT**

- (A) UL Listed (1598A – Marine Outside Type Saltwater) quartz halogen floodlight. Ratings as shown on the plans.
- (B) Luminaires shall be suitable for use in marine and wet environments; rated IP 66.
- (C) Housing material shall be copper free aluminum, with oven-cured polyester powder coat finish.
- (D) Lens shall be thermal and shock resistant high impact clear glass.
- (E) Gaskets shall be one-piece high temperature silicone.
- (F) Hardware shall be stainless steel. Latches shall be spring loaded and positive locking.
- (G) Reflector shall be highly specular hammertone aluminum.
- (H) Lampholder shall be spring loaded.
- (I) Luminaire shall be supplied with a stainless steel wire lens guard.
- (J) Counterweight pit floodlights shall be Pauluhn QA, or approved equal.

## **9. LIGHT SWITCH**

- (A) Light switches shall be provided as indicated and as required for proper operation of all luminaires.
- (B) Switches shall be UL listed, heavy-duty type, suitable for use in industrial environments.

- (C) Switches shall be rated 120 / 277 volts and at least 20 amperes. Pole and switching configuration shall be as indicated and as required for the circuit(s) served.
- (D) Switches shall be as manufactured by Hubbell, or approved equal.
- (E) Covers for switches in wet locations shall be weatherproof, plastic coated, galvanized cast iron alloy with, with external actuating handles.

#### **10. RECEPTACLE**

- (A) Receptacles shall be UL listed, heavy-duty type, suitable for use in industrial environments.
- (B) General purpose receptacles shall be duplex grounding type rated 120 volts AC, 20 amperes (NEMA 5-20R). Receptacles installed in damp and wet locations shall be GFCI type
- (C) Receptacle configurations shall be as defined by NEMA for the rated voltage and current.
- (D) Receptacles shall be as manufactured by Hubbell, or approved equal.
- (E) Covers for receptacles in wet locations shall be cast aluminum, self-closing, rated "Raintight While In Use" type.

#### **11. SPAN NAVIGATION LIGHT**

- (A) The span navigation light shall be a factory assembled unit which is specifically designed for use in marking bascule spans in accordance with United States Coast Guard requirements. Arrangement of components and general dimensions shall be as shown on the plans.
- (B) The lamp housing shall be constructed of cast aluminum. The casting alloys shall be suitable for use in marine environments.
- (C) The overall assembly shall be fully gasketed and rain-tight.
- (D) Lenses shall be tempered fresnel glass. Lens sections shall be 180 degrees green over 180 degrees red. Each lens shall have an outside diameter of 205 millimeters, and be at least 6 inches high.
- (E) Lamp socket shall consist of a porcelain enclosed socket with nickel plated grip screw shell.
- (F) Suspension stem shall be 1-1/2 inch diameter Schedule 40 steel pipe, hot dip galvanized.
- (G) Swivel assembly shall allow the light to pivot in order to remain vertical as the bascule span raises, as well as be pivoted up (180 degrees) for access to the lamps. Swivel assembly shall be cast from the same material as the lamp housing, with a stainless steel spindle, and utilize appropriate gaskets and o-rings to achieve a watertight seal. All wiring shall pass through the assembly.
- (H) The swivel assembly shall also include an anti-swing brake which permits the light to pivot under its own weight, and also to be manually raised, but prevents oscillations during windy conditions.
- (I) The mounting base shall be of the same material as the lamp housing, with holes for four 1/2 inch diameter mounting bolts.
- (J) A junction box, matching the mounting base footprint and bolt pattern, shall be provided.

- (K) Control of switching between red and green shall be achieved separately from the navigation light assembly.
- (L) Lamps shall consist of a 120 volt LED array which provides an output of approximately 840 candelas (similar to a 75 watt incandescent lamp). Beam viewing angle shall be not less than 20 degrees. Output wavelength shall be approximately 510 nanometers for green lamps and 630 nanometers for red lamps. Lamp array shall have a standard medium screw base. Rated mean-time-between-failures rating of 100,000 hours.
- (M) Navigation lights shall be B&B Roadway Model BS, or approved equal.

## **12. SPAN LOCK LIMIT SWITCHES**

- (A) Heavy duty lever arm limit switch.
- (B) U.L. Listed.
- (C) Six circuit – three normally open and three normally closed. Contacts rated 20 amperes at 120 volts AC.
- (D) NEMA 4X, 6P, 7, AND 9 cast bronze housing.
- (E) -40C TO +90C operation.
- (F) Cycle life of over 1,000,000 operations.
- (G) 18 degree trip travel, 14 degree reset travel, 90 degree maximum travel. 27 inch-pounds operation torque.
- (H) Either clockwise or counter-clockwise operating as required. Bi-directional operation is not acceptable unless specifically called for.
- (I) With lever arm as indicated.
- (J) Namco Controls EA800, or approved equal.

## **13. CENTER LOCK LIMIT SWITCHES**

- (A) The limit switches for the new center locks are to be provided as part of the center lock assembly, and shall be considered a component of the center locks for measurement and payment purposes. Refer to the mechanical drawings and special provisions for additional information.

## **14. MEASUREMENT AND PAYMENT**

- (A) Work covered by this section is incidental to other items of electrical and/or mechanical work, and will not be separately measured or paid for. All costs associated with this section shall be included in the prices bid for the other items of electrical and/or mechanical work, as appropriate.

**END OF SECTION**

**SECTION C-1**  
**MAINTAINING LIFT SPAN BALANCE**

**1. SCOPE**

- (A) The Contractor shall be responsible for all labor and material necessary to maintain the existing balance condition throughout construction. At the conclusion of all work on the lift span, the balance condition shall again be evaluated and confirmed by the Engineer, with any adjustments required to restore proper balance condition being performed by the Contractor.
- (B) This section is a component of the Memorial Lift Bridge Special Provisions. The provisions and requirements of Section A – General Special Provisions are hereby incorporated into this section by this reference, and shall have the same force and effect as if printed here in full.

**2. MATERIALS**

- (A) Additional balance weights for installation in the counterweight pockets, if necessary beyond that provided by NCDOT, shall be furnished by the Contractor, and shall be 50 pounds each, all of the same weight. New balance weights shall be ASTM A36 Steel plate no larger than 12 inches high by 12 inches wide, with a hand hole or handle at the top for ease of handling. Steel balance weights shall be painted with an approved rust inhibitor.

**3. BALANCE CONDITION DETERMINATION**

- (A) The existing bridge balance condition, and the final balance condition (after all work completed) shall be determined by the strain gage method or by reading the drive motor torque on the existing flux vector drives during raising operation.
- (B) If the flux vector drive torque readings are utilized, they shall be taken at the slowest possible steady running speed, at 20 feet above seated. Several readings shall be taken and averaged. Readings shall be taken both immediately before work is performed and after all work is completed. Speed shall be identical for all readings. Readings shall be taken when the lift span is dry, and with little or no wind.
- (C) The Contractor shall convert the motor torque readings to equivalent weight values as measured at each end of the lift span.

**4. REQUIRED BALANCE RANGE**

- (A) During construction, the acceptable balance condition shall be within 1,000 pounds of the existing weight (downward reaction) at each end of the lift span. Balance conditions shall be strictly maintained within the above stated range during all construction activities.
- (B) The Contractor shall provide balance calculations for all additions and removals of components and materials to and from the lift span and counterweights. Such calculations shall be submitted to the Engineer for each operation that involved any alterations to the weight or balance of the lift span.
- (C) When weight adjustments are necessary to maintain the balance condition, weight shall be added to or removed from the counterweight pockets in accordance with the approved calculations. The bridge balance conditions shall be adjusted the same day that construction activities result in any alteration of the bridge balance, and prior to any required openings for waterway traffic. At no time shall any brakes or span locks be released or disengaged, respectively, until bridge balance has been properly adjusted.



- (D) Temporary equipment and tools shall be removed from the lift span prior to each bridge operation, and therefore need not be included in the balance.
- (E) At completion of the project, acceptable balance condition shall be the initial balance condition prior to any work being performed, plus or minus 500 pounds downward reaction at each end as measured at 20 feet above seated as described above.

**5. PERFORMANCE**

- (A) The Contractor shall perform balance calculations as herein specified. The balance calculations shall be performed by a Professional Engineer licensed in the State of North Carolina. The calculations shall account for the detailed weight of all materials removed and added as part of this project and their locations on the lift span. The weights shall be precise and accurate and account for all material including fill plates, welds, bolts, washers, nuts and any other components removed, added or replaced as part of this project.
- (B) Calculations shall be submitted on spreadsheets showing the material callout, weight, location on the lift span, and resulting impact on balance conditions at both ends. Weight removed and weight added shall be tabulated on separate sheets from the balance calculations. A summary balance table shall be developed. The summary tables shall show the staging of the balance and proposed imbalances. The calculations shall also account for the placement of any new balance blocks, and the removal or repositioning of any existing balance blocks. A brief narrative shall be included with the outline of the proposed construction staging, the duration of the unbalance and all the other aspects of the work. This information shall be coordinated with the Contractor's scheduling requirements and shall be submitted to the Engineer for approval prior to commencement of any work on the lift span. The weights shall be shown on the shop drawings for each component. The calculations and spreadsheet shall be updated daily by the Contractor throughout construction on the lift span and submitted to the Engineer daily.

**6. MEASUREMENT AND PAYMENT**

- (A) There will be no separate measurement and payment for additional balance bars. Balance bars shall be furnished by NCDOT Div 3 Bridge Maintenance (approximately 30,000 lbs. available). Contact Mr. Trevor Carroll at (910) 341-2000 for location of bars and to schedule pick up.
- (B) There will be no separate measurement and payment for maintaining the span balance condition. This work is considered to be an integral part of the overall mechanical work, and the costs thereof shall be included in the price bid for other mechanical work items.

**END OF SECTION**

**SECTION C-2**  
**LIVE LOAD BEARING REHABILITATION**

**1. SCOPE**

- (A) This section covers all products, labor, services, incidentals, and related work necessary for the rehabilitation of the live load bearings.
- (B) This section is a component of the Memorial Lift Bridge Special Provisions. The provisions and requirements of Section A – General Special Provisions are hereby incorporated into this section by this reference, and shall have the same force and effect as if printed here in full.

**2. MATERIALS**

- (A) Cast steel for the expansion bearings upper shoes and the rocker assemblies and the fixed bearings upper and lower shoes shall be ASTM A148 Grade 130-115.
- (B) The pin steel for the expansion bearing shall be ASTM A668 Class G.
- (C) The structural steel for the bearings shall be ASTM A709 Grade 50.
- (D) The shim material shall be ASTM A709 Grade 50 at all locations. The shim will be supplied in thicknesses to allow 1/32" adjustments plus one shim equal to the full allowance.
- (E) High strength bolts shall be 7/8" diameter ASTM A325, with ASTM A563 Grade DH nuts and hardened washers conforming to ASTM F436.
- (F) The 7/8" diameter tap bolts shall be ASM A325.
- (G) Anchor bolts shall be ASTM F1554 Grade 55, press swedged with 6" of threads at top end with ASTM A563 Grade DH nuts and hardened washers conforming to ASTM F436. Mechanically galvanize nuts, bolts and washers.
- (H) The concrete for the new bearing pedestals shall be early high strength concrete with a minimum 24-hour compressive strength of 3000 PSI, and a minimum 28 day compressive strength of 8,000 PSI.
- (I) Non-shrink grout for new anchor bolts shall be ASTM C-881, Type I or IV, Grade 3.
- (J) Bedding material under masonry plates shall be elastomeric material with multiple layers of embedded synthetic fiber. The bedding material shall have a minimum compressive strength of 8,000 PSI.
- (K) Bearing weldments shall be stress relieved by heat treatment per AASHTO/AWS D1.5 – 2008.
- (L) Surface Roughness Requirements:
 

Pins and Pin Holes	– ANSI 125
Sliding Bearing Surfaces	– ANSI 125
Rocker	– ANSI 250

**3. SUBMITTALS**

The following items shall be submitted for approval a minimum of 30 working days prior to the beginning of work:

- (A) Plans for the maintenance of traffic to be used during the live load bearing rehabilitation.
- (B) A written narrative of the bearing retrofit procedures. The contractor is responsible for ensuring that the adopted procedure does not cause any damage to the bridge. The procedure shall include all of the required steps for removing the existing bearing material and installing the new bearing material, all steps required for installing and removing temporary blocking and all steps required for final bearing adjustments after installation.
- (C) Structural steel shop drawings and erection drawings for live load bearing rehabilitation.
- (D) Catalog cuts for anchor bolt grout and bearing bedding material.
- (E) Calculations for temporary blocking. All calculations shall be prepared and sealed by a professional engineer, licensed in the state of North Carolina.

#### **4. DETAILS AND WORKMANSHIP**

- (A) Welding shall be in accordance with ANSI/AASHTO/AWS Bridge Welding Code D1.5 – 2008.
- (B) Painting shall conform to Section 442 of the NCDOT Standard Specifications.
- (C) Anchor bolt and bearing installation shall conform to Sections 440-4 and 420-12 of the NCDOT Standard Specifications.
- (D) Anchor bolt grouting shall conform to Section 440-13 of the NCDOT Standard Specifications.
- (E) All dimensions shall be field verified prior to the start of any development of shop drawings or fabrication of new material.
- (F) Remove the existing concrete bearing pedestal flush with the pier top and install new bearing pedestals 3/4" lower than existing pedestals. Construct new pedestals 1" larger in each direction than the new masonry plates all around.
- (G) Provide variable thickness shim plates to be installed under the new bearing masonry plates for final bearing height adjustments.

#### **5. MEASUREMENT AND PAYMENT**

Mechanical work required by this section shall be measured as a single item, MEMORIAL LIFT BRIDGE LIVE LOAD BEARING REHABILITATION, complete and fully functional in place. This price shall include all products, labor, tools, equipment, testing, and incidentals necessary to complete the work in accordance with these contract documents. Payment shall be on the basis of a single lump sum item.

**END OF SECTION**

**SECTION C-3**  
**MAIN and AUXILIARY COUNTERWEIGHT WIRE ROPE REPLACEMENT**

**1. SCOPE**

This section includes the removal of existing main and auxiliary counterweight rope assemblies and the furnishing, testing, and installing of the new main and auxiliary counterweight wire ropes, complete with their sockets, pins, bolts, nuts, cotter pins, and all other necessary parts.

Provide all apparatus, tools, devices, materials and labor to remove existing counterweight rope assemblies (both main and auxiliary) and install, erect, align, adjust, lubricate and test the new main and auxiliary counterweight wire rope assemblies in an approved manner as provided herein. Determine and maintain the lift span balance condition throughout the entire Contract. Thoroughly clean all existing main and auxiliary counterweight rope sheave grooves, rope guides, rope deflectors, connection rods and attachment points to remove all old lubricant and debris in the wire rope grooves.

The work shall include removal of existing and furnishing, manufacture, fabrication, testing, pre-stretching, stripping, erection, installation, tensioning, lubricating, and placing into satisfactory service, the wire ropes, sockets, pins and all other associated components necessary to assure proper installation and operation of all new wire rope assemblies, all in accordance with these specifications and contract drawings or as directed by the NCDOT. The jacking, installation, and adjustment shall be by millwrights experienced in this class of work.

Items include the following:

- (A) For each tower: main and auxiliary counterweight ropes, rope sockets, wire rope dressing and equipment necessary for proper removal of existing and installation of the new ropes. Rope lengths are shown in the plans and are per the original design which will require additional jacking to connect the new main counterweight ropes.
- (B) High strength stainless steel pins, bolts, nuts, cotter pins and all other miscellaneous hardware.

This section is a component of the Memorial Lift Bridge Special Provisions. The provisions and requirements of Section A – General Special Provisions are hereby incorporated into this section by this reference, and shall have the same force and effect as if printed here in full.

**2. REFERENCES**

The issue date of references included in these project specifications need not be more current than provided by the latest Change Notice to this specification. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The latest revisions only shall be used for all references.

**AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)**

Manual of Steel Construction, "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings"

**AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)**

- |             |                 |
|-------------|-----------------|
| ANSI B 1.1  | Screw Threads   |
| ANSI B 46.1 | Surface Texture |

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO Movable Highway Bridge Design Specifications, 2007, 2<sup>nd</sup> Edition (published by the American Association of State Highway and Transportation Officials).

AASHTO Standard Specifications for Movable Highway Bridges, 1988, Including 1992 Revisions (published by the American Association of State Highway and Transportation Officials).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A276	Stainless Steel Bars
ASTM A 325	Structural Steel Bolts, Heat Treated
ASTM A 563	Carbon and Alloy Steel Nuts
ASTM A 668	Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 1007	Carbon Steel Wire for Wire Rope
ASTM A 1023	Stranded Carbon Steel Wire Rope
ASTM B 6	Zinc (Slab Zinc)

FEDERAL SPECIFICATIONS (Fed. Spec.)

North Carolina Department of Transportation's Standard Specifications

RR-S-550	Wire Rope Sockets
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**3. QUALITY ASSURANCE**

Inspection. Materials and fabrication procedures are subject to inspection and testing in the mill, shop and field by the NCDOT and/or their Engineering Representative. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

- (A) Design of Items and Connections: All details shown on the Contract Drawings are typical and apply to general conditions on the bridge, unless otherwise indicated. All dimensions and details (including main and auxiliary counterweight rope lengths) shall be verified at the site and submitted to the NCDOT and/or their Engineering Representative before proceeding with any work and to avoid causing subsequent delay in work.
- (B) The NCDOT shall be notified immediately for clarification whenever any portion of work is not clearly or accurately defined or dimensioned.
- (C) Certified Test Reports: As used herein, certified test reports refer to reports of tests conducted on previously manufactured materials or equipment intended for use on the Cape Fear Vertical Lift Bridge. Tests shall have an accuracy and precision inherent to conventional industrial test instruments and equipment. Certification of truthfulness and accuracy shall be required by an authorized representative of the testing agency
- (D) Factory Tests: As used herein, factory tests refer to tests required to be performed on the actual materials or equipment proposed for use prior to shipment to the construction site. Results of

the tests shall be submitted in accordance with the provisions of this Contract for laboratory test results. "Factory" tests shall be performed at the manufacturer's plant or supplier's premises, or at a separate, independent accredited test laboratory, if appropriate.

- (E) Quality Assurance Testing: The NCDOT or designated engineering inspectors may select sample materials for quality assurance testing for specification compliance. Testing may be on-site or by an independent laboratory. Test results shall be furnished to the NCDOT for reference, or for other applicable disposition if not in compliance.
- (F) Warranty: The Contractor shall remedy defects due to quality of work, erection, materials or design for a period of one year after final tests and acceptance have been made, at his own expense. The Contractor shall furnish a satisfactory guarantee to ensure correction of defects. If necessary, such defects may be corrected by other capable contractors, as approved by the NCDOT, at the expense of the Contractor.
- (G) Contractor Experience

The following lists of Contractor experience shall be submitted to NCDOT.

1. The Contractor shall submit a tabulation of experience in the installation of movable bridge components, specifically for vertical lift bridges. The experience shall specifically show past projects involving vertical lift bridge counterweight rope change out as well as working in a United States Coast Guard marine outage.
2. The span balancing subcontractor shall have successfully conducted strain gage balancing of a minimum of 3 vertical lift bridges.
3. The on site supervisory personnel of the main and auxiliary counterweight rope removal and installation shall have conducted a minimum of two successful main replacements of all counterweight ropes on a vertical lift bridge.

#### **4. SUBMITTALS**

##### **4.1. General**

- (A) The Contractor shall submit copies of producer or manufacturer data, e.g. specifications, test results and installation instructions for the following items and materials including (but not excluding other items or materials not specifically mentioned):

1. Mill reports and physical tests of all metals.
2. Pins, bolts, and nuts.
3. Lubricants as endorsed by the wire rope manufacturer.
4. Results of required rope tests presented herein.
5. Paint.
6. Standard stocked items.

- (B) **Manufactured Items**

1. The Contractor shall submit shop drawings to the NCDOT for approval. These shall include complete details, classification of materials, schedules for fabrication and shop assembly, procedures and diagrams showing sequence and details for erection and approval.

2. Shop drawings shall be given a suitable title to describe the parts detailed thereon. Each drawing shall be identified by the complete project name and number and shall include:
  - a. Dimensions, callouts and notes to completely define the form, fit, function, manufacturing process and allowable deviations for each item.
  - b. Material specifications for each item.
  - c. Heat treatment or specific hardness requirements where applicable.
  - d. The surface finish of machined surfaces and tolerances for each dimension for which a specific fit is required. A general tolerance block shall be used to define the tolerances of all other dimensions. Fits and finishes shall meet or exceed the more rigorous of the AASHTO specifications or suggested manufacturer's specifications. In the absence of requirements in the AASHTO specifications, cited manufacturer tolerances or specifications shall apply when drawings call out a particular manufacturer and model "or equal". In no manner shall "suggested manufacturer" indicate a sole-sourced intent on the part of the NCDOT when competitive products exist.
  - e. Quantity required.
  - f. Capacity and normal operating ratings for each rope assembly.
  - g. Dimensions of all principal elements within the item.
  - h. Certified external dimensions affecting interfaces or installations.
  - i. Gross weight.
  - j. Method and recommended type of lubrication.
  
3. Shop drawings, which have not been approved or require correction, shall be resubmitted until such time as they are acceptable to the NCDOT. Resubmission and approval shall not be considered a cause for delay. The Contractor shall bear all costs or damages, which may result from the ordering or fabrication of any materials prior to the acceptance of the shop drawings. As a means of expediting delivery prior to acceptance of the shop drawings, the Contractor may request in writing from the NCDOT approval to order raw materials of the correct type for later fabrication from accepted shop drawings. Such approval by the NCDOT shall be in writing. After acceptance of the shop drawings, the Contractor shall supply the NCDOT with additional copies of the accepted drawings as may be required.

#### 4.2 Procedures

Specific and detailed procedures shall be submitted to the NCDOT for approval prior to commencing construction for the following work items:

- (A) Counterweight rope installation and initial tensioning procedure. – The Contractor shall include all temporary construction details, false work, jacks, and miscellaneous items required for removal of existing and installation and tensioning of the new counterweight ropes, both main and auxiliary. This procedure shall be signed and stamped by a North Carolina Professional Engineer.

- (B) Counterweight and auxiliary rope tension testing and adjustment procedure. – The Contractor shall include a procedure for tension testing, and tension adjustments for both the main and auxiliary counterweight ropes.
- (C) Lubrication plan – The Contractor shall include shop and field lubricants and sealants endorsed by the wire rope manufacturer in writing as well as application procedures for each. The dates that the lubricant was applied to each component shall be included.
- (D) Cleaning and painting procedure. – The Contractor shall include a procedure for cleaning the required components to SSPC-SP 1 and SSPC-SP 3 conditions and for the painting of non-working surfaces.

## **5. MACHINERY, COMPONENTS AND MATERIALS**

### **(A) General**

1. Materials and components shall conform to the drawings and referenced standards.
2. Hardness and toughness shall be tested and reported for any items or details where plans and specifications require hardness or CVN toughness values.
3. No item shall be fabricated without sufficient advance notice given to the NCDOT to permit inspection.
  - a. The Contractor shall furnish all facilities and provide for the free access at the plant or shop for the inspection of machinery, components, material and quality of work.
  - b. Initial nominal acceptance of a material or item shall not preclude subsequent rejection if injurious defects are found upon later inspection or discovery.
  - c. The Contractor shall furnish the NCDOT with the number of copies of purchase orders as requested.
  - d. Unless otherwise provided, the Contractor shall furnish without charge, test specimens required herein, and all labor, testing machines, tools and equipment necessary to prepare the specimens and to make the physical tests and analyses. Two copies of test reports and chemical analyses shall be furnished to the NCDOT.

### **(B) Standard Products**

1. Materials and equipment shall be commercial standard or cataloged products of manufacturers regularly engaged in production of such materials or equipment, and shall have at least five (5) years of satisfactory commercial or industrial use prior to bid opening.
2. Materials of equal or greater strength, ductility, CVN toughness or corrosion resistance than shown on the design drawings can be proposed, but are subject to approval by the NCDOT.
3. Heavy hexagonal head structural bolts, heavy hexagonal nuts, and hardened washers shall comply with respectively ASTM A325, Type 3, A563, Grade C3, and F436, Type 3. Where surfaces are substantially roughened, washer contact areas shall be spot-faced before final tightening of nuts.



4. Threads for the pins shall be machine cut, and conform to the Unified National (UN) system of threading. The number of threads chosen shall correspond to the closest bolt diameter of the UN system.
5. The paint system shall comply with Section 442 of NCDOT's Standard Specifications and shall be submitted for approval.

(C) Manufacturer's Recommendations

1. If the wire rope Manufacturer or Supplier requires specific installation procedures to insure long life service of the wire ropes, printed copies of these recommendations shall be furnished to the NCDOT prior to shipment. Shipment of the ropes will not be allowed to proceed until such recommendations are received by the NCDOT.

**6. GENERAL QUALITY OF WORK AND SURFACE FINISH**

- (A) Wire rope assemblies shall be finished, assembled, and adjusted in an approved manner and according to the best shop practice, as defined by the latest edition of the *Wire Rope Users Manual*. The limits of accuracy that are to be observed in machining the work, and the allowances for all metal fits shall be placed on the Contractor's working drawings. Fits and finishes of machinery parts shall be as called for on the contract drawings or as specified by the AASHTO specifications.
- (B) Where surface finishes are indicated on the drawings or specified herein, the symbols used or finishes specified are in accordance with ANSI B46.1, "Surface Texture". Values of roughness height are specified in micro-inches as an arithmetical average deviation from the mean line. Roughness specified is the maximum value, and any smoother finish will be satisfactory. Compliance with specified surface will be determined by trained sense of feel and by visual inspection of the work compared to a standard roughness gage and in accordance with the provisions of ANSI B46.1. Values of roughness width and waviness are not specified, but shall be consistent with the general type of finish specified by the roughness height. Flaws such as scratches, ridges, holes, peaks, cracks or checks, which will make the part unsuitable, will be cause for rejection.
- (C) Unspecified surface finishes shall conform to the AASHTO specifications. Mating surfaces shall be machined to provide even, true bearing. Surfaces with rotating or sliding contact shall be highly polished and finished true to the given dimensions.
- (D) All work shall be laid out to secure proper matching of adjoining unfinished surfaces. Large discrepancies between adjoining unfinished surfaces, shall be remediated to realize proper alignment. Depressions or holes not affecting the strength or function of the parts may be filled in a manner approved by the NCDOT.
- (E) Wire Ropes
1. All main counterweight wire ropes shall be 2-1/8" diameter, made of Extra-Extra Improved Plow Steel with a minimum ultimate tensile strength of 420,000 pounds, and shall be 6 x 25 filler wire construction with fiber core (FC), and meet all the requirements of ASTM A1023. The wire ropes shall be right regular lay, with a maximum lay length of 16". The wire ropes shall be preformed. Each strand shall consist of 19 main wires and 6 filler wires fabricated in one operation, with all wires interlocking.
  2. All auxiliary counterweight wire ropes shall be 7/8" diameter, made of Extra Improved Plow Steel with a minimum ultimate tensile strength of 70,800 pounds, and shall be 6 x 25 filler wire construction with fiber core (FC), and meet all the requirements of ASTM

A1023. The wire ropes shall be right regular lay, with a maximum lay length of 6.56". The wire ropes shall be preformed. Each strand shall consist of 19 main wires and 6 filler wires fabricated in one operation, with all wires interlocking.

3. The wire ropes shall be made by an established manufacturer, whose facilities and experience have been approved by the NCDOT. Ropes shall be laid in accordance with the best practice. Every effort shall be made to obtain ropes of uniform physical properties. The ropes shall be fabricated in the greatest length practicable, and shall be cut from ropes manufactured with one setting of one stranding machine, and one setting of one closing machine.
4. The actual diameter of the wire rope shall be defined as the diameter of the circumscribed circle. The actual diameter of the rope, measured with the rope under a tension equal to 12 percent of its ultimate tensile strength, shall not be less than its nominal diameter, and not more than 3/64" for the auxiliary counterweight ropes and 3/32" for the main counterweight ropes, in excess of its nominal diameter.
5. The actual length of each wire rope assembly, measured centerline to centerline of end socket pins, shall not vary from the specified length by more than 1/4" per 100 feet when measured under loading conditions described herein.
6. All portions of the wire rope shall be lubricated during fabrication with a lubricant containing a rust inhibitor.
7. NO splicing of the ropes or individual strands will be permitted.
8. The wire from which the wire ropes are made shall be tested in the presence of an inspector designated by the NCDOT. Excepting that the filler wires may be made to the manufacturer's standards, the physical properties of the uncoated individual wires before manufacturing into rope shall be as follows:

The ultimate tensile strength for the main counterweight wire rope wire shall be within the limits found following:

<u>Wire Diameter (d) - Inches</u>	<u>Tensile Strength (Min) psi.</u>	<u>Tensile Strength (Max) psi.</u>
0.038-0.060	268,000	291,000
0.061-0.100	263,000	287,000
0.101-0.140	255,000	283,000
0.141-0.190	246,000	275,000

The ultimate tensile strength for the auxiliary counterweight wire rope wire shall be within the limits found following:

<u>Wire Diameter (d) - Inches</u>	<u>Tensile Strength (Min) psi.</u>	<u>Tensile Strength (Max) psi.</u>
0.038-0.060	244,000	291,000
0.061-0.100	239,000	287,000
0.101-0.140	232,000	283,000
0.141-0.190	223,000	275,000

9. Torsion Test: The test specimens of the wire shall be subjected to a torsion test in which the distance between the jaws of the testing machine is 8". The number of complete successive turns of 360 degrees in one direction through which the 8" wire can be twisted around its longitudinal axis without breaking or showing any signs of splitting or other defects, shall not be less than the following:

<u>Wire Diameter (d) - Inches</u>	<u>Number of Turns (8"length)</u>
0.038-0.060	2.3/d
0.060-0.100	2.2/d
0.101-0.140	2.1/d
0.141-0.190	2.0/d

The distance between the jaws of the testing machine may be 4 inches for wires up to 0.040 inch in diameter and 6 inches for wires up to 0.060 inch in diameter. Wires with a 4-inch test length shall not break when twisted to one-half the revolutions specified above. Wires with a 6-inch test length shall not break when twisted three-quarters the revolutions specified above.

In all the torsion tests, one end of the wire shall be rotated with respect to the other end of the wire at a continuous uniform speed until breakage occurs. During the test, the applied tension shall be sufficient to keep the wire straight. The speed of rotation shall not exceed 60 twists per minute. Such tests shall be carried out by a mechanically driven device, such as a gearmotor or belt drive, in order to secure operation at constant uniform speed.

10. All the tests specified above (in (8) and (9)) shall be made upon fair samples taken from either end of any coil of wire, and such samples shall be taken from not less than ten percent of the total number of coils.
11. Tolerance Limits: The tolerance limits on diameters of like position wires in the strands of the wire rope shall not exceed the following values:

<u>Wire Diameter – Inches</u>	<u>Allowable Diameter Variation – Inches</u>
0.038-0.060	-0.0005 +0.0010
0.061-0.093	-0.0010 +0.0010
0.094-0.142	-0.0010 +0.0015
0.143-0.200	-0.0015 +0.0020

12. Rope Sockets.

- a. All rope sockets shall be galvanized open spelter sockets, Type A. The open spelter sockets, the socketing of the wire ropes, and the Inspection and Non-Destructive Testing of all sockets shall conform to Federal Specification RR-S-550, latest revision. The requirements for Type A, open spelter sockets shall apply. Sockets shall be attached to the ropes by using zinc of a quality not less than that defined in the current specifications for Slab Zinc (Spelter), ASTM B6 High Grade. Maximum socket slip or seating of the zinc cone, with the rope, when tensioned to 80% of its specified ultimately strength, under the test specified previously, shall be 1/6 the nominal diameter of the rope. If a greater slip should occur, the socketing method shall be changed until satisfactory results are obtained.

- b. Variations or substitute designs of sockets will be considered acceptable if they meet or exceed the functional requirements for strength, materials, and other applicable provisions of the Federal Specification.
- c. Sockets shall be stronger than their ropes. If a socket should break during the test specified herein, two other job sockets shall be selected at random and attached to another piece of rope, and the test repeated, and this process shall be continued until the Inspector is satisfied of socket reliability, whereupon the lot shall be accepted. However, if 10% or more of the tested sockets fail at a load less than the specified minimum ultimate strength of the rope, the entire lot of sockets shall be rejected, and new ones shall be furnished which meet specification requirements.
- d. If the pin and socket fits shown on the Plans differ from those specified by the Federal Specification, the fits shown on the Plans shall be met.
- e. Sockets shall be shop galvanized in accordance with ASTM A153.
- f. Sockets for the main counterweight rope assemblies use special stainless steel pins at both the counterweight and lifting girder connections, as shown on the plans. Sockets for the auxiliary counterweight rope assemblies shall use the standard galvanized clevis pins.

### 13. Wire Rope Testing

- a. The wire rope used in making up the main and auxiliary counterweight rope assemblies, including their sockets, shall be tested prior to fabricating the individual rope assemblies. Test pieces with a length between the sockets of not less than 25 rope diameters, and preferably not less than 50 rope diameters, shall be cut, and shall have sockets, selected at random from the job lot, attached to their ends. The number of test pieces shall be not less than two from each manufactured length of rope, not more than 10% of the total number of finished assemblies of rope to be fabricated. The test pieces shall be taken from both ends of the manufactured lengths of rope. A suitable mark shall be placed around the rope near the base of the socket, so that any relative movement of the latter can be readily detected. These test pieces are to be tested to destruction in a suitable testing machine, with the machine running at its slowest speed for the first sample of each size. The sockets used for these tests shall not be used in the structure. The wire ropes shall develop the ultimate strength given above.
- b. If the physical properties of the rope or of its individual wires fall below those specified, the entire length from which the test pieces were taken shall be replaced by the manufacturer with a new length, the physical quantities of which conform to those specified.
- c. **Facilities for Wire Rope Testing**

The Wire Rope Manufacturer shall provide facilities for making required tests at their own expense. Tests shall be made in the presence of an inspector representing the NCDOT. The manufacturer shall provide all necessary and proper facilities and shall otherwise cooperate as necessary in the making of tests which are to be in the presence of an inspector.

### 14. Wire Rope Assemblies

- a. Each main counterweight rope assembly shall be pre-stretched as follows:
  1. Tension the rope to 168,000 pounds and hold that load for 5 minutes.
  2. Reduce the load to 21,000 pounds.
  3. Repeat the load-unload cycle two more times.
  4. Release the load completely.
- b. Each auxiliary counterweight rope shall be pre-stretched as follows:
  1. Tension the rope to 28,300 pounds and hold that load for 5 minutes.
  2. Reduce the load to 3,540 pounds.
  3. Repeat the load-unload cycle two more times.
  4. Release the load completely.
- c. The length of each main counterweight rope assembly, center to center of socket pins, shall be measured while the rope is twisted to the correct lay, and supported throughout its length in a straight line and under a tension equal to 49,300 pounds, which is equal to its calculated load in service. The method of measurement shall be such to guarantee measurement of all ropes under identical conditions, and shall be satisfactory to the NCDOT. The length variation shall be as previously stated.
- d. The length of each auxiliary counterweight rope assembly, center to center of socket pins, shall be measured while the rope is twisted to the correct lay, and supported throughout its length in a straight line and under a tension equal to 5400 pounds, which is approximately equal to its load in service. The method of measurement shall be such to guarantee measurement of all ropes under identical conditions, and shall be satisfactory to the NCDOT. The length variation shall be as previously stated.
- e. While each main and auxiliary counterweight rope assembly is under tension, it shall be marked with a longitudinal streak of brightly colored paint or other marking so as to determine the exact relation of rope strands and sockets with each other, and when erected, care shall be taken to see that the rope has no twist, but that they occupy exactly the same relation to each other which existed when the rope was measured. Each rope shall be suitably marked or tagged for identification and erection. The final rope length (centerline pin to pin) shall be stamped on the socket at a location recommended by the socket manufacturer.
- f. Wire Ropes are to be purchased by the Contractor. The Contractor shall, upon receipt of the ropes, determine that upon payout of rope from each reel that they are free of injurious defects, such as deep pits, kinks, abrasions, and are free from substantial corrosion from inappropriate storage. The Contractor shall store such rope in a protective environment until actual use, with corrosion inhibitive wrapping, bagging or oils, and kept free of grit or unwanted debris.
- g. All other details shall conform to the plans and these specifications.

## 7. REMOVAL OF EXISTING AND INSTALLATION OF THE NEW MAIN AND AUXILIARY COUNTERWEIGHT ROPES

### (A) Removal of Existing Main Counterweight Wire Rope Assemblies

1. To remove the main counterweight rope assemblies, it is necessary to first "hang" the counterweights using the existing counterweight hanger plates. Move the hanger plates from their retracted outer position to the inner position, where the hanger plates are approximately 3-1/4" apart, in-to-in of plates. There are four hanger plates per counterweight.
2. Jack both ends of the span a distance that allows the insertion of the bottom hanger pin through a hole in the counterweight lifting girder and both hanger plates. Install the locking nuts on the pin. Note: A total of 4 bottom hanger pins, and 8 nuts are required. If these are not available from NCDOT, the Contractor shall fabricate new pins and nuts according to the Plans and the Contractor's field measurements. The jacks will remain the property of the Contractor, and shall be removed from the site at the completion of the contract.  
For reference, the lift span total weight is approximately 3160 kips.
3. With both counterweights hanging from the tower top girders, jack the span an additional distance to allow the ropes to go slack for ease of removal. The elastic deformation of the main counterweight ropes is approximately 4".
4. Remove the protective cap nut and heavy nut from each span lifting girder rope anchor rod, 8 per corner, 4 long and 4 short.
5. Remove rope socket pins at span and counterweight and remove existing rope assemblies.
6. Clean and remove all sharp edges and re-paint all rope deflector castings on the span and counterweight lifting girders. Clean, chase, and lubricate anchor rod threads. Clean all old lubricant, debris, etc. from existing main counterweight rope grooves, guides, deflectors, connection rods and attachment points to SSPC-SP 1 and SSPC-SP 3 condition. Existing main counterweight take-up rods, nuts, and cap nuts shall be removed, cleaned, and threads chased full length before reinstallation. All non-working surfaces shall be painted with the approved paint system and working surfaces shall be protected with an application of the approved lubricant.

### (B) Install New Main Counterweight Wire Rope Assemblies

**NOTE:** The new counterweight rope lengths shown on the Plans are per the original design drawings. The lift span must be jacked an additional distance to account for the existing rope stretch (this is in addition to approximate 4" of elastic deformation of the ropes). This additional distance will be determined by the Contractor's field measurements of the existing rope lengths.

1. Rope length shall not be adjusted after shipment from the manufacturer.
2. The counterweight ropes shall be carefully removed from reels or coils by revolving them and shall be erected as to avoid any kinks or bends. The ropes shall not be pulled through dirt or water or over abrasive surfaces. The stripe painted on each rope in the shop shall be straight after the rope is installed. The Contractor shall show the erection procedure for the main counterweight ropes on the shop drawings. The new ropes shall be installed in the same position as the existing ropes, with regard to the longer and shorter length rope assemblies.

3. After the lift span is in operating condition, the Contractor shall properly clean all new ropes of all foreign material and shall furnish and apply hot, in an approved manner, and when weather conditions are suitably dry and warm, one coat of lubricant that is compatible with that applied during rope fabrication and recommended by the wire rope manufacturer in writing. The Contractor shall remove all seizing at all sockets, properly clean the area, and apply an approved sealing compound at the end of the sockets as per the wire rope manufacturers recommendations. The Contractor shall furnish copies of letters from the wire rope manufacturer endorsing the lubricants and sealants used.

(C) Removal and Replacement of Auxiliary Counterweight Wire Rope Assemblies

1. This work should be accomplished in coordination with the removal and replacement of the main counterweight ropes, as specified above. For reference, each auxiliary counterweight weighs approximately 10,000 pounds.
2. Temporarily hang the four auxiliary counterweights from the front tower legs. The Contractor shall show the replacement procedure for the auxiliary counterweight ropes on the shop drawings.
3. When the span is jacked to accomplish the main counterweight rope replacement, remove and replace the auxiliary counterweight wire rope assemblies.
4. Clean, chase, and lubricate anchor rod threads. Clean all old lubricant, debris, etc. from existing auxiliary counterweight rope grooves, connection rods and attachment points to SSPC-SP 1 and SSPC-SP 3 condition. Existing auxiliary counterweight take-up rods and nuts shall be removed, cleaned, and threads chased full length before reinstallation. Existing arm shaft and hitch connection components shall be removed, disassembled, cleaned, and all rotating or sliding surfaces lubricated. All non-working surfaces shall be painted with the approved paint system and working surfaces shall be protected with an application of the approved lubricant.
5. Follow guidelines as specified in B. above for installation of new auxiliary counterweight ropes.

**8. DELIVERY, STORAGE and HANDLING**

- (A) All components and materials shall be delivered to the site in accordance with the approved schedule of work. Any special provisions used for material handling shall be provided by the Contractor.
- (B) Components and materials shall be properly packaged and protected from initial shipment until the time of installation.
- (C) Assembled units shall be mounted on skids or otherwise crated for protection during shipment and storage.
- (D) Finished and unpainted metal surfaces that would be damaged by corrosion, shall be coated with a .030" minimum film thickness, as soon as practicable after finishing, of No-Ox-Id, A-Special, as manufactured by San-Chem Company, Chicago, Illinois, or approved equal. This coating shall be removed from all surfaces prior to lubrication for operation and from all surfaces prior to painting after erection. If the anti-rust coating on any part becomes compromised prior to part installation, the coating shall be restored immediately. As an alternative, metallic components may be wrapped in paper treated with volatile corrosion inhibitors (VCIs) or polyethylene VCIs, and further wrapped in polyethylene. VCIs are available from Daubert Chemical of Burr Ridge, IL; Grofit Plastics of Northbrook, IL; Cromwell-Phoenix of Alsip, IL; or CorTec of St. Paul, MN. When weatherproof containers are used, they shall be lined with multiple bags of silica gel

desiccant.

- (E) All wire ropes shall be shipped on reels, the diameter of which is not less than 25 times the diameter of the ropes, which shall be mounted on skids or otherwise crated for protection during shipment and storage.
- (F) Material storage on site shall afford easy access for inspection and identification, protection from the ground and prevent distortion or damage.
- (G) The Contractor shall dispose of all removed materials in accordance with all pertinent existing legal and environmental requirements and guidelines for material disposal in effect at the time of letting. The NCDOT shall specifically identify which items are to be retained. Retained items shall be delivered and stored as directed by the NCDOT, and all others shall be properly discarded as required.

## **9. TRANSFERRING LOAD TO NEW COUNTERWEIGHT ROPES**

The complete counterweight loads shall be transferred to the new counterweight ropes in the following recommended order:

- (A) The jacked span shall be lowered slowly until the ropes are tensioned, and the hanger bottom pins can be removed. The hanger plates are then moved to their retracted position and clamped in place. Then the span can be lowered to the seated position. The position of the lift span shall be monitored during the counterweight load transfer to ensure that the lift span does not raise off of the jacks at anytime during or after the full transfer of the counterweight load.
- (B) After completing the load transfer of the counterweight to the new ropes, the Contractor shall remove any temporary devices and prepare the lift span and counterweight for final strain gage balance testing.

## **10. LIFT SPAN BALANCING**

- (A) Initial strain gage balancing shall be performed by the Contractor prior to beginning construction. Strain gages shall be mounted on the two east and two west cross shafts to record torsional strain which shall be converted into loads to each corner of each tower. The microstrain shall be recorded on a strip chart or digital data acquisition system along with lift span height indication for a minimum of three complete lift cycles. Span imbalance for each corner of the lift span shall be determined. The percentage of full load torque of the span drive motor(s) and the friction for the vertical lift system measured for the full operating cycle shall also be determined and submitted.
- (B) After the initial balance is measured by the Contractor, the NCDOT will review the results and determine the acceptable balance window for after the rope replacement process.
- (C) After completing the installation (wire ropes) the Contractor shall strain gage balance the lift span again to verify the final desired balance. The Contractor will be responsible for adjusting the span balance as necessary at the end of construction.
- (D) The Contractor shall be responsible for all labor and materials required to provide an acceptable balance, as directed by the NCDOT. If weight changes to the span or counterweight are required, a new series of tests shall be performed on the span and the above process repeated until the balance condition is acceptable. All testing, data analysis, and weight adjustments shall be carefully documented and formally submitted.
- (E) Once the desired lift span balance is achieved and accepted by the NCDOT, the Contractor can proceed with test operating the span as required in the Rope Tensioning section below.



**11. ROPE TENSIONING**

This section presents a recommended method to test individual rope tension by counting vibrations. The Contractor may propose alternative methods to the NCDOT for approval. Tension tests shall be performed after the bridge has been operated through no less than 15 operating cycles.

- (A) Place the span in the fully seated position with the entire weight of the counterweight transferred to the ropes on each tower.
- (B) Induce vibrations in the span side length of each wire rope, one at a time. Using a stop-watch and touching or holding the ropes, record the time for a minimum of twenty vibrations (first order "free vibrations"). Conduct three separate tests for each rope and calculate the average number of vibrations per second. Any approved method may be used to establish the vibrations in the ropes; the frequency of the vibrations does not depend upon the method used. Useable vibrations will be noticeable to the touch and must be first-order.
- (C) Adjustments to equalize the tensions should be made by adjusting the anchor rod nuts on the span lifting girders and each rope retested as required until the average frequency for each individual rope is within 15% of the average frequency for all of the ropes on one tower.
- (D) Repeat this procedure for both towers.

**12. BASIS OF PAYMENT**

- (A) Mechanical work required by this section shall be measured as a single item, MEMORIAL LIFT BRIDGE MAIN AND AUXILIARY COUNTERWEIGHT ROPE REPLACEMENT, complete and fully functional in place. This price shall include all products, labor, tools, equipment, testing, and incidentals necessary to complete the work in accordance with these contract documents. Payment shall be on the basis of a single lump sum item.

Lubricants will not be measured for payment but the cost thereof shall be included in the prices stipulated.

**END OF SECTION**