

**FY 2014/2015 QC Category No. 10D**  
**STATEWIDE INSPECTION GUIDELIST**  
**Bridge Structures - Post-tensioning (PT)**

**GENERAL**

1. The PT foreman (Level II) and PT crew members (Level I) must successfully complete a Post-Tensioning Institute (PTI) course and be qualified by CTQP. The PT crew must have at least two CTQP qualified members one of which may be the foreman. The grouting foreman must successfully complete an American Segmental Bridge Institute (ASBI) course and be qualified by CTQP as Level II and grouting crew members must successfully complete an ASBI or PTI course and be qualified by CTQP as Level I. The grouting crew must have at least two CTQP qualified members one of which may be the foreman. Conduct all stressing and grouting operations in the presence of the Engineer. [Spec. 105-8 & 462-4]
2. The vacuum grouting foreman must have experience and training in the use of vacuum grouting equipment and procedures. [Spec. 105-8 & 462-4]

**MATERIALS**

3. All materials must be stored in weatherproof buildings, sheds or containers. [Spec. 462-6]
4. The following material specs. must be met: 926-Epoxy Grout, 930-Magnesium Ammonium Phosphate Concrete, 938-Grout, 960-Post-Tensioning components, 975–Elastomeric Coating Systems. [Spec. 462-2]
5. Prestressing materials that must be approved, be in compliance and be undamaged are: prestressing steel including strands and bars, and PT systems including anchorage assemblies, bearing plates, couplers, grout caps, vent tubes, valves, inlets/outlets, ducts, wedge plates & wedges. [Spec. 462-2, 933]
6. Ducts must be protected from a variety of damaging elements at all times, be sealed at ends with caps/plugs, and be stored properly. [Spec. 462-6]
7. Inlets/outlets must have mechanical shut offs, be the correct diameter, extend sufficiently, and be properly bonded to the duct. [Spec. 462-7]
8. Grouts must be on the QPL and be mixed with the specified water; fluidity must be maintained per manufacturer's limits; wick induced bleed tests must be performed; and on-site grout must be properly stored for not more than one month. Grouts that are more than 6 months old must be retested and certified or removed from the project. [Spec. 462-6, 923, 938]
9. PT Systems must be approved by the State Structures Design Office and required test reports must come from a certified independent lab. [Spec. 462-2, 960]
10. Certain materials must be sampled and tested, others must be certified, and some require LOT number identification at all times. [Spec. 462-6]

11. These tests may be required: Tendon Modulus of Elasticity Test (optional), In Place Friction Test (required for tendons longer than 100'). [Spec. 462-8]

### ***PROTECTION OF PT STEEL***

12. PT steel must be clean, bright, uniformly colored; have no corrosion pitting; and be rejected if damaged or deteriorated. [Spec. 462-6]

13. PT strands must be low relaxation (stabilized) per the requirements of ASTM A 416 and be in shipping containers with special corrosion inhibitor and in packaging that must be marked with specified information. [Spec. 462-6]

14. All PT superstructure steel must be stressed and grouted within 14 calendar days after placement in its final position. Substructure PT bars must be stressed and grouted within 21 days of placement. [Spec. 462-7]

15. If chloride contamination requires remediation, duct flushing may be performed using water with slack lime or quicklime. [Spec. 462-7]

### ***FABRICATION***

16. Duct splices must be minimized. [Spec. 462-7]

17. Internal ducts must be secured at not more than 30" intervals for steel pipes, 24" intervals for round plastic ducts, and 12" intervals for flat plastic ducts. Ducts, joints, tendons, rebar and anchorages must be within specified position tolerances. [Spec. 462-7]

18. External tendon duct must be straight between connections to internal locations. [Spec. 462-7]

19. Ducts, anchorage connections, splices, inlets and outlets must be sealed at all times before grouting except that low point outlets must be left open. [Spec. 462-7]

20. Duct tape is not permitted for repairing or sealing splices, joints, couplings or connections. [Spec. 462-7]

21. Grout inlets and outlets must be located per plans, shop drawings, specifications, or per Engineer if conflicting with reinforcement. [Spec. 462-7]

22. When required by the Engineer, the duct system must be pressure tested before placement of concrete at 1.5 psi for 1 minute and have pressure loss of not more than 0.15 psi. [Spec. 462-8]

23. After concrete is placed and cured, a torpedo, ¼ inch smaller all around than the duct, must be passed through all ducts to detect blockages without excessive effort or mechanical assistance. Correction of blockages requires approval of the Engineer. Flat, 4-strand transverse tendon ducts in segmental box girders may be proved by moving the tendons freely by hand within the duct. [Spec. 462-8]

## **POST-TENSIONING OPERATIONS**

24. Tendons must be pulled or pushed through ducts without snagging and during the insertion of a post-tensioning strand into a duct; the strand shall not be intentionally rotated to facilitate insertion by any mechanical device. [Spec. 462-7]
25. PT forces must not be applied until concrete has minimum strength required by Contract Documents. [Spec. 462-7]
26. Initial, permanent and maximum tendon stresses must be within specified limits and single or double end stressing must be per plans or shop drawings or Engineer. [Spec. 462-7]
27. Stressing equipment must be provided by the PT system supplier and stressing jacks must be calibrated, and a master gauge may be used. [Spec. 462-7]
28. Tendon elongations must be measured to the nearest 1/16-inch and observed elongation shall be within 7% of theoretical. Tendons must not be over stressed to achieve the required elongation. [Spec. 462-7]
29. A tendon force diagram reflecting the PT system actually used must be submitted and if friction is too high a lubricant may be used per spec. [Spec. 462-7]
30. Tendon wires may break or slip as allowed by the spec. but failed wires must never exceed 5% of the tendon cross sectional area. [Spec. 462-7]
31. Cut PT steel by an abrasive saw or plasma torch not less than 3/4 to 1-1/2 inches from the anchoring device. Flame cutting of PT steel is not allowed. Do not cut tendon to final length prior to acceptance. [Spec. 462-7]
32. Records of the tendon stressing operation are required and must contain 17 items required by the specification as well as any other relevant information. [Spec. 462-7]
33. For internal and external ducts, after stressing and prior to grouting, the system must be pressure tested at 50 psi for 1 minute with pressure loss of not more than 25 psi for tendons equal to or less than 150 ft. and a pressure loss not more than 15 psi for tendons longer than 150 ft. and corrections must be made with approval of the Engineer. [Spec. 462-8]
34. Within 4 hours after stressing, grout and anchorage caps must be installed and all other tendon openings must be sealed. If tendon contamination occurs, the tendon is to be removed and replaced. [Spec. 462-7]

## **GROUTING OPERATIONS**

35. A Grouting Plan must be submitted and approved 6 weeks before the start of grouting operations. Grouting must be performed according to the approved Grouting Plan and modifications to the Plan must be approved before they are used. [Spec. 462-7]

36. A pre-grouting meeting must be conducted with Contractor, Subcontractor, and Engineer and should include all individuals involved in managing, performing and inspecting the grouting operation. [Spec. 462-7]
37. Grouting equipment must be per spec. and shall include a colloidal mixer, storage hopper, water meter, positive displacement pump, pump pressure gage, vacuum grouting equipment, and standby equipment. [Spec. 462-7]
38. Maximum grout temperature must not exceed 90°F and grouting operations are prohibited when the ambient temperature is below 40°F or is expected to fall below 40°F within one day after grouting. [Spec. 462-7]
39. Efflux or Wet Density testing must be performed on the pumped grout initially and at the anchorage outlet when discharge begins and a bleed test is required at the start of each days grouting. A failing test requires adjustments to the grout mix before the resumption of grouting. [Spec. 462-7, 938]
40. Normal pumping pressure must range from 10 psi to 50 psi measured at the grout inlet. The maximum pumping pressure of 145 psi for round ducts and 75 psi for flat ducts at the grout inlet must not be exceeded. [Spec. 462-7]
41. The discharge from outlets must follow the order in the Grouting Plan and once the anchorage outlet is closed, discharge a minimum of 2 gallons of grout from the anchorage cap outlet into a clean receptacle to ensure that free air and water are completely expelled. [Spec. 462-7]
42. After initial grouting is complete and the system is sealed, the pressure must be increased to the equivalent realized grout pumping pressure for 2 minutes to check for leaks. If no leaks, reduce pressure to 5 psi for a minimum of 10 min. then bleed each outlet and leave 30 psi residual pressure. [Spec. 462-7]
43. If grouting pressure exceeds the maximum allowed, move pumping to the next outlet and resume as per spec. If grouting cannot be completed, resume after 48 hours. [Spec. 462-7]
44. Grouting of vertical tendons requires the use of a standpipe that keeps the grout level above the anchorage at all times. [Spec. 462-7]
45. Grout inlets and outlets shall not be opened for at least 24 hours after grouting. [Spec. 462-8]
46. After grout is cured, all high points along the tendons as well as the inlets and outlets located at the anchorages must be drilled and inspected with an endoscope or probe per spec. and within 4 hours of drilling, seal the drilled void. Any significant deficiency voids that are found must be filled using the vacuum grouting method within 48 hours. [Spec. 462-8]
47. When grouting is incomplete, an endoscope must be used to establish the limits of sound grout. Probing is not allowed. The remaining unfilled duct must be vacuum grouted per specification. [Spec. 462-8]

48. A grouting report is required within 5 days of grouting completion. [Spec. 462-7]

### **FINAL FINISHING AND PROTECTION**

49. Lifting and access holes must be patched with Magnesium Ammonium Phosphate Concrete or Type Q Epoxy and before patching. Surfaces must be cleaned with grit or water blasting methods at 10,000 psi pressure. [Spec. 462-7, 930, 926]

50. After deck grooving, patched areas must be coated with Methyl Methacrylate extending 6" beyond the perimeter of the patched area; however, Methacrylate is not required if Type Q Epoxy is used to patch. [Spec. 462-7]

51. Grout inlets/outlets must be sealed with a plastic cap and be patched with epoxy grout. [Spec. 462-7, 926]

52. Anchorages must be protected within 7 days of grouting completion and epoxy grout pourbacks must be placed in properly prepared forms using specified placement methods. Surfaces in contact with pourback material must be cleaned with grit or water at 10,000 psi. [Spec. 462-7, 926]

53. Pour backs or anchorage caps must be coated with elastomeric material 30 to 45 mils thick over a properly cleaned surface and only after concrete to be coated is 28 days old and within 90 days of grouting. The coating material must be applied to a test block per spec. and applicators must have 3 yrs. of experience with similar materials. [Spec. 462-7, 975]

### **CRACK AND DUCT INSPECTION**

54. Inspect all post-tensioned concrete box girder top slab, bottom slab and web wall interior and exterior surfaces for cracks immediately after all post-tensioning of a span is complete. If the segmental cantilever erection method is used, inspect all surfaces of web walls of all previously placed segments after each new segment is placed. Since these cracks can be very narrow and hard to see, use of a magnifying device, high intensity white light and spraying with water to increase their visibility may be beneficial during inspection. The width, length, depth, termination points, and precise location of any cracks must be properly documented to scale (crack map). Report all cracks to the Project Administrator so that their status can be addressed immediately. [Spec. 400-21, CPAM 10.7]

55. Monitor and document growth of individual cracks to determine if cracks are active or dormant. [Spec. 400-21, CPAM 10.7]

56. 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. [CPAM 10.7]

57. 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. [CPAM 10.7]