

ORGINATION FORM

THE INFORMATION BELOW IS TO BE PROVIDED BY THE ORIGINATOR

(The person who receives or originates the issue and needs to forward the issue for action.)

Modify Specification _____.
Section/File number

New Section _____938_____.
Section number

Subject: Post-Tensioning Grout

Origination date: September 18, 2002

Originator: Robert Robertson

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Userid:

Problem statement: Severe corrosion in some structures and voids in the tendon grout.

Information source: State Structures Office.

Background data: Recent inspections of post-tensioned structures revealed we were having severe corrosion in some of the structures and most had voids in the tendon grout. In an effort to improve the corrosion protection and assure fully grouted tendons the new specifications were developed along with new design details.

Desired implementation date:

Bridge projects beginning with the July 2003 letting.



Florida Department of Transportation

JEB BUSH
GOVERNOR

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THOMAS F. BARRY, JR.
SECRETARY

MEMORANDUM

DATE: October 24, 2002
TO: Specification Review Distribution List
FROM: Duane F. Brautigam, P.E., State Specifications Engineer
SUBJECT: **Proposed Specifications Change – D9380000 - Post-Tensioning Grout**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change to Section 938.

This change was proposed by Robert Robertson of the State Structures Office to improve the corrosion protection and assure fully grouted tendons.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965DB or duane.brautigam@dot.state.fl.us. Comments received after November 21, 2002 may not be considered. Your input is encouraged.

DFB/jf

Attachment

COMMENTS:

Submitted by:

Phone #:

POST-TENSIONING GROUT.
(REV 7-30-01 10-4-02)(7-02)

PAGE 875. The following new Section is added after Section 937.

SECTION 938
POST-TENSIONING GROUT

938-1 General Requirements.

This Section covers grouts to be used to protect post-tensioning steel. Grout applications are differentiated into three applications: horizontal, vertical and repair.

Grouts shall be prepackaged in *plastic pails or* plastic lined or coated bags. Grout bags shall indicate *application*, date of manufacture, LOT number and mixing instructions. Any change of materials or material sources requires *new* retesting and certification of the conformance of the grout with this Specification. A copy of the Quality Control Data Sheet for each lot number and shipment sent to the job site shall be provided to the Contractor by the grout supplier and furnished to the Engineer. Materials with a total time from manufacture to usage in excess of six months shall be retested and recertified by the supplier *that the product meets the QC Control Specifications* before use or the material shall be removed and replaced.

938-2 Qualified Products List.

~~Use *Only*~~ *Post-tensioning grouts listed on the Department's Qualified Products List (QPL) shall be used.* ~~shall be a product listed on the QPL.~~ Manufacturers of post-tensioning grout seeking evaluation of their product shall submit an application in accordance with Section 6 and include certified test reports from an *independent laboratory*, audited ~~and independent~~ *by* Cement Concrete Research Reference Laboratory (CCRL) which shows the material meets all the requirements specified herein. ~~Provide a~~ *A written certification from the manufacturer that the product meets the requirements of this Section must be provided.* ~~Compliance with the requirements stated in 938-5 and 938-6 may be by written manufacturers certification.~~

938-3 Mixing.

The material shall be mixed in accordance with the manufacturer's recommendations *using high speed mixers (1,400 to 1,800 rpm).*

938-4 Grout Physical Properties.

938-4.1 Gas Generation.

The grout shall not contain aluminum powder or components, which produce hydrogen gas, carbon dioxide or oxygen *gas*.

938-4.2 Laboratory Test.

The grout shall meet or exceed the specified physical properties stated herein as determined by the following standard and modified ASTM test methods *conducted at normal laboratory temperature (65-78°F [18-25°C]) and conditions.*

Property	Test Value	Test Method
Total Chloride Ions	Max. 0.08% by weight of cementitious material	ASTM C 1152
Fine Aggregate (if utilized)	Max Size # <i>99% passing the</i> No. 50 Sieve (300 micron)	ASTM C33 <i>C 136*</i>

D9380000
Post-Tensioning Jobs and
Jobs with cylinder piles

Volume <i>Hardened Height Change @ 24 hours and 28 days</i>	0.0% to + 0.32%	ASTM C 1090**
Expansion	≤ 2.0% for up to 3 hours	ASTM C 940
<i>Wet Density - Laboratory</i>	<i>Report maximum and minimum obtained test value lb/ft³ (kg/l)</i>	<i>ASTM C 185</i>
<i>Wet Density - Field</i>	<i>Report maximum and minimum obtained test value lb/ft³ (kg/l)</i>	<i>ASTM C 138</i>
Compressive Strength 28 day (Average of 3 cubes)	≥ 7,000 psi [48.3 MPa]	ASTM C 942
Initial Set of Grout	Min. 3 hours Max. 12 hours	ASTM C 953
Fluidity Text <i>Test***</i> Efflux Time from Flow Cone		
(a) Immediately after mixing	Min. 20 Sec. Max. 30 Sec.	ASTM C 939
	or Min. 9 Sec. Max. 20 Sec.	ASTM C 939****
(b) 30 minutes after mixing with remixing for 30 sec	Max. 30 Sec.	ASTM C 939
	or Max. 30 Sec.	ASTM C 939****
Bleeding @ 3 hours	Max. 0.0 percent	ASTM C 940*****
Permeability @ 28 days	Max. 2500 coulombs at 30 V for 6 hours	ASTM C 1202

* Use ASTM C117 procedure modified to use a #50 sieve. Determine the percent passing the #50 sieve after washing the sieve.

**Modify ASTM C1090 to include verification at both 24 hours and 28 days.

***Adjustments to flow rates will be achieved by strict compliance with the manufacturer's recommendations.

****Grout fluidity shall meet either the standard ASTM C939 flow cone test or the modified test described herein. Modify the ASTM C939 test by filling the cone to the top instead of to the standard level. The efflux time is the time to fill a one liter container placed directly under the flow cone.

*****Modify ASTM C940 to conform with the wick induced bleed test as follows:

(a) Use a wick made of a 20 inch [0.5 m] length of ASTM A416 seven wire 0.5 inch [12.7 mm] diameter strand. Wrap the strand with 2 inch [50 mm] wide duct or electrical tape at each end prior to cutting to avoid splaying of the wires when it is cut. Degrease (with acetone or hexane solvent) and wire brush to remove any surface rust on the strand before temperature conditioning.

(b) Condition the dry ingredients, mixing water, prestressing strand and test apparatus overnight at 65 to 75°F [18 to 24°C].

(c) Mix the conditioned dry ingredients with the conditioned mixing water and place 800 ml of the resulting grout into the 1,000 ml graduate cylinder. Measure and record the level of the top of the grout.

(d) Completely insert the strand into the graduated cylinder. Center and fasten the strand so it remains essentially parallel to the vertical axis of the cylinder. Measure and record the level of the top of the grout.

(e) Store the mixed grout at the temperature range listed above in (b).

(f) Measure the level of the bleed water every 15 minutes for the first hour and hourly for two successive readings thereafter.

(g) Calculate the bleed water, if any, at the end of the three hour test period and the resulting expansion per the procedures outlined in ASTM C940, with the quantity of bleed water expressed as a percent of the initial grout volume. Note if the bleed water remains above or below the top of the original grout height. Note if any bleed water is absorbed into the specimen during the test.

938-5 Simulated Field High Temperature Fluidity Test.

Perform a conditioned laboratory high temperature grout fluidity test as described below using production grouting equipment utilizing both mixing and storage tanks. *Grouts must conform with the requirements of 938-4 including initial fluidity test.* For the test to be successful, the grout ~~meeting the requirements of 938-4,~~ must have an efflux time of not greater than 30 seconds at the end of the one hour test period. Efflux time may be determined by either ASTM C939 or the modified ASTM C939 described herein.

(a) Perform the test in a temperature conditioned laboratory. Condition the room, grout, water, duct, pump, mixer and all other equipment to be used to *a temperature of 90°F [32.5°C]* ~~temperature~~ for a minimum of 12 hours prior to the test.

(b) Use 400 feet [122 m] (~~± 10 feet [3.0 m]~~) *(± 10 feet [3.0 m])* of duct (tube) for the test. Use a duct with an inside diameter of 1 inch [25 mm] ~~plus or minus 1/4 inch [6 mm]~~.

(c) Mix the grout to the specified water content ~~at and~~. *Pump* ~~pump~~ the grout through the duct until the grout discharges from the outlet end of the duct and is returned to the pump.

(d) Start the one hour test period after the duct is completely filled with grout. Record the time to circulate the grout through the duct. Constantly pump and recirculate the grout into the commercial grout mixer storage tank.

(e) Pump and recirculate the grout for a minimum of one hour.

(f) *Record at* ~~At~~ 10-15 minute intervals throughout the test period, ~~record~~ the pumping pressure at the inlet, ~~and test the grout and record the~~ temperature, and fluidity at the discharge outlet.

938-6 Accelerated Corrosion Test Method (ACTM).

Perform the ACTM as outlined in Appendix B of the "Specification for Grouting of Post-Tensioning Structures" published by the Post-Tensioning Institute. Report the time to corrosion for both the grout being tested and the control sample using *a 0.45 water-cement ratio* neat grout.

A grout that shows a longer average time to corrosion in the ACTM than the control sample *and the time to corrosion exceeds* ~~exceed~~ *1,000 hours* is considered satisfactory.

938-7 Variation in Testing for Specific Applications.

938-7.1 Horizontal Applications: *Horizontal grout applications are defined as grouting of all superstructure tendons and transverse substructure tendons in caps, struts, etc. All requirements defined in 938-4, 938-5 and 938-6 are applicable for grouts used in horizontal applications.*

938-7.2 Vertical Applications: *Vertical grout applications are defined as grouting of substructure column tendons. All requirements defined in 938-4, 938-5 and 938-6 are applicable for grouts used in vertical applications. In addition, perform the Schupack Pressure Bleed Test Procedure for Cement Grouts for Post-Tensioned Structures as outlined in Appendix C of the "Specification for Grouting of Post-Tensioned Structures" published by the Post-Tensioning Institute. Report the percent bleed for the grout tested. Test grout at the specified pressure of 100 psi (689 kPa). An acceptable test will result in no bleed water (0.0 percent).*

938-7.3 Repair Applications: *Repair applications are used to augment grouting operations which did not completely fill the duct or anchorage. For new construction, repairs may be made with the same grout approved for use in the tendon as long as the volume of the void is less 0.5 gal. (2.0 l). In all other cases, use a non-sanded grout meeting the requirements of 938-4 and 938-6 with a modified*

D9380000
Post-Tensioning Jobs and
Jobs with cylinder piles

maximum permeability of 2,800 coulombs (ASTM C 1,202 at 30 volts). Non-sanded grouts shall have 100% passing on the #100 sieve and 95% passing the #170 sieve as determined by ASTM C33. Each sieve may be washed and dried before weighing in accordance with the procedure in ASTM C117 modified for sieve size.