



FIVE STAR PRODUCTS, INC.

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DESIGN A SPEC™ GUIDELINES FIVE STAR® SPECIAL GROUT 400

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PART 1 - GENERAL CONDITIONS – CEMENTITIOUS GROUTING

1.1 SCOPE

Guide specification for the placement of precision non shrink cementitious grout for post-tensioned structures

1.2 QUALITY ASSURANCE

- A. The manufacturer shall have been in the business of manufacturing nonshrink cementitious grouts for over 15 years, maintain an ISO 9001 certified quality assurance program, offer technical services and provide a representative at the jobsite for product training, prior to product installation, upon request and with reasonable notice.
- B. The contractor shall submit to the engineer or owner, at least three job references where the contractor has successfully completed similar applications.

1.3 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered to the jobsite in their original, unopened packages, clearly labeled with the manufacturer's identification, printed instructions and batch code, identifying day and year of manufacture.
- B. Store and condition the specified product in accordance with the appropriate product data sheet.
- C. For cautionary statements and handling instructions, refer to the Safety Data Sheet prior to use.

1.4 PROJECT/SITE CONDITIONS

Refer to PART C - PREPARATION, ENVIRONMENTAL CONDITIONS, or contact the manufacturer directly for any physical or environmental limitations required by the product.

1.5 MEASUREMENT AND PAYMENT

- A. Measurement of the grouting work shall be on a cubic foot (liter) basis of material in place.
- B. Payment for the grouting work shall be at the unit price bid on a cubic foot (liter) basis. This payment shall constitute full compensation for all labor, materials, tools, equipment and other items as necessary to complete the work as described in the contract documents. Progress payments will be made on the percentage of the work satisfactorily completed during each payment period in accordance with the provisions of the contract documents.

PART B - MATERIAL SPECIFICATION - CEMENTITIOUS GROUTING

2.01 MATERIALS

- A. Nonshrink cementitious fluid grout for cables and tendons shall be a pre-proportioned, pre-packaged, thixotropic cement-based grout requiring only the addition of potable water. The manufacturer shall be ISO 9001 certified and have at least 10 years experience in the manufacture of precision cement-based grouts. The manufacturer shall offer technical services and provide a representative at the jobsite for product training prior to product installation upon five days advance notice.
- B. The grout material shall meet all the following typical performance criteria when cured at 70°F (21°C):
1. Grout shall not contain expansive cement or aluminum powder or components that produce hydrogen, carbon dioxide or oxygen gas.
 2. Early Height Change, ASTM C 827 Positive Expansion
 3. Hardened Height Change, ASTM C 1090 0.0 to 0.2%
 4. Compressive Strength, ASTM C 942

1 Day	3500 psi (24.1 MPa)
28 Days	8500 psi (58.6 MPa)
 5. Bleeding, ASTM C 940

4 Hours	0.0%
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 6. Schupack Pressure Bleed Test¹

Horizontal Applications – 50 psi for 5 min	0 mL max
Vertical Applications – 100 psi for 5 min	0 mL max

¹ PTI Specification for Grouting of Post-Tensioned Structures, Section C4.4.6.2
 7. Accelerated Corrosion Test² Better than Standard

² PTI Specification for Grouting of Post-Tensioned Structures, Appendix B
 8. Working Time at 90°F (32°C) 2 Hours

The data shown above reflect typical results based on laboratory testing under controlled conditions. Reasonable variations from the data shown above may result in the field. Test methods are modified where applicable.

- C. An acceptable product which meets these criteria is:

Five Star® Special Grout 400

As manufactured by Five Star Products, Inc., Shelton, CT 203-336-7900.

- D. Subject to meeting the performance criteria stated above, other products may be formally submitted to the engineer for approval up to three days prior to the bid date. All requests for approval shall contain certified test data verifying conformance with this specification. Three references of successfully completed projects of similar nature and scope of the work detailed in this specification shall be provided as well as a minimum ten-year history of use in the industry. The testing laboratory shall certify to any modifications made to the tests performed and provide details of modifications.

PART C – PREPARATION - CEMENTITIOUS GROUTING

3.01 DUCTS

- A. All ducts, inlet and outlet areas shall be clean and free of dirt, oil and other bond inhibiting contaminants. Purge areas with oil free compressed air to remove water, debris and contaminants
- B. Prior to placement, soak concrete surfaces thoroughly for a minimum of eight hours to an optimum 24 hours with potable water. Concrete surfaces shall be roughened, saturated and free of standing water at time of placement.

3.02 METAL SURFACES

- A. Where bond to metal substrates is required, degrease areas with suitable solvent.

3.03 EQUIPMENT AND MATERIALS

- A. All necessary tools, equipment and materials shall be as close as possible to the area being grouted, such as mortar mixers, measuring containers, trowels and grout.
- B. Appropriate clothing and safety equipment shall be worn to avoid breathing dust and prevent eye and skin contact with both dry and mixed grout.
- C. Wheelbarrows, buckets, shovels and pumps shall be clean, dampened and readily available for transporting mixed grout.

3.04 MIXING

High Speed Shear (Colloidal) Mixer

- A. Provide an adequate number of high speed shear (colloidal) mixers in good operating condition for uninterrupted placement. Do not exceed one-half the maximum capacity of the mixer.
- B. Pre-wet mixer, empty excess water.
- C. Start by adding approximately 6 quarts premeasured potable water to mixer per bag of grout. While mixing, slowly add grout and mix to a uniform consistency of 9 – 20 seconds through flow cone in accordance with ASTM C 939 modified to PTI requirements.
- D. Mix thoroughly for approximately 4 - 5 minutes. Do not exceed maximum water content as stated on product packaging or add an amount exceeding 6 ½ quarts water per bag. Continue to agitate material in holding hopper.
- E. Do not mix more material than can be placed within the working time of the grout. Do not re-temper the mix by adding additional water beyond maximum water content.

PART D – APPLICATION - CEMENTITIOUS GROUTING

4.01 EXPOSURE INTERVALS AND TEMPORARY CORROSION PROTECTION

- A. Proceed with grouting as soon as possible after the tendons are stressed in the ducts. To minimize adverse effects, do not exceed time intervals where specified between installing the tendons in the ducts in an unstressed condition and grouting after stressing.
- B. If the exposure period exceeds specified limits, provide temporary corrosion protection. Cut and cap the ends of the tendons within 4 hours in aggressive environments (or as soon as practical in less severe environments), after an extension of the interval has been approved. In aggressive environments (such as chloride exposure, salt air, acid vapors, or other harmful industrial products), cover the tendon ends for protection until the Engineer has approved cutting the tendon tails.
- C. Larger, transparent inlets and outlets with dual mechanical shut-off installed at high points in tendon profile and on ends of tendon. All inlets and outlets require two lever-action ball valves (gas cocks). Inlets and intermediate outlets need the additional secondary valves for injection nozzle disconnects, and all inlets and outlets use the secondary valves as pressure safeties when closing primary valves after grouting.

4.02 GROUTING PROCEDURES - HORIZONTAL

- A. A mock up should be performed and approved by the Engineer prior to commencement of actual grouting operations. Open all grout vents when grouting starts. Unless otherwise approved by the Engineer, inject grout into tendons in an uphill direction from the lowest inlet. To maintain optimal flowability, use grout within 45 - 60 minutes after mixing.
- B. Grout a tendon or a designated group of tendons in one operation, maintaining a continuous one-way flow of grout. Inject grout at a rate of approximately 16 ft of duct per min to 49 ft/min (5 m/min and 15 m/min).

The injection method should ensure that the grout completely fills the ducts and completely surrounds the strands or bar with grout. Pump grout through the duct until it flows continuously at the first outlet after the inlet. When no visible slugs of water or air are ejected, and the consistency of the grout is the same as the grout being injected, close that outlet. Close each

succeeding outlet in the same way, in sequential order in the direction of flow.

- C. A pressure gauge should be placed at the inlet and pressures should not exceed 150 psi, normal grouting operations may be done at approximately 75 – 125 psi.
- D. When one-way flow of grout cannot be maintained, or when grouting is interrupted, immediately flush the grout out of the duct with water. Keep a water pump available on site for this purpose. Limit the flushing pressure to the maximum specified above for grouting.

GROUTING PROCEDURES - VERTICAL

Follow the procedures for horizontal grouting with these additional steps:

At the upper end of each vertical tendon, provide a standpipe capable of preventing the grout level from falling below the highest point of the upper anchorage device. Collect and remove all bleed water from the grout. Do not allow bleed water to be absorbed into the grout.

If the grout level should drop below the highest point of the anchorage device, immediately add more grout to the standpipe.

Remove the standpipe when the grout has hardened.

PART E – FINISHING AND CURING (POST GROUTING)

5.01 POST-GROUTING OPERATIONS

- A. Do not remove or open valves, caps, and pipes at the inlet and outlet until the grout has set. Protect the filled ducts from shock and vibration for at least 24 hours after grouting.
- B. Not less than 24 hours after grouting, inspect the level of grout in the outlets and grout caps. Top off as necessary with freshly mixed grout.
- C. Where the outlet and inlet openings of internal tendons are directly exposed to an aggressive environment, remove the ends at least 25 mm (1 in) below the surface of the concrete and permanently seal and fill them flush with the concrete surface. Permanently seal the recess areas. . Remove all miscellaneous material (tie wire, duct tape, etc.) used for sealing grout cap connections prior to carrying out further work to protect end anchorages, including filling of any concrete anchorage blockouts.
- D. Repair any splits, holes or other damage to exposed ducts.
- E. Permanently seal all external tendons. Seal all outlet and inlet openings.
- F. Permanently protect anchorages to prevent entry of water or other aggressive agents.
- G. Thoroughly clean all equipment after grouting.