

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 moisture proof containers. Grout bags shall indicate application, date of manufacture, LOT number and mixing instructions. Any change of materials or material sources requires new testing 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 tested and certified by the supplier that the product meets the quality control specifications before use or the material shall be removed and replaced.

938-2 Approved Product List.

Only post-tensioning grouts listed on the Department's Approved Product List (APL) shall be used. 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 by the Cement Concrete Reference Laboratory (CCRL) which shows the material meets all the requirements specified herein. A written certification from the manufacturer that the product meets the requirements of this Section must be provided. Grout products will be qualified by application (horizontal, vertical or repair).

938-3 Mixing.

The material shall be mixed in accordance with the manufacturer's recommendations.

938-4 Grout Physical Properties.

938-4.1 Gas Generation: The grout shall not contain aluminum or other components which produce hydrogen, 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 and FM test methods conducted at normal laboratory temperature (65°F-78°F) and conditions. Conduct all grout tests with grout mixed to produce the minimum time of efflux. Establish the water content to produce the minimum and maximum time of efflux.

Property	Test Value	Test Method
Total Chloride Ions	Max. 1.0 lbs/yd ³	FM 5-516
Fine Aggregate (if utilized)	99% passing the No. 50 Sieve (300 micron)	ASTM C136*
Hardened Height Change @ 24 hours and 28 days	0.0% to + 0.2%	ASTM C1090**
Expansion	≤ 2.0% for up to 3 hours	ASTM C940
Wet Density - Laboratory	Report maximum and minimum obtained test value lb/ft ³	ASTM C185

Property	Test Value	Test Method
Wet Density - Field	Report maximum and minimum obtained test value lb/ft ³	ASTM C138
Compressive Strength 28 day (Average of 3 cubes)	≥7,000psi	ASTM C942
Initial Set of Grout	Min. 3 hours Max. 12 hours	ASTM C953
Time of Efflux	***	***
(a) Immediately after mixing	Min. 20 Sec. Max. 30 Sec.	ASTM C939
	or Min. 9 Sec. Max. 20 Sec.	ASTM C939****
(b) 30 minutes after mixing with remixing for 30 sec	Max. 30 Sec.	ASTM C939
	or Max. 30 Sec.	ASTM C939****
Bleeding @ 3 hours	Max. 0.0 percent	ASTM C940*****
Permeability @ 28 days	Max. 2,500 coulombs at 30 V for 6 hours	ASTM C1202
*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. The time of efflux is the time to fill a one liter container placed directly under the flow cone. ****Modify the ASTM C939 test by filling the cone to the top instead of to the standard level. *****Modify ASTM C940 to conform with the wick induced bleed test as follows: (a) Use a wick made of a 20 inch length of ASTM A416 seven wire 0.5 inch diameter strand. Wrap the strand with 2 inch 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 F to 75°F. (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 3 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 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 exceed 1,000 hours is considered satisfactory.

938-6 Variation in Testing for Specific Applications.

938-6.1 Horizontal Applications: Horizontal grout applications are defined as grouting of all superstructure tendons and transverse substructure tendons in caps, struts, etc. All physical requirements defined in 938-4 and 938-5 are applicable for grouts used in horizontal applications.

938-6.2 Vertical Applications: Vertical grout applications are defined as grouting of substructure column tendons. All physical requirements defined in 938-4 and 938-5 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 Section 4 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. An acceptable test will result in no bleed water (0.0 percent).

938-6.3 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. In all other cases, use a non-sanded grout meeting the requirements of 938-4 and 938-5 with a modified maximum permeability of 2,800 coulombs (ASTM C1202 at 30 volts). Non-sanded grouts shall have 95% passing on the #100 sieve and 90% 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.