Batch, deliver, mix and apply shotcrete in accordance with Subarticles 1002-3(E) and 1002-3(F) and the contract. Make preconstruction test panels in the presence of the Engineer with forms in a vertical position and from the same shooting position anticipated for construction. Do not disturb test panels for the first 24 hours after shotcreting.

(E) Mixing and Delivery

Produce shotcrete of required strength, consistency, quality and uniformity with minimum rebound. Do not use rebound or previously expanded material in the shotcrete mix. Thoroughly mix materials in sufficient quantity to place shotcrete continuously. Regulate the delivery so the maximum interval between the shooting of batches at the work site does not exceed 20 minutes. Comply with Articles 1000-9 through 1000-12 to the extent applicable for shotcrete instead of concrete.

(F) Shooting Requirements

Use equipment capable of handling and shooting shotcrete at a steady uninterrupted flow. Use air supply systems that supply clean, dry air free of contamination and capable of maintaining sufficient nozzle velocity at all times. Apply shotcrete with the same equipment and methods as used for the preconstruction test panels.

The shotcrete temperature at the time of shooting shall be not less than 50°F nor more than 90°F. Do not apply shotcrete during heavy rains or runoff or high winds so the nozzle stream separates during shooting. Do not apply shotcrete if surface to receive shotcrete is frozen or the air temperature measured at the location of the shotcreting operation in the shade away from artificial heat is below 40°F. Apply shotcrete before the time between adding the mixing water to the shotcrete mix and shooting the shotcrete exceeds 60 minutes.

(G) Production Test Panels

Provide one production test panel for every 33 cy of shotcrete with at least one test panel for each day shotcreting occurs. Use 18" x 18" forms at least 3.5" thick for production test panels. Make production test panels with forms in a vertical position from the same shooting position and at the same time as shotcreting is done. Do not disturb test panels for the first 24 hours after shotcreting.

SECTION 1003
GROUT PRODUCTION AND DELIVERY

1003-1 DESCRIPTION

This section addresses grout to be used for traffic barriers, foundations, retaining walls, slopes and other applications in accordance with the contract. Produce non-metallic grout composed of Portland cement and water and at the Contractor's option, fine aggregate and pozzolans. Include chemical admixtures as required or needed. Ground granulated blast furnace slag, fly ash or silica fume may be substituted for a portion of the Portland cement. Provide nonshrink, freeze-thaw durable, sand cement or neat cement grout as required. Define "sand cement grout" as grout with fine aggregate and "neat cement grout" as grout without fine aggregate.

Mixes for all grout shall be designed by a Certified Concrete Mix Design Technician or an engineer licensed by the State of North Carolina.

1003-2 MATERIALS

Refer to Division 10.

Item	Section
Chemical Admixtures	1024-3
Fine Aggregate	1014-1

Item	Section
Fly Ash	1024-5
Ground Granulated Blast Furnace Slag	1024-6
Portland Cement	1024-1
Silica Fume	1024-7
Water	1024-4

Do not use grout that contains soluble chlorides or more than 1% soluble sulfate.

At the Contractor's option, use an approved packaged grout instead of the materials above except for water. A list of approved packaged grouts is available from the Materials and Tests Unit. Consult the manufacturer to determine if the packaged grout to be used is suitable for the application and meets the height change, durability and compressive strength requirements.

1003-3 GROUT FOR TRAFFIC BARRIERS, FOUNDATIONS, RETAINING WALLS, SLOPES AND OTHER APPLICATIONS

(A) Composition and Design

When using approved packaged grout, a grout mix design submittal is not required. Otherwise, submit proposed grout mix designs for each grout mix to be used in the work. Mix proportions shall be determined by a testing laboratory approved by the Department. Base grout mix designs on laboratory trial batches that meet this section.

Submit grout mix designs in terms of saturated surface dry weights on Materials and Tests Form 312U at least 35 days before proposed use. Adjust batch proportions to compensate for surface moisture contained in the aggregates at the time of batching. Changes in the saturated surface dry mix proportions will not be permitted unless revised grout mix designs have been submitted to the Engineer and approved.

Accompany Materials and Tests Form 312U with a listing of laboratory test results of density, flow or viscosity and compressive strength and if applicable, aggregate gradation, height change and durability. List the compressive strength of at least three 2" cubes at the age of 3 and 28 days.

The Engineer will review the grout mix design for compliance with the contract and notify the Contractor as to its acceptability. Do not use a grout mix until written notice has been received. Acceptance of the grout mix design or use of approved packaged grouts does not relieve the Contractor of his responsibility to furnish a product that meets the contract. Upon written request from the Contractor, a grout mix design accepted and used satisfactorily on any Department project may be accepted for use on other projects.

Perform laboratory tests in accordance with the following test procedures:

Property	Test Method
Aggregate Gradation for Sand Cement Grout	AASHTO T 27
Density	AASHTO T 133
Flow for Sand Cement Grout	ASTM C939[A]
Viscosity for Neat Cement Grout	ANSI/API RP[B] 13B-1 Section 6.2, Marsh Funnel
Height Change for Nonshrink Grout	ASTM C1090[C]
Durability for Freeze-Thaw Durable Grout	ASTM C666[D]
Compressive Strength	AASHTO T 106

A. Modify flow cone outlet diameter from 1/2" to 3/4"
B. American National Standards Institute/American Petroleum Institute Recommended Practice
C. Moist room storage required
D. Procedure A (Rapid Freezing and Thawing in Water) required

(B) Chemical Admixtures

Use a quantity of chemical admixture within the range shown on the current list of approved admixtures issued by the Materials and Tests Unit.

(C) Strength of Grout

Provide grout with a compressive strength at 3 and 28 days of at least 2,500 psi and 4,500 psi, respectively, unless required otherwise in the *Standard Specifications*. The compressive strength of the grout will be considered the average compressive strength test results of three 2" cubes at each age. Make cubes that meet AASHTO T 106 from the grout delivered for the work or mixed on-site. Make cubes at such frequencies as the Engineer may determine and cure them in accordance with AASHTO T 106.

(D) Height Change

Provide nonshrink grout with a height change at 28 days between 0% and 0.3%.

(E) Durability

Provide freeze-thaw durable grout with a durability factor of at least 80.

(F) Temperature Requirements

The grout temperature at the time of placement shall be not less than 50°F nor more than 90°F. Do not place grout when the air temperature measured at the location of the grouting operation in the shade away from artificial heat is below 40°F.

(G) Elapsed Time for Placing Grout

Agitate grout continuously before placement. Regulate the delivery so the maximum interval between the placing of batches at the work site does not exceed 20 minutes. Place grout before exceeding the times in Table 1003-1. Measure the elapsed time as the time between adding the mixing water to the grout mix and placing the grout.

TABLE 1003-1
ELAPSED TIME FOR PLACING GROUT
(with continuous agitation)

Air or Grout Temperature, Whichever is Higher	Maximum Elapsed Time	
	No Retarding Admixture Used	Retarding Admixture Used
90°F or above	30 minutes	1 hr. 15 minutes
80°F through 89°F	45 minutes	1 hr. 30 minutes
79°F or below	60 minutes	1 hr. 45 minutes

(H) Mixing and Delivery

Use grout free of any lumps and undispersed cement. Comply with Articles 1000-9 through 1000-12 to the extent applicable for grout instead of concrete.

SECTION 1005
GENERAL REQUIREMENTS FOR AGGREGATE

1005-1 GENERAL

Obtain aggregates from sources participating in the Department's Aggregate QC/QA Program as described in Section 1006. Obtain aggregates from pre-approved sources, or have the source approved before use. Approval of such sources is based not only on the quality of the aggregate, but also on satisfactory production facilities and procedures. A list of approved aggregate sources participating in the Department's Aggregate QC/QA Program in