

ITEM 564.02 04 - BRIDGE HANGER ASSEMBLIES

DESCRIPTION:

This work shall include fabricating, transporting and erecting bridge hanger assemblies as shown on the plans and in accordance with the provisions of the Contract Documents. Each hanger assembly shall include the two structural strands and the associated sockets, threaded anchor rods, pins, nuts, washers, pivot plates, pin caps and appurtenances, and all field adjustments to hanger tension and roadway profile grade required or ordered. The Contractor's attention is directed to §106-01, Source of Supply and Quality Requirements, with regard to advising the Region and the Deputy Chief Engineer Structures (DCES) of the sources of proposed materials. The manufacturer/contractor shall contact the Department to request inspection as soon as the contract is awarded. No work shall commence prior to distribution of approved drawings as per section 202.5 of the Steel Construction Manual. For assemblies manufactured under this specification, inspection and rescheduling issues should be requested 5 working days prior to the commencement of work. Fabrication done without approved drawings or state inspection will be rejected.

MATERIALS:

The materials for this work and fabrication shall be in strict conformance with the *New York State Steel Construction Manual (SCM)*, and the following subsections of §700 – Materials of the Standard Specifications:

Paint as specified	708
High Strength Bolts, Nuts, and Washers	715-14
Painting Procedures	740
Painting Galvanizing Surfaces	740-03

- A. **Structural Strand:** The structural strand shall be an arrangement of wires laid helically around a center wire to produce a symmetrical cross-section. The structural strand shall meet the requirements of ASTM A586 and shall be provided with a Class A weight zinc-coated inner wires and Class C weight zinc-coated outer wires. The structural strands shall be prestretched under a tension not to exceed 55% of the breaking strength shown in the table below. After prestretching, the minimum Modulus of Elasticity, E, shall be as specified in the table below.

Nominal Strand Diameter Ø mm (in)	Breaking Strength Metric Tons (Tons)	Metallic Area mm ² (in ²)	Modulus of Elasticity, E Prestretched MPa (ksi)
38.1 (1 1/2")	119.8 (132.0)	871.0 (1.35)	158,600 (23,000)
52.4 (2 1/16")	229.5 (253.0)	1645.2 (2.55)	158,600 (23,000)
58.7 (2 5/16")	287.6 (317.0)	2071.0 (3.21)	158,600 (23,000)
79.4 (3 1/8")	513.5 (566.0)	3780.7 (5.86)	151,700 (22,000)

The manufacturer's quality procedures plan and manual shall be subject to approval by the Department.

Certified copies of the results of the tests conducted by the manufacturer shall be furnished to the D.C.E.S. in accordance with the requirements of §715-01, Structural Steel.

- B. **Cast Sockets and Socket Pins:** The cast sockets and socket pins shall be designed by the

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Contractor. The sockets and pins shall be designed to develop the minimum required ultimate strength of the structural strand without suffering stresses beyond the yield point of the socket steel or excessive creep of the zinc filler under load. Open strand socket castings shall be cast steel conforming to the requirements of 715-02 of the Standard Specifications except that the material shall be ASTM A 148M Grade 725-585 (ASTM A 148, Grade 105-85) with Supplementary Requirement S9. One socket per casting heat shall be radiographed in accordance with Section 1600 of the SCM and ASTM E 280. One specimen per heat shall be Charpy V-notch impact tested at -29°C (-20 °F) with the documented results submitted to the D.C.E.S. Socket pin material shall at a minimum meet the requirements of A 668M (A 668) Class F and may be machined from forged stock. Galvanizing shall meet the requirements of ASTM A 153M (ASTM A 153). All socket pins shall be furnished with a recessed hexagonal nut and stainless steel cotter pin. Any material alterations or substitutions must be approved by the D.C.E.S. prior to fabrication.

The manufacturer's quality procedures plan and manual shall be subject to approval by the Department.

Certified copies of the results of the tests conducted by the manufacturer shall be furnished to the D.C.E.S. in accordance with the requirements of §715-01, Structural Steel.

- C. Threaded Anchor Rods:** Connections to the arch ribs shall be made, as shown on the plans, using threaded anchor rods conforming to the requirements of ASTM A 576, Grade 1045 or AISI 4140 Tensile – Yield (meeting socket body). Charpy impact test properties shall be determined on each heat from a set of three Charpy V-notch specimens. Test specimens shall be prepared as Type A and tested in accordance with ASTM A 370. If Charpy V-notch test values are less than 20 Joules (15 ft-lbf) at 4°C (40°F) for any heat, anchor rods represented by that heat shall be rejected. Nuts shall conform to the requirements of ASTM A 563, Grade A. Anchor rods, nuts and washers shall be galvanized in accordance with ASTM A 153M (ASTM A 153). Anchor rods, nuts and washers shall be furnished by the socket supplier.

The manufacturer's quality procedures plan and manual shall be subject to approval by the Department.

Certified copies of the results of the tests conducted by the manufacturer shall be furnished to the D.C.E.S. in accordance with the requirements of §715-01, Structural Steel.

- D. Pivot Pins:** Pins shall be stainless steel conforming to Nitronic 60 {ASTM A 276, UNS S21800, Condition A – Minimum Brinell 241, Charpy V-notch at -29 °C (-20 °F)}, with a minimum yield strength of 345 MPa (50 ksi). Pivot pins shall be furnished by the socket supplier.

Certified copies of the results of the tests conducted by the manufacturer shall be furnished to the D.C.E.S. in accordance with the requirements of §715-01, Structural Steel.

- E. Pivot Plates, Washer Plates, Pin Caps and Socket Spacers:** Plates, spacers and pin caps shall conform to ASTM A709M, Grade 345W. Pivot plates and pin caps shall be furnished by the socket supplier.

- F. Neoprene Spacers:** Neoprene spacers shall be furnished to the dimensions shown on the plans and shall conform to §728-03 of the Standard Specifications.

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CONSTRUCTION DETAILS:

This work, including fabrication, transportation, and erection shall be in accordance with the provisions of the SCM. Shop drawings shall be prepared, approved, and distributed in accordance with the requirements of the SCM.

A. Testing of Strand Wire: Prior to fabrication, the zinc-coated steel wire used in the manufacture of the structural strand shall be tested, in the presence of the DCES or authorized representative, for physical properties in accordance with paragraph 5 of ASTM A 586 and the following:

1. The test for tensile strength shall be made on samples of not less than 10 percent of the coils of any lot of zinc-coated wire. If tests of any of these coils fail to meet the requirements, the DCES may require that all coils of such lot be tested and shall reject all individual coils which do not meet the requirements for tensile strength.
2. The test for stress at 0.7 percent extension shall be made on samples of not less than 10 percent of the coils of any lot of zinc-coated wire. If tests of any of these coils fail to meet the requirements, the DCES may require that all coils of such lot be tested and shall reject all individual coils which do not meet the requirements for stress.
3. Tests for zinc coating (weight and adherence) shall be made on samples of not less than 5 percent of the coils of any lot of zinc-coated wire. If tests of any of these coils fail to meet the requirements, the DCES may require that all coils of such lot be tested. Unless at least 80 percent of the coils pass the test, the entire lot shall be rejected. Any coil failing to meet the requirements shall be rejected.

B. Fabrication of Structural Strand: The strand shall be manufactured to meet or exceed the strength requirements specified herein. Documentation of compliance with these requirements and the make-up of the wires in the strand shall be submitted to the DCES.

1. The strand shall be manufactured on machines of sufficient size to insure good workmanship and shall be fabricated in the greatest length possible. Once the manufacture of the strand has been started, no changes shall be made as to the grade of wire, construction or lay of strand, or other factors that would affect the uniformity of the finished product. Straightening of bent wires shall not be permitted. Any kinked or damaged strands shall be rejected.
2. All strands shall be prestretched by stressing each strand with a load equal to 55 percent of the breaking strength in straight tension. The load shall be maintained and/or repeated until the strand reaches a stable condition and shows a well-defined and uniform elastic stretch and recovery under stressing.
3. The modulus of elasticity of each prestretched length of strand shall be determined in accordance with ASTM A 586. This information shall be submitted to the DCES.
4. The strand shall be measured in the shop for the various hanger lengths while under tension equal to one-half of the full dead load as shown on the plans and cut for use in the hangers. When cutting the strand an allowance shall be made for obtaining test specimens for strand and socket testing as specified in section C.
5. At the time the strands are measured, a continuous paint stripe shall be made on one side of the strand for its entire length to assure correct alignment of the strands during erection.

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6. Strand identification marks shall be provided in order to facilitate erection. Each strand shall have a legible waterproof tag firmly attached to it giving the fabricated length and the location where it is to be installed on the bridge.
7. Strands shall be properly coiled or rolled on reels in such a manner so that no permanent deformation of wires in the strand will occur. Strands shall be stored in a well-protected location. Handling, transporting and storing of strands shall be in accordance with the AISI Wire Rope User's Manual. Any strands or sockets damaged by handling, transporting or storing shall be replaced by the Contractor at no cost to the State.

C. Testing of Structural Strand: From each prestretched length of strand, one piece not less than 2.54 m (100") long shall be cut and tested, in the presence of the DCES, to demonstrate the strength of the strand and sockets as specified in paragraph 9 of ASTM A 586. The ends of the test pieces shall be socketed with sockets selected at random from those that are to be used in filling the order. The material and method of socketing shall be the same for both the test pieces and the production strand. Sockets shall be attached to the jaws of the testing machine in such a manner that stresses in the socket will reproduce those expected when the socket is installed in the bridge (i.e. pins at the lower socket and anchor rods at the upper socket). Positive means shall be provided to assure that the strand does not twist after prestretching and that the upper and lower sockets are kept free from rotating with respect to each other. The first six test pieces, and any others directed by the DCES, shall be stressed to destruction in a suitable testing machine. All pieces shall be tested to not less than the minimum specified breaking strength. The sockets in every instance shall be of sufficient strength to produce failure in the strand material. If, after six or more tests of prestretched strands have been made, the DCES finds that the strength and elasticity have sufficient uniformity, the DCES may direct that the testing be reduced to two pieces, one from each end of each manufactured length of strand instead of one from each prestretched length. The sockets used for these tests shall not be used in the bridge.

1. If a socket should break during the strand testing specified above, two additional sockets shall be selected and attached to strand and the test repeated. This testing shall continue until the DCES is satisfied of the socket reliability, at which point the lot shall be accepted. If 10 percent or more of all the sockets tested break at a load less than the specified minimum breaking strength, the entire lot shall be rejected and new ones, of greater resistance, shall be furnished.

D. Socket Finishing: Sockets shall be neatly finished to the exact dimensions shown on the approved shop drawings. Each socket shall be visually examined for defects. Defects judged to be unacceptable by the DCES shall be repaired to the satisfaction of the DCES, or the socket shall be replaced by a new casting. The DCES shall be the sole judge as to the reparability of a socket. To determine the type and amount of repair, where repairs are required, the Contractor shall perform such additional non-destructive tests at each unacceptable defect as the DCES may consider necessary. Such tests may be radiograph, ultrasonic, magnetic particle, or liquid penetrant as the DCES may direct or approve and shall be at the sole expense of the Contractor. Weld preparation shall be examined by magnetic particle or liquid penetrant methods in accordance with ASTM A 781M, S5 (ASTM A 781, S5). Repaired areas shall be retested using magnetic particle or liquid penetrant methods as directed or approved. At the DCES's option, large repairs may require heat treatment in accordance with ASTM A 148M (ASTM A 148) requirements. The DCES shall be the sole judge as to the suitability of a repaired socket.

1. Socket manufacturer shall supply each strand socket drawing along with calculations for each socket. Only cast strand sockets designed for strand shall be supplied.
2. Socket manufacturer and steel fabricator shall review each other's drawings insuring that all pin

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and jaw dimensions meet. It is suggested that the socket manufacturer supply one each type cast open strand socket pin to steel fabricator for final fabrication.

3. Holes for socket pins shall be line-bored to final dimensions.
4. After fabrication it shall be demonstrated that the nuts, when turned by hand, move freely on the threads of the anchor rods for the Type 6 anchor sockets.

E. Socket Installation: The sockets shall be attached to the strands in accordance with the procedures submitted to the DCES prior to socketing.

1. Sockets shall be attached to the structural strand at 20% of the minimum breaking strength of each diameter strand.
2. The wires of a strand, after being splayed in preparation for socketing, shall be cleaned of grease and other impurities by a carefully controlled process that will assure no harm is done to the wire galvanizing coating. After socketing, the strand wires adjacent to the socket shall be relubricated.
3. The basket of the socket shall be preheated to expel moisture and to prevent the molten zinc from congealing before it has completely filled the narrow lower end of the basket. Strands shall be rejected if the socketing procedure results in bare wires within the socket.
4. The zinc used to attach the sockets to the strand shall comply with ASTM B 6, High Grade, or better. The molten zinc shall be placed at the lowest practical temperature, usually within the range of 496°C (925°F) to 524°C (975°F) and never over 538°C (1000°F), so as to minimize the affect of heat on the strands. The zinc temperature at time of pouring shall be recorded for each socket and submitted to the DCES. Filling of the socket with molten zinc shall be performed in one continuous operation.
5. Care shall be taken to insure socket and strand alignment and that the lengths of the hanger after socketing are correct. A tabulation of shop-measured lengths of each hanger shall be submitted to the DCES for use in erecting the hangers.

F. Pivot Plates, Pivot Pins and Pin Caps: Fabrication of pivot plates, pins and pin caps shall conform to §564-3 of the Standard Specifications. Pivot plates and pin caps shall be painted in accordance to Item 16572.03nnnn - SHOP APPLIED STRUCTURAL STEEL PAINT SYSTEM.

G. Delivery to Job Site: The hanger assemblies shall be inspected and approved for shipping by the DCES. The hanger assemblies shall be transported to the job site in a manner such that no permanent deformation of the bridge strand wires occurs. Any bridge hanger assembly damaged by handling, transporting or storing, shall be replaced by the Contractor at no cost to the State.

H. Hanger Erection: Hangers shall be erected with sockets in the same relative position to each other as existed when strands were measured and with paint stripe in a straight line. Each strand in a two-strand hanger shall be equally stressed. Extreme care shall be taken to prevent twisting of the strands during erection and field adjustments to hanger tension and roadway profile grade in accordance with the following:

1. Field adjustments to hanger tension and roadway profile grade shall be made under floor system framing dead load and again under full dead load. Each strand in a two-strand hanger shall be tensioned to one-half of the hanger force shown on the plans and shall be equally stressed (+/- 5%).

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Strands shall be tensioned simultaneously using calibrated jacks in accordance with the approved jacking procedure.

- 2. The Contractor shall submit a written hanger installation procedure to the DCES for approval.

The Contractor shall submit to the DCES the complete method of erecting and tensioning the hanger assemblies in accordance with Section 204 of SCM.

I. Certificate of Compliance: The Contractor shall submit records of all tests results and Certificates of Compliance to the DCES indicating that all materials, testing and fabrication of the hanger assemblies and dampening devices meet the requirements specified herein.

METHOD OF MEASUREMENT:

Lump Sum. The provisions of §564-4.01 of the Standard Specifications concerning castings, forgings, fasteners, cable and other metal parts shall apply.

BASIS OF PAYMENT:

The price bid shall include the cost of testing, fabricating, transporting and installing bridge hanger assemblies as shown on the plans, and all field adjustments to hanger tension and roadway profile grade required or ordered.

- A. **Progress Payments – Lump Sum:** These shall be calculated by multiplying the lump sum price bid less 20% by the ratio which represents the bridge hanger assemblies erected during the payment period in question less any partial payments made for the hanger assemblies erected. The ratio will be computed by dividing number of the erected bridge hanger assemblies by the Total Quantity of bridge hanger assemblies (i.e. 57 bridge hanger assemblies). The remaining 20% will be paid upon final adjustment and acceptance of all hangers as specified under Construction Details §H, Hanger Erection (refer to §109-03).

Progress Payment Formula:

$$((LS\ Price\ Bid - 20\%) \times (x/y)) - z$$

x – No. of Hangers Assemblies Installed/payment period

y – Total no. of Hanger Assemblies

z – Partial payment (if any) made on x Hanger Assemblies Installed in the payment period

If the Contractor elects, provisions of §109-04, Partial Payments shall apply. Partial payment for material shall be deducted prior to making progress payments as stated above.