Section 10.7

POST-TENSIONED BRIDGES

10.7.1 Purpose

The purpose of this procedure is to direct Construction Engineering and Inspection (CEI) personnel in the inspection, monitoring and engineering duties required to assure quality post-tensioned (PT) bridge construction in compliance with the Contract Documents. This procedure is primarily intended to be used by CEI staff familiar with PT bridge construction. This procedure includes system installation, post-tensioning operations and duct filler injection operations. Duct filler material can be one of two types: flexible filler (wax) or grout filler.

10.7.2 Authority

Section 334.048, Florida Statutes
Rule Chapter 5J-17, Florida Administrative Code

10.7.3 CEI Responsibility Categories

In Person Observations: The responsibilities of this category require CEI staff to be physically present when a construction activity is being performed by the Contractor or shortly before a critical operation is to be performed and to visually verify that the activity is being performed in accordance with the Contract Documents. Responsibilities of this category also include personally performing, while in the field, surveying, documenting, testing and measuring. At a minimum, conduct a pre-operation meeting with the Contractor prior to the first time a construction activity of a given type (control survey, casting, erection, stressing, filler injection) is to be performed.

Verification of Contractor's Procedures and Records: The responsibilities of this category require CEI staff to review Contractor procedures and records to verify their accuracy and compliance with the Contract Documents. These reviews may not require CEI staff to directly observe the specific construction operation performed by the Contractor. Responsibilities involve review of Contractor calculations, observation of Contractor Quality Control (QC) test procedures and other QC procedures, review of contractor survey data, verification of data collection form accuracy and completeness as well as other required Contractor records.
**Record Keeping:** The responsibilities of this category require CEI staff to personally gather and record data for entry into various forms and other records. These forms and records shall be on file at the CEI field office. Other forms may be developed by the CEI as necessary. Upon approval of the State Construction Structures Engineer (SCSE), CEI staff may use copies of Contractor forms or records that are verified by the CEI staff to be accurate and complete but the copy shall bear a statement that it was verified by the CEI and shall include the signature of the CEI employee that performed the verification. The CEI shall retain an independent copy of all such verified records.

**10.7.4 Additional Requirements**

Verify that all Contractor operations are conducted in accordance with the following QC Guidelists:

8B Concrete Materials

10A Bridge Structures – General Concrete

10C Bridge Structures – Concrete Decks

10D Bridge Structures – Post-tensioning (PT)
10.7.5 **Segmental Casting Yard Operations**

**A. Activities Required Prior to Casting a Segment**

1. **In Person Observations**
   
a. Survey tower and casting beds are rigidly constructed and will not deflect. Perform periodic independent surveys to verify tower position throughout the course of the project. Perform independent surveys to develop and maintain survey control data throughout the course of the project.

b. Record independent horizontal and vertical measurements at formwork control points for each segment. Verification measurements may be taken at the same time that Contractor QC measurements are taken. If permitted by the Contractor, Contractor survey equipment may be used by the CEI for performing formwork surveys prior to casting a segment.

c. **FORMS –** Observe and verify the following:
   
   - Forms are rigidly constructed and have sufficient strength to prevent deformation while supporting plastic concrete.
   
   - Form surfaces are in good condition.
   
   - Form and match-cast surfaces are coated with form release compound.
   
   - Mandrels or other devices used to secure duct openings at the bulkhead are rigid and properly positioned.
   
   - Form joints are sufficiently tight to prevent leakage of concrete slurry.

d. **REINFORCEMENT –** Observe and verify the following:
   
   - Size, spacing, position, grade and cover are correct. (For segmental construction, extra attention should be paid to reinforcing in pier segments and deviator segments.)
   
   - Spacers, chairs and bolsters have sufficient strength to prevent deformation during concrete placement and are listed on the Department’s *Approved Products List.*
   
   - Tie wires do not protrude into the concrete cover.
• Reinforcing and prestressing steel are free from loose rust, dirt, paint, etc.

• Reinforcing is securely tied.

e. DUCTS – Observe and verify the following:

• All PT system components must meet the requirements of Section 960 and be selected from the Structures Design Office (SDO) Approved PT Systems website. No substitutions, modifications, or deletions of any PT components are allowed without consent from the SDO and the SCSE, with the exception of mild reinforcing and prestressing steel.

• Post-tensioning ducts are free from debris and are securely capped.

• Pipe deviator position and rotation are correct.

• Duct size, position, alignment and cover are correct. (For segmental construction, extra attention should be paid to ducts in pier segments and deviator segments.)

• Ducts are properly sealed with no cuts, breaks, lips, kinks, dents, or unacceptable deviations.

• Duct couplers are properly installed within the match-cast segment.

2. Verification of Contractor’s Procedures and Records

a. Prior to commencement of field survey operations, verify that the segment geometry control methodology proposed in the Contractor’s Casting Manual and proposed method for geometry adjustments provide the accuracy and precision required in the Contract Documents.

b. Segment geometry measurements are accurate and have been correctly recorded.

c. Check Contractor’s calculations for revised segment geometry to correct segment alignment per the theoretical casting curve.

3. Record Keeping
a. Generate and maintain independent records and geometry adjustment calculations for elevations and horizontal measurements at survey control points for comparison with the Contractor’s records.

b. Generate checklists to track the Observations and Verifications listed above. See Attachments 10-7-1(a) and 10-7-1(b) “Sample Segment Casting Record”.

B. Casting Activities

1. In Person Observations
   a. Concrete is placed according to the Contract Documents. Vibrators are only used in accordance with the Specifications.
   b. Verify the “Mass Concrete Control Plan” has been approved by the Department (if applicable).

2. Verification of Contractor’s Procedures and Records
   a. Contractor concrete QC test specimens are taken from the point of placement.
   b. Curing compound application rate is calculated by contractor, that there are records documenting this and that it meets the requirements of the Contract Documents.

3. Record Keeping
   a. Generate checklists to track the Observations and Verifications listed above.

C. Post-Casting Activities

1. In Person Observations
   a. Record independent horizontal and vertical measurements at segment control points for each segment. Verification measurements may be taken at the same time that QC measurements are taken. If permitted by the Contractor, Contractor survey equipment may be used by the CEI for performing segment surveys.
   b. Visually inspect segment surface per CPAM 10.3. Use a pocket microscope to accurately measure crack widths smaller than 25 mils.
   c. Follow CPAM 10.2 for the disposition of defects.
d. All duct end openings are capped such that water or other foreign material cannot enter duct.

e. Verify mass concrete temperature readings are within allowable Specification limits (if applicable).

f. Lifting, transportation, and storage of segments are per Specification 452-7.

g. If segment post-tensioning is required prior to removing the segment from the form, complete the procedures in Section 10.7.6 (B) of this chapter.

h. Mark segments which have passed all inspections and which are ready for delivery to erection site by means of a stamp applied with indelible ink. Record date that each segment is stamped.

2. Verification of Contractor’s Procedures and Records

a. Elevations and horizontal measurements of as-cast segment are accurate and have been correctly recorded.

b. Concrete has reached strength required in the Contract Documents prior to tendon stressing, removal from formwork and lifting as applicable.

c. Segment dimensions agree with those required by Contractor Casting Manual and theoretical casting curve to within the tolerances specified in the Contract Documents.

3. Record Keeping

a. Develop and maintain forms to track the Observations and Verifications listed above.

b. Graphically depict crack maps, spalls, honeycombs, or other concrete surface flaws or repairs on an accurately scaled drawing of each segment (refer to CPAM 10.3 for detailed requirements).

10.7.6 Field Construction Operations

A. Segmental Erection Activities

1. In Person Observations
a. All erection operations are in accordance with the Contract Documents and approved *Erection Manual*. Verify forces in temporary erection PT components.

b. Elevations and horizontal measurements at survey control points, and bearing seats are recorded before and after segment erection. Review QC survey information for compliance with theoretical alignment.

c. Only approved shimming procedures and materials or other methods are used to correct vertical and/or horizontal misalignments. Notify the SCSE if shimming frequency exceeds every other segment for one full span or full cantilever.

d. Duct couplers are correctly installed in all continuous ducts.

e. Allowable mixing/application time of epoxy jointing material is not exceeded. Verify epoxy temperature limits are not exceeded.

f. Epoxy jointing material between segments is uniformly applied immediately before segment erection. At closure pours, epoxy bonding compound, if used, has been uniformly applied on adjacent segments immediately before placing concrete.

g. Contractor’s method for preventing epoxy from falling beneath the bridge is effective.

h. Verify PT ducts permit passage of a torpedo through duct immediately after initial stressing of bars or tendons.

i. Epoxy “squeeze out” is visible along entire length of joint.

2. Verification of Contractor’s Procedures and Records

a. Check the Contractor’s proposed Erection Manual and method for calculating adjustments to elevations and horizontal measurements at survey control points.

b. Contractor’s Erection Manual and temporary loads are in accordance with the Contract Documents.

c. Elevations and horizontal measurements at survey control points are accurate and have been correctly recorded.

d. Check calculations to adjust elevations and horizontal measurements at survey control points.
e. Verify the Contractor’s proposed methods to correct vertical and/or horizontal misalignment.

f. Proposed epoxy jointing material properties comply with the Contract Documents.

3. Record Keeping

a. Generate independent records and geometry adjustment calculations for elevations and horizontal measurements at survey control points, for comparison with the Contractor’s records.

b. If cracks or spalls occur during erection or stressing, graphically depict crack maps or spalls on an accurately scaled drawing of each segment (refer to CPAM 10.3.5 for detailed requirements).

c. Develop and maintain epoxy jointing records of all epoxy jointing operations. See Attachment 10-7-2 “Sample Epoxy Joint Record”.

B. Stressing Operations for all PT Bridge Types

1. In Person Observations

a. PT steel is properly stored and protected.

b. PT steel is placed into the ducts properly without damage to prestressing steel or ducts with a clean strand surface.

c. Concrete has reached strength required in the Contract Documents prior to erection and tendon stressing.

d. Witness and record all PT stressing operations, including: hydraulic jack gauge pressure readings and tendon or PT bar elongation measurements.

e. Stressing equipment is furnished by the supplier of PT system.

2. Verification of Contractor’s Procedures and Records

a. Hydraulic jacks have been properly calibrated and certified calibration curves have been provided for each hydraulic jack, in compliance with the Specifications.

b. In-Place Wobble and Friction Tests and/or Tendon Modulus of Elasticity Tests have been performed and obtain test reports.
c. Verify the Contractor’s procedures, measurement, calculation and documentation of tendon elongations, and documentation of hydraulic jack gauge pressure readings and jacking forces.

d. The Project Administrator shall coordinate a resolution to all differences between the CEI and the Contractor in the measurement and/or documentation of tendon elongations. In the event that measured elongations do not match those predicted by the Specialty Engineer and/or differences exist between the CEI and the Contractor in the way hydraulic jack readings and/or elongations are measured and recorded, the Project Administrator shall contact the SCSE and notify the Contractor that his Specialty Engineer needs to be involved in resolving these differences. If approved by the SCSE, the stress in a tendon can be verified using lift-off tests at either the live or dead end of a tendon, if deemed appropriate, on a case-by-case basis.

3. Record Keeping

   Develop and maintain independent stressing records of all PT stressing operations. See Attachment 10-7-3 “Sample Stressing Record”.

C. Filler Injection Operations: Grout

1. In Person Observations

   a. Air pressure tests are performed successfully.

   b. Grouting equipment is tested for accuracy on each day of use before performing grouting operations.

   c. Confirm location of all leaks and/or crossovers during the Duct Field Pressure Test for each tendon.

   d. Field grout operations are performed as specified, within specified time, and in conjunction with specified tests. A minimum of two CEI Inspectors shall be present during field grouting operations, one to observe grout mixing and pumping operations, and one to observe grout discharge at outlet locations.

   e. Confirm duct grout ports at high points and inlets and outlets located at anchorages have been drilled out, inspected for voids using a borescope, and vacuum grouted to fill voids where needed.
f. Confirm anchorages are as shown on the Design Standards and that all levels of protection at anchorages are in compliance with Specification 462-7.3.3.

2. Verification of Contractor’s Procedures and Records


b. Verify full-scale mockup was performed successfully.

c. Prepackaged grout is on the Approved Products List, and proposed equipment is in compliance with the Specifications.

d. Obtain grout manufacturer’s Quality Control Data Sheets to obtain specific density and mixing parameters for each shipment of grout on the project. Verify time that grout has been stored on the project site does not exceed six months.

e. Verify submittal of the Contractor’s Grouting Report after each grouting operation.

f. Verify the accuracy and completeness of the Contractor’s Grouting Records after each grouting operation.

g. Confirm all required grout testing have been performed and documented on the grouting record sheet. See Attachment 10-7-4(a) for required testing information.

3. Record Keeping

a. Develop and maintain Grouting Records, separate from the Contractor’s records. See Attachment 10-7-4(a) “Sample Grouting Record”.

b. Document the results of the post grouting inspection. See Attachment 10-7-5(a) “Sample Post-Grouting Inspection Record”.

D. Filler Injection Operations: Wax

1. In Person Observations

a. Air pressure and vacuum tests (when using vacuum assistance) are performed successfully.

b. Confirm location of all leaks and/or crossovers during the Duct Field Pressure and Vacuum Tests (when using vacuum assistance) for each tendon.
c. Confirm wax temperature is within 212°F and 240°F per the Specifications and that the entire mass of wax is liquefied prior to commencement of injection.

d. Wax injection operations are performed as specified. A minimum of two CEI Inspectors shall be present during wax injection operations, one to observe wax pumping operations, and one to observe wax vacuum (when using vacuum assistance) and/or discharge operations at outlet locations.

e. Confirm duct high points and anchorages have been visually inspected for voids, and address any voids using the methods described in the approved Wax Injection Operations Plan and Specification 462-8.3.2.

f. Confirm anchorages are as shown on the Design Standards and that all levels of protection at anchorages are in compliance with Specification 462-7.3.3.

2. Verification of Contractor’s Procedures and Records


b. Verify full-scale mockup test was performed successfully.

c. Microcrystalline wax is on Approved Products List, and proposed equipment is in compliance with the Specifications.

d. Obtain wax manufacturer’s certification that the product meets the requirements of the Specifications. Obtain the manufacturer’s Quality Control Data Sheets for each shipment of wax on the project.

e. Verify submittal of the Contractor’s Wax Injection Operations Report after each wax injection operation.

f. Verify the accuracy and completeness of the Contractor’s Wax Injection Records after each wax injection operation.

3. Record Keeping

a. Obtain written certification from the PT system manufacturer installation technician that the installation process is in conformance with the approved Wax Injection Operations Plan for the first two days of wax injection.

b. Develop and maintain Wax Injection Records, separate from the Contractor’s records. See Attachment 10-7-4(b) “Sample Wax Injection Record”.
c. Document the results of the post wax injection inspection. See *Attachment 10-7-5(b) “Sample Post Wax Injection Inspection Record”*.

**E. Post Grouting Inspection of External Tendon Ducts and Couplers**

1. In Person Observations

   a. Inspect external tendon ducts and couplers for grout voids, fractured grout, delamination, as well as duct and coupler material punctures, splits or other damage by sounding them and by visual inspection of all visible duct and coupler surfaces. Sound each duct and coupler a minimum of seven days after grouting is complete by tapping the surface using a 16 ounce hammer with a steel head. Use a tapping force that will not cause the duct or coupler material to split, dent, crush or incur any other damage and that will not cause fracturing, chipping or damage to the grout within the duct or coupler. Sound each duct and coupler at 12 inch intervals along their length and at each interval, as a minimum, tap them on the top sides and bottom.

   b. Mark the limits of any defect on the surface of the duct or coupler with a high visibility permanent marker and when it can be determined for sounding or observation alone, label the defect type as one or more of the following: void, fracture, delamination, split, other.

2. Verification of Contractor's Procedures and Records

   Verify that the Contractor repairs all defects. Before corrective action is taken, verify Contractor’s proposed course of action in accordance with *CPAM 10.10.6.3*. Prior to the any void investigation, the Project Administrator shall contact the State Materials Office Corrosion and Durability Lab for guidance regarding how fluid contained in a void is to be captured as well as to establish what the State Material Office role will be in the investigation of the fluid.

3. Record Keeping

   a. Document the location and type of all defects found.

   b. Document all corrective actions.

**F. Post Wax Injection Inspection of External Tendon Ducts and Couplers**

1. In Person Observations
a. Inspect external tendon ducts and couplers for wax voids as well as duct and coupler material punctures, splits or other damage by sounding them and by visual inspection of all visible duct and coupler surfaces. Sound each duct and coupler between 24 and 48 hours after wax injection is complete by tapping the surface using a rubber mallet. Use a tapping force that will not cause the duct or coupler material to split, dent, crush or incur any other damage. Sound each duct and coupler at 12 inch intervals along their length and at each interval, as a minimum, tap them on the top sides and bottom.

b. Mark the limits of any defect on the surface of the duct or coupler with a high visibility permanent marker and when it can be determined for sounding or observation alone, label the defect type as one or more of the following: void, split, other.

2. Verification of Contractor’s Procedures and Records

Verify that the Contractor repairs all defects. Before corrective action is taken, verify Contractor’s proposed course of action in accordance with CPAM 10.10.6.3.

3. Record Keeping

a. Document the location and type of all defects found.

b. Document all corrective actions.
ATTACHMENT 10-7-1(a)
SAMPLE SEGMENT CASTING RECORD

FDOT Project No: Bridge No: Bridge No: CEI Inspectors:

Casting Date: Segment Type: Pier / Typical / Deviator / Expansion Joint Drawings Used:

Form Removal Date: Curing Method:

<table>
<thead>
<tr>
<th>Formwork</th>
<th>Embedded Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Item</td>
</tr>
<tr>
<td>Inspected &amp; Date</td>
<td>Inspected &amp; Date</td>
</tr>
<tr>
<td>Remarks</td>
<td>Remarks</td>
</tr>
<tr>
<td>Form Dimensions</td>
<td>Access Openings</td>
</tr>
<tr>
<td>Match Segment</td>
<td>Lifting holes / lugs</td>
</tr>
<tr>
<td>Aligned</td>
<td>All Debris Cleaned</td>
</tr>
<tr>
<td>Form Clean / Oiled</td>
<td>Embedded Bearing Plates</td>
</tr>
<tr>
<td>Joints Tight / Sealed</td>
<td>Blockouts</td>
</tr>
<tr>
<td>Form Ties / Supports</td>
<td>Geometry Control Insert</td>
</tr>
<tr>
<td>Match Cast</td>
<td>PT Bar Sleeves</td>
</tr>
<tr>
<td>Debonding Agent</td>
<td>Filler Vents</td>
</tr>
<tr>
<td>Core Form Setup</td>
<td>Steel Pipe (at Deviator or Diaphragm)</td>
</tr>
<tr>
<td>Form Venting</td>
<td>Drainage Opening</td>
</tr>
<tr>
<td>Blockouts Installed</td>
<td>Special Inserts for Erection Equipment</td>
</tr>
<tr>
<td>Drip Edge Installed</td>
<td>Plumbing / Elec. Conduits</td>
</tr>
<tr>
<td>Blister Dimensions</td>
<td></td>
</tr>
<tr>
<td>Deviator Dimensions</td>
<td></td>
</tr>
<tr>
<td>Shear Keys (at Bulkhead)</td>
<td></td>
</tr>
<tr>
<td>Alignment Keys (at bulkhead)</td>
<td></td>
</tr>
<tr>
<td>Chamfer Form</td>
<td></td>
</tr>
<tr>
<td>Duct/Anchorage Position</td>
<td></td>
</tr>
</tbody>
</table>

Note: This standard data collection forms is provided as an example of minimum data collection requirements. Additional fields may be added by the Senior Project Engineer. All data fields on the attached forms shall be incorporated into the forms used for the project. If certain data fields are not applicable for a project, these fields may be omitted from project forms with written approval of the SCSE.
### ATTACHMENT 10-7-1(b)
### SAMPLE SEGMENT CASTING RECORD

<table>
<thead>
<tr>
<th>Reinforcing</th>
<th>Post Tensioning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item</strong></td>
<td><strong>Item</strong></td>
</tr>
<tr>
<td>Bottom Slab, Web, Top Slab Rebar</td>
<td>Cantilever PT Ducts</td>
</tr>
<tr>
<td>Blister Rebar</td>
<td>Cantilever PT Anchorages</td>
</tr>
<tr>
<td>Deviator Rebar</td>
<td>Transverse PT Ducts</td>
</tr>
<tr>
<td>Diaphragm Rebar – Position / Congestion</td>
<td>Transverse PT Anchorages</td>
</tr>
<tr>
<td>Cathodic Protection (if applicable)</td>
<td>Ducts Securely Tied</td>
</tr>
<tr>
<td>Bar Spacing</td>
<td>Filler Outlets Plugged</td>
</tr>
<tr>
<td>Clear Cover (including tie wire)</td>
<td>Ducts Capped</td>
</tr>
<tr>
<td>Bar stability - % tied - Walls</td>
<td>Continuity PT Ducts</td>
</tr>
<tr>
<td>Bar stability - % tied – Slabs</td>
<td>Continuity PT Anchorages</td>
</tr>
<tr>
<td>Bar stability - % tied – Diaphragm/ Deviator</td>
<td>Filler Tubes</td>
</tr>
<tr>
<td>Embedded PT anchorage</td>
<td>Bulkhead Mandrels in Place</td>
</tr>
<tr>
<td>Splice Lengths</td>
<td>Match Cast Duct Coupler</td>
</tr>
<tr>
<td>Local Zone Anchorage Reinforcement</td>
<td>Contingency Ducts</td>
</tr>
<tr>
<td>PT Duct alignment</td>
<td>Vertical PT in Diaphragm</td>
</tr>
<tr>
<td>Duct couplers</td>
<td>Horizontal PT in Diaphragm</td>
</tr>
<tr>
<td>Ducts secure?</td>
<td>Vertical Web PT</td>
</tr>
<tr>
<td>Transverse Tendons Inserted</td>
<td>Deviator Pipe</td>
</tr>
<tr>
<td></td>
<td>Orientation/ Rotation</td>
</tr>
<tr>
<td></td>
<td>Temporary PT Ducts</td>
</tr>
</tbody>
</table>

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ATTACHMENT 10-7-2
SAMPLE EPOXY JOINT RECORD

<table>
<thead>
<tr>
<th>Joint Location</th>
<th>Date</th>
<th>Ambient Temp.</th>
<th>Concrete Temp.</th>
<th>Lot Nos. (for all Epoxy Bonding Agent Compounds)</th>
<th>Time Mixing Started</th>
<th>Time Applied</th>
<th>Time Stressed</th>
<th>Epoxy Volume</th>
<th>Weather Conditions</th>
<th>Shims – TBR (Top, Bottom, Right, etc)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Remarks:
Method of Application; Repairs (include locations and reason for repairs)

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### ATTACHMENT 10-7-3

#### SAMPLE STRESSING RECORD

<table>
<thead>
<tr>
<th>FDOT Project No:</th>
<th>Tendon Position:</th>
<th>CEI Inspector(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge No:</td>
<td># of Strands/Diam:</td>
<td>Contractor:</td>
</tr>
<tr>
<td>Location:</td>
<td>Strand Area:</td>
<td>Contractor Personnel:</td>
</tr>
<tr>
<td>Jack No. End 1:</td>
<td>Elongation in Jack: (d)</td>
<td></td>
</tr>
<tr>
<td>Jack No. End 2:</td>
<td>Jacking Force:</td>
<td>Date Installed:</td>
</tr>
<tr>
<td>Gauge No. End 1:</td>
<td>Reel/Heat #:</td>
<td>Date Stressed:</td>
</tr>
<tr>
<td>Gauge No. End 2:</td>
<td>Pack #:</td>
<td></td>
</tr>
</tbody>
</table>

- **Theoretical Dead End Anchor Set:**
- **Theoretical Live End Anchor Set:**
- **Actual Dead End Anchor Set:**
- **Actual Live End Anchor Set:**
- **Theoretical Dead End Anchor Set (100%-20%):** (c)
- **Theoretical Modulus of Elasticity:** (f)
- **Actual Modulus of Elasticity:** (g)
- **Ratio (R=f/g):** (R)

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Tendon Number</th>
<th>Stressing Mode: Single End or Double End</th>
<th>20% Stressing Force Gauge Pressure</th>
<th>100% Stressing Force Gauge Pressure</th>
<th>Elongation at 20% Stressing Force (b)</th>
<th>Elongation at 100% Stressing Force (a)</th>
<th>Theoretical Elongation Between Wedges (e)</th>
<th>Expected Elongation 100%-20% (0.8x(e+d)+c)xR</th>
<th>Actual Elongation (a-b)</th>
<th>Percent Elongation Actual vs. Expected</th>
<th>Elongation Pass (P) of Fail (F)</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

**Notes:**
1. 100% Elongation measurement is before lock-off.
2. The Contractor's Engineer of Record will determine whether Live End Anchor Set is to be measured separately and added to the Expected Elongations.

**Remarks:**

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Note: This standard data collection form is provided as an example of minimum data collection requirements. Additional fields may be added by the Senior Project Engineer. All data fields on the attached forms shall be incorporated into the forms used for the project. If certain data fields are not applicable for a project, these fields may be omitted from project forms with written approval of the SCSE.
ATTACHMENT 10-7-4(a)
SAMPLE GROUTING RECORD

<table>
<thead>
<tr>
<th>FDOT Project No:</th>
<th>Grout Type:</th>
<th>Inspectors:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge No:</td>
<td>Grout Manufacturer:</td>
<td>Contractor:</td>
</tr>
<tr>
<td>Location:</td>
<td>Lot Number:</td>
<td>Contractor Personnel:</td>
</tr>
<tr>
<td>Bag Weight:</td>
<td>Bag Date:</td>
<td>Bags (Grout Batching):</td>
</tr>
<tr>
<td>Bags (Grout Batching):</td>
<td>Water (Grout Batching):</td>
<td>Date:</td>
</tr>
<tr>
<td>Water/Cement Ratio:</td>
<td>Grout Temperature:</td>
<td>Ambient Temperature:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tendon No.</th>
<th>Tendon Length</th>
<th>Bleed Test</th>
<th>Efflux Time (Fluidity Test)</th>
<th>Maximum Pressure (psi)</th>
<th>Estimated Time (sec)</th>
<th>Actual Time (sec)</th>
<th>Theoretical Grout Volume</th>
<th>Measured Grout Volume</th>
<th>Discharged Grout Volume</th>
<th>Post Grout Inspection</th>
<th>Date Tendon Installed</th>
<th>Date Tendon Stressed</th>
</tr>
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<tbody>
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</tbody>
</table>

Tendon #: Wick Bleed Test Results:
15min:____ 30min:____ 45min:____ 60min:____ 120min:____ 180min:____
Air Test Pressure Loss:____

Remarks:
(Note whether Standard or Modified Fluidity test was used, problems encountered, variations to approved grouting plan, etc.)

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ATTACHMENT 10-7-4(b)
SAMPLE WAX INJECTION RECORD

<table>
<thead>
<tr>
<th>FDOT Project No:</th>
<th>Wax Type:</th>
<th>Inspectors:</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

<table>
<thead>
<tr>
<th>Bridge No:</th>
<th>Wax Manufacturer:</th>
<th>Contractor:</th>
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<table>
<thead>
<tr>
<th>Location:</th>
<th>Lot Number:</th>
<th>Contractor Personnel:</th>
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<table>
<thead>
<tr>
<th>Ambient Temperature:</th>
<th>Date of Injection:</th>
</tr>
</thead>
<tbody>
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</table>

<table>
<thead>
<tr>
<th>Tendon No.</th>
<th>Tendon Length</th>
<th>Wax Locking Pressure (psi)</th>
<th>Vacuum Gauge Pressure (psi) / % Vacuum</th>
<th>Wax Temperature (°F)</th>
<th>Theoretical Wax Volume</th>
<th>Actual Wax Volume in Duct</th>
<th>Volume of Wax Discharged</th>
<th>Post Wax Injection Inspection</th>
<th>Date Tendon Installed</th>
<th>Date Tendon Stressed</th>
</tr>
</thead>
<tbody>
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<table>
<thead>
<tr>
<th>Tendon #:</th>
<th>Air Test Pressure Loss:</th>
<th>Vacuum Loss (%) = (P1-P2)/P1*100%:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tendon #</td>
<td></td>
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<td>Tendon #</td>
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<tr>
<td>Tendon #</td>
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</tbody>
</table>

Remarks:
(Note problems encountered, variations to approved wax injection plan, etc.)

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## ATTACHMENT 10-7-5(a)
SAMPLE POST GROUTING INSPECTION RECORD

<table>
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</tbody>
</table>

**Void in External Tendon Duct?**

If yes, indicate size and location below.

(Shade in voided area)

**Notes:**

---

Note: This standard data collection form is provided as an example of minimum data collection requirements. Additional fields may be added by the Senior Project Engineer. All data fields on the attached forms shall be incorporated into the forms used for the project. If certain data fields are not applicable for a project, these fields may be omitted from project forms with written approval of the SCSE.
### ATTACHMENT 10-7-5(b)
#### SAMPLE POST WAX INJECTION INSPECTION RECORD

<table>
<thead>
<tr>
<th>FDOT Project No:</th>
<th>Inspectors:</th>
<th>Bridge No:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Anchor Location</th>
<th>Span</th>
<th>Tendon Designation</th>
<th>Anchor Cap</th>
<th>Wax Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of Inspection</td>
<td>Void Found?</td>
<td>Estimate % of Void</td>
<td>Depth Probed with Wire</td>
<td>Void Found?</td>
</tr>
<tr>
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<td>Location of Inspection</td>
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</tr>
</tbody>
</table>

Void in External Tendon Duct? ____________
If yes, indicate size and location below.
(Shade in voided area)

![Void Diagram]

**Notes:**

---

*Note: This standard data collection form is provided as an example of minimum data collection requirements. Additional fields may be added by the Senior Project Engineer. All data fields on the attached forms shall be incorporated into the forms used for the project. If certain data fields are not applicable for a project, these fields may be omitted from project forms with written approval of the SCSE.*
ATTACHMENT 10-7-6
SAMPLE CASTING YARD SURVEY CONTROL POINTS
FOR SEGMENTAL SUPERSTRUCTURES

SEGMENT PLAN VIEWS IN THE CASTING YARD

Survey Tower
(For Horizontal Control)

Survey Tower
(For Horizontal Control and Elevation)

Survey Control Points A', A and D
Survey Control Points B', B and E
Survey Control Points C', C and F

NOTES:
1. The horizontal Baseline is established between Survey Towers, and the bulkhead is set perpendicular to this Baseline.
2. Points B' and B are on the Baseline, and Point E is offset from the Baseline as shown.
3. Horizontal Measurements are taken between Control Points A-A', B-B' and C-C'.
4. Elevations are taken at Points A', C', A, C, D and F.
5. All elevations and measurements are taken before and after casting the Poured (New) Segment.
ATTACHMENT 10-7-7
ALTERNATE SAMPLE CASTING YARD SURVEY CONTROL POINTS
FOR SEGMENTAL SUPERSTRUCTURES

SEGMENT PLAN VIEWS IN THE CASTING YARD

SEGMENT CROSS SECTION

NOTES:
1. Horizontal measurements are taken between Control Points A-A', C-C', A-B', C-B', A-D, C-F, B-D and B-F before casting the Poured (New) Segment.
2. Elevations are taken at Points A', C', A, C, D and F before and after casting the Poured (New) Segment.
3. Horizontal measurements are taken between Control Points A-A', C-C', A-B' and C-B after casting the Poured (New) Segment.
ATTACHMENT 10-7-8
TENDON ELONGATION MEASUREMENT FOR A
TYPICAL HYDRAULIC JACK

HYDRAULIC JACK DURING STRESSING

HYDRAULIC JACK AFTER STRESSING
(WHEN JACK IS PULLED BACK)
ATTACHMENT 10-7-9
TYPICAL WEB CRACKS ON SEGMENTAL SUPERSTRUCTURE

SEGMENT CROSS SECTION

BRIDGE ELEVATION
ATTACHMENT 10-7-10
CASTING YARD AND SEGMENT FABRICATION

Contractor
Constructs
Casting Yard

Are the Survey
Towers, Casting
Beds & Equipment
Satisfactory?

Are the placement
of the Reinforcement
and PT Ducts correct?

Inspect Concrete
Placement and
Casting

Final Survey the
Match Cast and
New Segments

Calculate or Confirm
the Contractor's
Calculations for
Geometry Adjustments for the
next New Segment
Pour

Confirm Contractor's
Methods before
moving Segment to
Storage Muf
methods?

Begin Fabrication for
next Segment Pour

Repair Defects

Are Stored
Segments free of
Defects and Cured
properly with curing
compound?

Are the Form
Tolerances and
Structural Integrity
Adequate?

Does Survey for Match
Cast and New Segments
match the Theoretical
Casting? Curve?

Adjust Reinforcement
or PT Ducts

Modify

YES

YES

YES

YES

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO
ATTACHMENT 10-7-11
SEGMENT ERECTION AND JOINTING

Contractor Prepares to Erect Segment

Confirm Adequacy of Erection Equipment

Is Segment being Erected at Pier Segment?

NO

Determine Elevations and Horizontal Survey Control Points for the Previously Erected Segment

YES

Erect and Secure the Pier Segment

Determine Elevations and Horizontal Survey Control Points

Does the Survey Match the Results Predicted by the As-Cast Curve?

YES

CONFIRM HYDRAULIC JACK CALIBRATION

Modify Elevations and Horizontal Survey Control Points for Segment to be Erected

NO

Confirm Method for Catching Epoxy during Jointing Operations is in-Place

Inspect and Document the Placement of Double Faced Strip

Inspect and Document Temporary Post-Tensioning Stressing Operations

Confirm Ducts are Swabbed Clean after Stressing

Does Final Survey of Erected Segment Match the Results of the As-Cast Curve?

NO

Modify Elevations and Horizontal Survey Points for the Next Segment to be Erected

YES

Prepare to Erect the Next Segment
ATTACHMENT 10-7-12
POST TENSIONING

Contractor Prepares to Perform Post-Tensioning Operations

Have Hydraulic Jacks been Certified, and have the Calibration curves been Provided?

YES

Contractor Remediates

NO

Have Calculations been Performed Correctly?

YES

Contractor Repeats Calculations

NO

Project Administrator seeks Resolution with the State Construction Structures Office

Does Tendon Stressing Prove to be Adequate after further investigation (such as double end stressing, lift offsets, etc.)?

YES

Does Analysis by the Specialty Engineer Confirm Structural Adequacy, and is this Analysis Acceptable to the District?

YES

Contractor's Specialty Engineer Develops a Remediation Plan

NO

Stressing Complete

Does Tendon Elongation Meet the Specifications when Compared to the Theoretical Tendon Elongation?

NO

Contractor Remediates

YES

Observe and Document Stressing at 20% of the Final Jacking Force and Main Tension for Elongation Measurement

Observe and Document Stressing at 100% of the Final Jacking Force

Measure Tendon Elongation between 20% and 100% of the Final Jacking Force

Confirm Pressure Gauge Readings for 20% and 100% of the Final Jacking Force for each Hydraulic Jack and Tendon Combination

Conduct Pre-Operation Meeting(s) with the Contractor to Discuss the Requirements for Guideline No. 100

Sum all Losses due to Tendon Elongation between 20% and 100% of the Final Jacking Force
ATTACHMENT 10-7-13(b)
WAX INJECTION

Contractor Prepares to Perform Wax Injection Operations

Has the Wax Injection Plan been Reviewed and Approved?

Contractor Revises and Resubmits the Wax Injection Plan

Do the Pressure Tested Ducts Leak and/or can Decks not Maintain a 50% Vacuum?

Repair Leaks and Identify Possible Crossover Locations

Contractor Revises and Resubmits the Wax Injection Plan

Is Wax heated to within the Temperature Range per Specification?

Contractor Revises and Replaces the Equipment, as Necessary

Continue Heating and Make Temperature Adjustments as Necessary

Is the entire mass of wax liquefied?

Begin Wax Injection Operations

Are any Voids Present?

Voids must be eliminated

Confirm Inlet/Outlet Wax Injection Procedure and Wax Discharge are Performed in accordance with the Specifications, and Document Lapses

During Wax Injection Confirm Pump Pressure and Wax Pumping Rate, and Laminarity of the Wax Flow and Document Specification Violations

Obtain Wax Injection Report from the Contractor and Install Anarchage Protection

Contact Pre-Operation Meetings with the Contractor and Discuss the Requirements of Guideline No. 10D

Does Wax Injection Equipment meet Specification and is it in Good working Order?

YES

NO
ATTACHMENT 10-7-14
CRACK INSPECTION AND REPAIR

Inspect Concrete Elements after Casting, Stripping, and Application of Dead Loads and Traffic Load

Are Cracks Found?

NO

NO

No Action

YES

Has the Project Administrator determined that the cracks are non-structural?

NO

Project Administrator informs Senior Project Engineer, who informs the Construction Project Manager

YES

Repair in accordance with Specification Section 400

Informs the District Construction Engineer (DCE) and the State Construction Structures Office (SCSO)

Informs the District Construction Engineer DCE and the District Structures Design Office (DSIDO)

SCSO or DSIDO reviews the Contractor's Recommendations and advises the DCE

Does the DCE accept the Contractor's Recommendations?

NO

The Contractor's Specialty Engineer re-reviews the Recommendations for Remedial Action

YES

Project Manager asks the Contractor to have his Specialty Engineer make Recommendations for Remedial Action

Contractor implements repairs