

Special Specification 4107

Electrically Isolated Post-Tensioned Tendon



1. DESCRIPTION

The Post-Tension Supplier shall provide a Protection Level 3 (PL-3) as defined in PTI/ASBI M50 for a specified number of tendons in accordance with the plans and the requirements of this item.

PL-3 consists of complete electrical isolation of the entire tendon; the wedge plate, and pre-stressing steel shall be isolated by an insert between the bearing plate. The isolated tendon will act as a waterproof envelope protecting the strand from corrosion. Junction boxes with electrical terminals and electrical cable connections directly to the wedge plate and reinforcement shall be installed to ensure long-term monitorability.

Follow the minimum requirements of PL-3 unless shown otherwise:

- Install 2 electrically isolated tendons at the bent location specified in the plans.
- Connect one end of the cable to the wedge plate by bolted connection and the other end to the junction box connector by bolted connection.
- Connect another cable end to the reinforcement cage near the anchorage and bolt the other end to the junction box connector.
- Take readings from the junction boxes immediately after stressing, and 28 days after grouting

2. REFERENCE SPECIFICATIONS

Observe the following standards:

- Post-Tensioning Institute (PTI) and American Segmental Bridge Institute (ASBI), *PTI/ASBI M50.3-12 "Guide Specification for Grouted Post-Tensioning"*. 2012.
- ASTRA/SBB AG, *Richtlinie "Massnahmen zur Gewährleistung der Dauerhaftigkeit von Spanngliedern in Kunstbauten" (in German, 2nd edition)*. 2007: Berne, Switzerland. ASTM D4541 Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testing
- ASTRA/SBB AG, *Richtlinie "Massnahmen zur Gewährleistung der Dauerhaftigkeit von Spanngliedern in Kunstbauten" (in German, 1st edition)*. 2001: Berne, Switzerland.
- ASTRA/SBB AG, *Guideline "Measures to Ensure Durability of Post-Tensioning Tendons in Structures" (English translation of 2nd edition)*. 2007: Berne, Switzerland.
- *fib Bulletin no. 33 "Durability of post-tensioning tendons"*. 2005: International Federation for Structural Concrete (fib).
- EN 50162: Protection against corrosion by stray current from direct current systems. 2004.
- IEC 62128-2:2013: Railway applications - Fixed installations - Electrical safety, earthing and the return circuit - Part 2: Provisions against the effects of stray currents caused by d.c. traction systems. 2013.
- Swiss Society for Corrosion Protection (SGK), *Guideline "C3. Recommendations for the protection from corrosion caused by DC stray currents" (in German)*. 2011: Zurich, Switzerland.
- Elsener, B., *Monitoring of electrically isolated post-tensioning tendons, in Tailor made concrete structures*, J. Walraven and D. Stoelhorst, Editors. 2008, Taylor & Francis Group: London. p. 231-236.
- Elsener, B. and Büchler, M., *Quality control and monitoring of electrically isolated post-tensioning tendons, research report ASTRA/AGB 2004/010*. 2011, Swiss Federal Roads Administration.

3. MATERIALS

All materials, fabrication and installations are subject to inspection and testing by the Department or its designated representative. Use only specified materials.

- 3.1. **Corrugated Plastic Duct** Provide corrugated plastic duct that meets the requirements of PTI/ASBI M-50 section 4.3.5.2.
- 3.2. **Permanent Grout Caps** Permanent grout caps for PL-3 shall be nonmetallic and non-conductive in the certification documentation. Use permanent grout caps made from approved polymer for PL-3. The approved resins for use in the polymer shall have ultraviolet [UV] stabilizer added. Seal the cap to the bearing plate with "O"-ring seals, gaskets, or precision-fitted flat gaskets. Place a grout vent on the top of the cap. Grout caps shall be pressure tested prior to grout injection and certified to a minimum pressure of 150 psi by the PTS supplier. Use ASTM F593 Type 316 stainless steel bolts to attach the cap to the anchorage
- 3.3. **Trumpets** Trumpets for PL-3 anchorages shall be made of plastic. For plastic trumpets, the trumpet shall be made of high-density polyethylene or polypropylene. The thickness of the trumpet at the duct end shall not be less than the thickness of the duct.
- Pre-Stressing Steel Strand** Provide 7-wire steel strand meeting DMS-4500, "Steel Strand, Uncoated Seven-Wire Stress Relieved and Low Relaxation for Prestressed Concrete,"
- 3.4. **Grout** Provide grout that meets DMS 4670, "Grouts for Post-Tensioning"
- 3.5. **Electrical Components** Wiring used for electrical measurements on PL-3 tendons shall be at least #12 AWG solid copper. Wiring shall have water-proof insulation. When cast into concrete, the insulation shall be resistant to alkaline environment in the concrete. Alternatively, wiring shall be permitted to be placed in non-conductive electrical conduits.

Electrical contacts to the tendon shall be located at the anchorage at one end of the tendon. Contact shall be made by means of a stainless steel Grade 316 bolted electrical connectors. Galvanized conductors and contact bolts shall not be permitted. Prior to installing the bolted electrical connectors, any surface rust on the components shall be removed to ensure unimpeded electrical contact.

A non-conductive junction box with electrical terminals shall be installed at the anchorage end indicated in the plans. Junction boxes shall be provided with an air ventilation opening protected with anti-insect mesh at the lowest position of the box. Junction boxes shall be installed in an easily accessible position on the structure and shall be suitable to protect all cables and measuring connections from weather and mechanical damage.

Wiring shall be bolted to the terminals and sealed permanently with heat shrink tubes. Terminals shall be adequately labeled in the junction box including the tendon identification and whether the connection is with the tendon or reinforcement.

A reinforcing steel bars (or other approved metallic component) shall be installed in concrete section both parallel and perpendicular to the tendon to ensure continuous electrical conductance of the reinforcing steel cage. Bar size shall be at least 1/2 in diameter.

4. EQUIPMENT

Verification of Electrical Isolation Prior to grouting (but after stressing the tendon) and after grouting the AC impedance shall be measured between the tendon and reinforcing steel using the terminals in one of the junction boxes. Measured resistances < 10 Ω indicate the presence of a metallic contact between the tendon and the reinforcing steel.

The instrument used to measure AC impedance shall satisfy the following requirements:

-AC measuring frequency of 100 Hz

At least 20/40 V AC output voltage

-Digital display

-Measuring Ranges:

R: 0.1 Ω – 10 M Ω (with a resolution of 0.1 Ω at the lower end of the range)

C: 0.1 nF – 100 μ F

D: 0.001 – 10

5. QUALIFICATIONS

Submit in writing the qualifications for review and approval of the proposed personnel to perform the installation of the electrically isolated tendons.

- **Contractor.** Provide documentation verifying previous experience installing post-tensioned tendons to a PL-3. Provide personnel with at least 2 yr. of previous experience installing and taking measurements of electrically isolated tendons.

6. CONSTRUCTION

Obtain approval of personnel and procedures prior to installing duct, strand, and anchorage hardware. Notify Division at 512-416-2493, 2 weeks prior to installing post-tensioning duct.

The plans for the isolated tendons are not intended to be scaled for exact locations unless scales are explicitly stated on the drawing. Field conditions and non-interference with structural features determine exact locations.

- 6.1. **Work Plan.** Submit a detailed Work Plan for all phases of work and a description of proposed materials to be used in this project to the Engineer for approval prior to beginning work. Work plan must be reviewed and endorsed by the Engineer. Validation tests may be conducted by the Engineer, or his appointed representative.

Coordinate installation of the system components with all other construction operations.

- 6.2. **Demonstration.** Perform a demonstration of electrical isolation on all specified tendons prior to grouting and post grouting.

- 6.3. **Access.** Provide safe access for workers, supervisors and inspectors to all areas where work is being performed.

- 6.4. **Installation.** Provide safe access for workers, supervisors and inspectors to all areas where work is being performed.

Duct. Inspect the installed ducts for damage Ensure nothing infringes on the in-side dimension(s) of the ducts before releasing the installation for concreting. For PL-3 tendons, plastic duct shall be visually inspected before installation. In case of damage, they shall be rejected. Plastic ties should be used to secure duct in place.

For curved PL-3 tendons, the duct shall be protected from damage caused by support bars placed along the inside radius of the duct. At locations where the duct is in contact with support bars along the inside radius,

plastic half-shells shall be placed between the duct and the support bars. Half-shells shall be fixed in place using plastic ties (metal ties not allowed)

6.4.1. **Preparation of the Concrete Surface.**

Do not abrasive blast surfaces for coating before concrete repairs are completed and patch materials are allowed to cure as required.

Provide the following equipment and material meeting the requirements included:

7. MEASUREMENT

This Item will be measured by the Each.

8. PAYMENT

The work performed and the materials furnished in accordance with this Item and provided under "Measurement" will be paid for at the unit price bid "Electrically Isolated Post-Tensioned Tendon" This price is full compensation for all materials, access platforms, junction box, equipment, tools, testing, testing equipment, repair of defective area, labor-including services provided by post-tensioning specialist (if necessary), transportation and all other incidentals necessary to make the electrically isolated tendon operate as designed.