SP-150216a
(Replaces SP-150216)

SPECIAL PROVISIONS
FOR
POST-TENSIONING OF WIND TONGUES AND LONGITUDINAL RESTRAINTS

Scott County
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Effective Date
April 25, 2017

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

150216a.01 DESCRIPTION.

A. This work includes furnishing, installing, and post-tensioning the all-thread-bars at the wind tongues. It also includes furnishing and installing corrosion inhibiting grease, top and bottom caps with attachments, nuts, and washers as indicated in the plans. This work does not include fabricating, installing, or temporarily supporting the steel pipes, embedded base plates, and studs on the wind tongues, which are included in Design No. 817.

B. This work also includes furnishing, installing, and post-tensioning the all-thread-bars at the longitudinal restraints. It also includes furnishing and installing corrosion inhibiting grease, top and bottom caps with attachments, nuts, and washers as indicated in the plans. This work does not include fabricating, installing, or temporarily supporting the steel pipes, embedded base plates, grillage plates, and studs on the longitudinal restraints, which are included in Design No. 817.

150216a.02 QUALIFICATIONS AND INSPECTION.

A. Perform all post-tensioning field operations under the direct supervision (crew foreman) of a qualified post-tensioning technician.

B. Provide a crew foreman with the following:
- A minimum of 5 years bridge construction experience, including 2 years in post-tensioning-related operations,
- A minimum of 1 year as a foreman in responsible charge of post-tensioning-related operations, and
- Certification according to the “Post-Tensioning Training Course” of the Post-Tensioning Institute (PTI), or other equivalent and recognized alternative course.

150216a.03 TERMINOLOGY.

Anchorages: An assembly of various hardware components which secures the all-thread-bars at their ends after they have been stressed and transfers a compressive force into the concrete.

Job Site: The location where the post-tensioning is to be performed. Also called the "site".

Post-tensioning: A method of prestressing where tensioning of the tendons occurs after the concrete has reached a specified strength.

Set (also Anchor Set): Anchor set is the total movement of a point on the post-tensioning bar during load transfer from the jack to the permanent anchorages.

Tendon: A complete assembly consisting of post-tensioning anchorages, all-thread-bar, and ducts with corrosion inhibiting grease.

150216a.04 MATERIAL.

A. General.
Furnish all components of a post-tensioning system from a single supplier.

B. All-Thread-Bars.

1. Provide all-thread-bar conforming to ASTM A 722, Gr. 150, Type II, including Supplementary Requirement S1. Provide full load nuts and hardened washers according to the manufacturer's proprietary system design. Epoxy coat all all-thread-bars, nuts, and washers in accordance with ASTM A 775.

2. Fabricate the all-thread-bar with sufficient length beyond the custom bearing plates to allow for post-tensioning and anchorage device installation.

C. Corrosion Inhibiting Grease.
Provide corrosion inhibiting grease conforming to NLGI Grade 2 and the following requirements:

Test Description	Test Method	Acceptance Criteria
Dropping Point	ASTM D 566 or ASTM D 2265	300°F min.
Oil Separation @ 160°F	FTMS 791B Method 321.2	0.5% max. by mass
Water Content	ASTM D 95	0.1% max.
Flash Point (refers to oil components)	ASTM D 92	300°F min.
Corrosion Test (5% salt fog at 100°F, 5 mils, Q Panel Type S)	ASTM B 117	Rust Grade 7 or better after 1000 hrs of exposure according to ASTM D 610
Water Soluble Ions[a] a. Chlorides b. Sulfides c. Nitrates	 ASTM D 512 APHA[b] 4500S^{2}-E ASTM D 3867	 10 ppm max. 10 ppm max. 10 ppm max.
Soak Test (5% salt fog at 100°F, 5 mils, Q Panel Type S. Immerse panels 50% in a 5% salt solution and expose to salt fog)	ASTM B 117 (modified)	No emulsification of the coating after 720 hrs of exposure

Compatibility with sheathing a. Hardness and volume change of polymer after exposure to grease, 40 days at 150°F. b. Tensile strength change of polymer after exposure to grease, 40 days at 150°F.	ASTM D 4289 (ASTM D 792 for density) ASTM D 638	Permissible change in hardness 15%, volume 10%. Permissible change in tensile strength 30%.

a **Procedure:** The inside (bottom and sides) of a 1 L Pyrex beaker (approximate outside diameter 105 mm, height 145 mm) is thoroughly coated with 100 +/- 10 g of corrosion inhibiting grease. The coated beaker is filled with approximately 900 cc of distilled water and heated in an oven at a controlled temperature of 38 deg. C +/- 1°C for 4 hours. The water extraction is tested by the noted test procedures for the appropriate water-soluble ions. Results are reported as ppm in the extracted water.

b American Public Health Association (AHPA)

~~**D. Post-Tensioning Anchorage.**~~

~~**1.** Secure all all-thread-bars at the ends by means of permanent type anchorage devices. The design of the end anchorages is the sole responsibility of the post-tensioning system manufacturer.~~

~~**2.** Ensure that the anchorages develop at least 95% of the actual ultimate tensile strength of the all-thread-bars, when tested in an unbonded state, without exceeding the anticipated jacking force. Provide written certification that anchorages meet or exceed these testing requirements.~~

~~**3.** Design anchorages so that the average concrete bearing stress is in compliance with the AASHTO LRFD Bridge Design Specifications. Test anchorages with the actual local zone reinforcement present in the field. Provide written certification that anchorages meet or exceed the testing requirements in the AASHTO LRFD Bridge Construction Specifications.~~

~~**4.** Perform testing of post-tensioning anchorage devices using samples of the type of all-thread-bars to be used on the project. Assemble the test specimen in an unbonded state, and, in testing, the anticipated jacking force shall not be exceeded.~~

E. Top and Bottom Caps.

Provide top and bottom caps fabricated from ASTM A 588 steel and ASTM A 500 HSS with neoprene rubber washer and Type 316 stainless steel plug. ASTM A 572 or ASTM A 36 may be substituted at no additional cost. ASTM A53 Grade B shall be used for pipe.

F. Testing Requirements.

1. General.

a. Testing shall conform to the applicable ASTM Specifications for the post-tensioning material used.

b. Furnish all material samples for testing at no additional cost.

2. All-Thread-Bars.

a. Furnish samples for testing as described below for each manufacturer of all-thread-bar to be used on the project.

b. With each sample of all-thread-bar furnished for testing, submit a certification stating the manufacturer's "Guaranteed Ultimate Tensile Strength (GUTS)" of the sample furnished.

c. The Engineer will obtain the following sample of bar, at the plant or jobsite, from the all-thread-bar used for post-tensioning operations:

d. Three randomly selected samples, 5 feet long, per manufacturer, per size of bar, per heat

of steel, with a minimum of one sample per shipment.

e. One of each of the samples furnished to represent a lot will be tested. The remaining sample(s), properly identified and tagged, will be stored by the Engineer for future testing in the event of loss or failure of the component represented to meet minimum strength requirements. For acceptance of the lot represented, test results must show that 100% of the guaranteed ultimate tensile strength has been met.

3. Lots and Identification.
A lot is that parcel of components as described herein. All all-thread-bars from each mill heat of steel shipped to the site shall be assigned an individual lot number and shall be tagged in such a manner that each such lot can be accurately identified at the job site. Submit records to the Engineer identifying assigned lot numbers with the heat of material represented. All unidentified all-thread-bars received at the site will be rejected. Also, loss of positive identification of these items at any time will be cause for rejection.

4. Approval of Materials.
The approval of any material by the Engineer shall not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective for any reason.

150216a.05 SUBMITTALS.

A. General.

1. Submit detailed shop drawings, calculations, and manuals for all work related to post-tensioning. Provide shop drawings and calculations that are sealed by a Professional Engineer licensed in the state of Iowa. Do not commence work until the submittals have been approved by the Engineer.

2. All shop drawings are to accurately detail the actual methods, materials, equipment, etc., that will be used in the field on the project. Deviation is not permitted unless approved by the Engineer.

B. Submittals.

At a minimum, submit the following information:

1. A post-tensioning system that meets the requirements of the contract documents and is compatible with the local zone reinforcement already in place.

2. A detailed proposed sequence of construction, including any variations from the procedures provided herein.

3. Specific details regarding the assembly of the post-tensioning assemblies.

4. Properties, dimensions, and designations (where applicable) of each of the components of the post-tensioning assemblies, including the top and bottom caps.

5. Appropriate details of changes from the dimensions shown on the plans, with clear and concise cross reference to the appropriate plans to which the variations apply.

6. Details of the sequence of the stressing of the all-thread-bars;

7. Details of the post-tensioning jacking forces and elongation of each tendon, including stressing end seating losses at each stage of erection for all post-tensioning.

8. Elongation calculations and tolerances.

9. Equipment to be used in the post-tensioning operation.

10. Calculations for anticipated anchor set, elastic shortening, and long-term effects.

11. Calculations to substantiate the post-tensioning system and procedures to be used. These calculations shall show a typical tendon force after applying the anticipated losses for the stressing system to be used, including anchor set, elastic shortening, and long-term effects.

12. Details of corrosion inhibiting grease, greasing equipment and methods for injecting grease.

13. Any manufacturer's literature, where applicable.

14. Safety procedures.

15. Record of stressing operations. Submit within 7 days following completion and acceptance of the post-tensioning operations at each wind tongue or longitudinal restraint.

16. Qualifications and certifications for the crew foreman as described herein.

C. Submittal Procedures.
Unless noted otherwise, submit the above in advance of the start of construction to allow a 30 calendar day review period. All submittals not approved and requiring resubmittal shall be subject to the above review time period, with the review time beginning anew for each such submittal. Coordinate all submittals between various subordinates (contractors, suppliers, and engineers) to allow for a reasonable distribution of the review effort required by the Engineer at any given time.

150216a.06 CONSTRUCTION.

A. Protection of All-Thread-Bars and Hardware.

1. Protect all-thread-bars and hardware against physical damage or rust at all times (from time of manufacturer to greasing). All-thread-bars or hardware that have sustained physical damage at any time shall be rejected.

2. Package all-thread-bars in containers or shipping forms for protection of the steel against physical damage and corrosion during shipping and storage. Place a corrosion inhibitor, which prevents rust or other results of corrosion, in the package or form, or incorporate a corrosion inhibitor carrier type packaging material. Do not apply a corrosion inhibitor directly to the steel. The corrosion inhibitor shall have no deleterious effect on the steel or concrete. Provide a corrosion inhibitor carrier type packaging material conforming to the provisions of Federal Specification MIL-P-3420. Immediately replace or restore packaging or forms damaged from any cause to original condition.

3. Clearly mark the shipping package or form with a statement that the package contains high-strength all-thread-bars and the type of care that is to be used in handling. Also mark the type and amount of corrosion inhibitor used, the date when it was placed, safety orders and instructions for use on the package or form.

4. All-thread-bars shall be stored and handled in a manner which will protect them from physical damage or contamination at all times from manufacture until greased in place. All-thread-bars shall not be dragged on abrasive surfaces during fabrication and installation. Damaged, abraded, or contaminated all-thread-bars shall be rejected.

5. Store the all-thread-bars in a manner which will at all times prevent the packaging material from

becoming saturated with water and allow a free flow of air around the packages. If the useful life of the corrosion inhibitor in the package expires, it shall immediately be rejuvenated or replaced.

6. At the time the all-thread-bars are installed in the work, they shall be free from rust, loose mill scale, dirt, paint, oil, grease or other deleterious material. All-thread-bars which have experienced rusting shall be subject to rejection.

B. Post-Tensioning Operations.

1. General.
Apply post-tensioning forces after a minimum of 120 days following placement of the crossbeams and pedestals. Conduct all stressing operations in the presence of the Engineer.

2. Stressing Procedure.

a. General.

1) Tension all all-thread-bars with hydraulic jacks so that the jacking force is not less than that required by the contract documents and the approved shop drawings.

2) Tension tendons by jacking from the bottom of the crossbeam.

b. Wind Tongues.

1) During all-thread-bar installation, place the top cap and rubber washer and thread the jam nut onto the bar so that it is at the approximate final location as shown in the plans. Do not secure the top cap with the jam nut until post-tensioning operations are completed.

2) First, tension and lock-off all-thread-bars to one-half the values in the jacking force table below. Then, tension and lock-off the all-thread-bars to the values provided in the jacking force table below. For each tensioning phase, tension all-thread-bars 1 through 4 prior to or simultaneously with all-thread-bars 5 through 10.

All-Thread-Bar No.	Jacking Force per All-Thread-Bar (k)
1 through 4	200
5 through 10	260

c. Longitudinal Restraints.
First, tension and lock-off the eight all-thread-bars closest to the centerline of the pin to 275 k per bar. Then, tension and lock-off each of the remaining all-thread-bars to 275 k per bar.

3. Stressing Equipment.
Only use equipment furnished by the manufacturer of the post-tensioning system.

a. Stressing Jacks and Gauges.
Equip each jack with a pressure gauge for determining the jacking pressure. Provide a pressure gauge with an accurately reading dial at least 6 inch in diameter with display increments of 100 psi.

b. Calibration of Jacks and Gauges.

1) Within 30 days prior to use, calibrate each jack and its gauge as a unit with the cylinder extension in the approximate position it will be in at the final jacking force. Perform calibration when the jack is connected to the equipment (pumps and gauges) in the identical configuration as will be used on the job site, e.g. with the same length hydraulic lines. Initial calibration of the jacks and gauges shall be performed by an independent laboratory using a proven load cell. For each jack and gauge unit used on the project, furnish certified calibration charts from the independent laboratory prior to stressing the first all-thread-bar. The jack and its gauge shall be used together in the field.

2) Perform certified calibration at the start of the work or as requested by the Engineer.

Calibrations subsequent to the initial calibration with a load cell may be accomplished by the use of a master gauge. Supply the master gauge to the Engineer in a protective waterproof container capable of protecting the calibration of the master gauge during shipment to a laboratory. Provide a quick-attach coupler next to the permanent gauge in the hydraulic lines to enable quick and easy installation of the master gauge to verify the permanent gauge readings. The master gauge will be calibrated by, and remain in the possession of, the Engineer for the duration of the project.

3) Any jack repair, such as replacing seals or changing the length of the hydraulic lines, is cause for recalibration using a load cell.

4) No extra compensation will be allowed for the initial or subsequent calibrations or for the use and required calibrations of the master gauge.

c. Elongations and Agreement with Forces.

1) Ensure that the forces being applied to the tendon and the elongation of the post-tensioning tendon can be measured at all times.

2) Tension all tendons to a preliminary force as necessary to eliminate any take-up in the tensioning system before elongation readings are started. This preliminary force shall be between 5% and 25% of the final jacking force. Measure the initial force by a dynamometer, or by another approved method, so that its amount can be used as a check against elongation as computed and as measured. Each all-thread-bar shall be marked prior to final stressing to permit measurement of elongation.

3) Measure elongations to the nearest 1/32 inch.

4) For the required force, the observed elongation shall agree within 7% of the theoretical elongation or the entire operation shall be checked and the source of error determined and remedied to the satisfaction of the Engineer before proceeding further. Do not overstress the tendon to achieve the theoretical elongation.

C. Cutting of All-Thread-Bars.

Only cut the ends of the all-thread-bars if the jacking forces and elongations are satisfactory and approval has been obtained from the Engineer. Cut all-thread-bars by an abrasive saw to the length shown in the plans. Do not use flame cutting. Repair epoxy coating using approved procedures. Plasma cutting may be allowed under strict inspection and approval of the Engineer.

D. Tendon Protection.

Within 4 hours after stressing, temporarily install top and bottom caps and seal all other openings. If acceptance of the all-thread-bar is delayed, seal all openings and temporarily weatherproof the open ends. If contamination of the all-thread-bar occurs, remove and replace the all-thread-bar.

E. Greasing Operations.

1. General.

a. When stressing has been completed and the stressed tendons have been accepted by the Engineer, grease the annular space between the all-thread-bars and the duct at the locations indicated in the plans and as indicated herein. Conduct greasing operations in the presence of the Engineer.

b. The time between the first installation of the all-thread-bar in the duct and the completion of the greasing operations shall not exceed seven calendar days.

c. Any light surface corrosion that can be removed by wiping with a clean rag formed during this period of time will not be a cause for rejection of the all-thread-bar.

2. Wind Tongues and Longitudinal Restraints.

a. Install the bottom caps without the plug installed. Use thread sealant on the exterior threads of the bottom caps. Install the top caps with two temporary wood blocks between the top of the top cap and the underside of the rubber washer. Snug down the jam nut onto the rubber washer and wood blocks. The purpose of the temporary wood blocks is to hold the top cap in place during the greasing operation while allowing grease to flow out of the hole in the top of the top cap. Inject corrosion inhibiting grease through

the tapped hole in the bottom cap until a continuous flow of grease exits from the hole in the top of the top cap. Ensure that there are no leaks or air bubbles. If leaks or air bubbles are detected, repair as directed by the Engineer.

b. Remove the temporary wood blocks and any excess corrosion inhibiting grease from the surrounding surfaces. Install the rubber washer and jam nut to retain the top cap as indicated in the plans.

c. Remove any excess corrosion inhibiting grease from the surface of the bottom cap and threads of tapped hole. Install the plug in the tapped hole in the bottom cap using thread sealant.

150216a.07 METHOD OF MEASUREMENT.

A. Post-Tensioning of Wind Tongues.
Lump Sum. No method of measurement.

B. Post-Tensioning of Longitudinal Restraints.
Lump Sum. No method of measurement.

150216a.08 BASIS OF PAYMENT.

A. Post-Tensioning of Wind Tongues.
Payment for the post-tensioning of the wind tongues is full compensation for furnishing, installing, cutting, and greasing the post-tensioned tendons of the wind tongues.

B. Post-Tensioning of Longitudinal Restraints.
Payment for post-tensioning of longitudinal restraints is full compensation for furnishing, installing, cutting, and greasing the post-tensioned tendons of the longitudinal restraints.

C. Fabricating, installing, and temporarily supporting the steel pipes, embedded base plates, and studs for the wind tongues are not included with these items. See Design No. 817.

D. Fabricating, installing, and temporarily supporting the steel pipes, embedded base plates, grillage plates, and studs for the longitudinal restraints are not included with these items. See Design No. 817.

E. No additional payment will be made for extra concrete necessitated by approved modifications to the structure needed to accommodate the construction methods.

F. No additional payment will be made for extra reinforcement necessitated by approved modifications to the structure for the purposes of the construction methods.

G. No additional payment will be made for extra post-tensioning necessitated by approved modifications to the structure for the purposes of the construction methods.