



MEMORANDUM

TO: District Directors of Construction **DATE:** November 16, 2011

FROM: Brian D. Merrill, P.E.
BRG - Construction & Maintenance Branch

SUBJECT: Grouting of Post-Tensioned Tendons

There have been several recent issues involving post-tensioning operations in Texas and around the country. We have been in contact with several State DOT's and industry experts to try and understand the issues and to develop procedures to prevent problems. I serve on a national committee tasked with writing new specifications for P-T grouting and this group is working on solutions to be incorporated into the new Post-Tensioning Institute (PTI) specifications.

There have been two main issues:

1. chlorides in the grout (from a contaminated cement source);
2. Soft/segregated grout due to a combination of the following:
 - a. improper storage of grout bags
 - b. mixing/pumping issues
 - c. grouting procedures not followed
 - d. elevated pumping pressures and speed

To address these issues we recommend the following:

1. Send one bag from each lot of grout to CST/M&P for testing for chlorides and physical properties. On large jobs this may have to be done several times to capture all of the lots. Some level of effort will be needed to identify all the lots of grout in a pallet of bags – they sometimes combine lots in a shipment.
2. Enforce the following during grouting (see below for resources)
 - a. Insure that grout is stored no more than one month on-site and is kept in a dry, cool (as much as possible) location. The shelf life stamped on the bags is normally based on storage at 73F and 50% RH.
 - b. Insure they follow the grout plan and other requirements for mixing. These grouts are very sensitive to excess water and mixing conditions. The grouting personnel should run both the modified flow cone and mud-balance (specific gravity) tests every time before they grout.
 - c. Make sure they stick to the grouting plan which should include pumping pressures, sequence of valve closures, vent locations, duct pressure testing, ...

- d. Do not let them pump at excessive pressures. It is hard to determine what is excessive but ideally they should pump at less than 30 psi. If questions arise about pumping pressures and possible grout segregation, we can have them run the flow cone and mud-balance tests again using the grout coming from the outlet.
 - e. They need to expel a significant quantity (2-3 gallons) of grout at vents and outlets to make sure there is no air or water trapped in the ducts.
3. Post-grouting inspection:
- a. Inspect the grout caps and other vents 24-48 hours after grouting. This is done by removing the grout vent cap or screw and probing to determine if the grout has hardened and to check for voids. If voids or soft grout are found, then the cap must be removed for more detailed inspection.

Resources: BRG has four engineers and one technician that have all been through both the Post-Tensioning Institute's (PTI) "Bonded PT Installer Certification Program" and the American Segmental Bridge Institute's (ASBI) Grouting Certification Program. Several others in BRG have attended only the ASBI class. We are available to assist you with these operations and in many cases can do turn-key inspections if given sufficient notice. We can also review the grouting plans required by Item 426. Finally, BRG is developing standard PT details so that PT suppliers and installers can more easily understand our requirements. Contact me at 512-416-2232 or by email at Brian.Merrill@txdot.gov if you need any assistance with PT operations.

TxDOT's Standard Specification Item 426, "Prestressing", covers post-tensioning and grouting operations. All of the recommendations above comply with Item 426 except for the mud balance (specific gravity) test. This test was developed after the 2004 specs were written but should be mentioned in the required grouting plan as it is covered in the required ASBI Grouting Certification Training. The mud balance test is an American Petroleum Institute test that can be found in API Recommended Practice 13B-1. The 2014 version of this Item will cover only PT operations (the current version also addresses pre-tensioning) and will require PT installers to have both the PTI and ASBI certifications. The new specification will also reference the PTI specification for all P-T operations.

cc: Dist Bridge Engineers