

1 the same shooting position and at the same time as shotcreting is done. Do not disturb
2 test panels for the first 24 hours after shotcreting.

3 (H) Handling and Storing Test Panels

4 Notify the Area Materials Engineer when preconstruction or production test panels are
5 made within 24 hours of shooting the panels. Field cure and protect test panels from
6 damage in accordance with ASTM C1140. The Contractor shall core the panels in the
7 presence of the Engineer. The Department transports core to a Materials and Tests
8 Regional Laboratory for testing.

9 SECTION 1003

10 GROUT PRODUCTION AND DELIVERY

11 1003-1 DESCRIPTION

12 This section addresses cement grout to be used for structures, foundations, retaining walls,
13 concrete barriers, embankments, pavements and other applications in accordance with the
14 contract. Produce non-metallic grout composed of Portland cement and water and at the
15 Contractor's option or as required, aggregate and supplementary cementitious materials.
16 Include chemical admixtures as required or needed. Provide sand cement or neat cement
17 grout as required. Define "neat cement grout" as grout without aggregate.

18 The types of grout with their typical uses are as shown below:

19 **Type 1** – A cement grout with only a 3 day strength requirement and a fluid consistency that
20 is typically used for filling subsurface voids.

21 **Type 2** – A nonshrink grout with strength, height change and flow conforming to ASTM
22 C1107 that is typically used for foundations, ground anchors and soil nails.

23 **Type 3** – A nonshrink grout with high early strength and freeze-thaw durability requirements
24 that is typically used in pile blockouts, grout pockets, shear keys, dowel holes and recesses for
25 concrete barriers and structures.

26 **Type 4** – A neat cement grout with low strength, a fluid consistency and high fly ash content
27 that is typically used for slab jacking.

28 **Type 5** – A low slump, low mobility cement grout with minimal strength that is typically
29 used for compaction grouting.

30 1003-2 MATERIALS

31 Refer to Division 10.

Item	Section
Chemical Admixtures	1024-3
Fine Aggregate	1014-1
Fly Ash	1024-5
Ground Granulated Blast Furnace Slag	1024-6
Portland Cement	1024-1
Silica Fume	1024-7
Water	1024-4

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

33 At the Contractor's option, use an approved packaged grout instead of the materials above
34 except for water. Use packaged grouts that are on the NCDOT APL.

35 Use admixtures for grout that are on the NCDOT APL or other admixtures in accordance with
36 Subarticle 1024-3(E) except do not use concrete additives or unclassified or other admixtures
37 in Type 4 or 5 grout. Use Class F fly ash for Type 4 grout and Type II Portland cement for
38 Type 5 grout.

Section 1003

1 Use well graded rounded aggregate with a gradation, liquid limit (LL) and plasticity index
2 (PI) that meet Table 1003-1 for Type 5 grout. Fly ash may be substituted for a portion of the
3 fines in the aggregate. Do not use any other supplementary cementitious materials in Type 5
4 grout.

TABLE 1003-1			
AGGREGATE REQUIREMENTS FOR TYPE 5 GROUT			
Gradation		Maximum Liquid Limit	Maximum Plasticity Index
Sieve Designation per AASHTO M 92	Percentage Passing (% by weight)		
3/8"	100	N/A	N/A
No. 4	70 – 95		
No. 8	50 – 90		
No. 16	30 – 80		
No. 30	25 – 70		
No. 50	20 – 50		
No. 100	15 – 40		
No. 200	10 – 30	25	10

5 **1003-3 COMPOSITION AND DESIGN**

6 When using approved packaged grout, a grout mix design submittal is not required.
7 Otherwise, submit proposed grout mix designs for each grout mix to be used in the work.
8 Mixes for all grout shall be designed by a Certified Concrete Mix Design Technician or an
9 Engineer licensed by the State of North Carolina. Mix proportions shall be determined by a
10 testing laboratory approved by the Department. Base grout mix designs on laboratory trial
11 batches that meet Table 1003-2 and this section. With permission, the Contractor may use a
12 quantity of chemical admixture within the range shown on the current list of approved
13 admixtures maintained by the Materials and Tests Unit.

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

19 Accompany Materials and Tests Form 312U with a listing of laboratory test results of
20 compressive strength, density and flow or slump and if applicable, aggregate gradation, height
21 change and durability from a certified laboratory. List the compressive strength of at least
22 three 2 inch cubes at the age of 3 and 14 or 28 days per Table 1003-2 for Type 1 through 4
23 grouts. List the compressive strength of at least three 6 inch x 12 inch cylinders at the age of
24 3 and 28 days for Type 5 grout.

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

1 Perform laboratory tests in accordance with the following test procedures:

Property	Test Method
Aggregate Gradation ^A	AASHTO T 27
Compressive Strength	AASHTO T 106
Density (Unit Weight)	AASHTO T 121 AASHTO T 133 ^B , ANSI/API RP ^C 13B-1 ^B (Section 4, Mud Balance)
Durability	AASHTO T 161 ^D
Flow	ASTM C939 (Flow Cone)
Height Change	ASTM C1090 ^E
Slump	AASHTO T 119 (Except do not rod grout)

- 2 **A.** Applicable to grout with aggregate.
3 **B.** Applicable to Neat Cement Grout.
4 **C.** American National Standards Institute/American Petroleum Institute Recommended
5 Practice.
6 **D.** Procedure A (Rapid Freezing and Thawing in Water) required
7 **E.** Moist room storage required.

8 **1003-4 GROUT REQUIREMENTS**

9 Provide grout types in accordance with the contract. Use grouts with properties that meet
10 Table 1003-2. For Type 1 through 4 grouts, the compressive strength of the grout will be
11 considered the average compressive strength test results of three 2 inch cubes at the oldest age
12 per Table 1003-2. Make cubes that meet AASHTO T 106 from the grout delivered for the
13 work or mixed on-site. Make cubes at such frequencies as the Engineer may determine and
14 cure them in accordance with AASHTO T 106. For Type 5 grout, the compressive strength of
15 the grout will be considered the average compressive strength test results of three 6 inch x
16 12 inch cylinders at the age of 28 days. Make cylinders in accordance with AASHTO T 23
17 except do not rod grout. Make cylinders at such frequencies as the Engineer may determine
18 and cure them in accordance with AASHTO T 23.

Type of Grout	Minimum Compressive Strength at			Height Change at 28 days	Flow ^A /Slump ^B	Minimum Durability Factor
	3 days	14 days ^C	28 days			
1	3,000 psi	-	-	-	10 – 30 sec	-
2	Table 1 ^D				Fluid Consistency ^D	-
3	5,000 psi ^E	5,000 psi	-	0 – 0.2%	Per Accepted Grout Mix Design/ Approved Packaged Grout ^F	80
4 ^G	600 psi	-	1,500 psi	-	10 – 26 sec	-
5	100 psi	-	250 psi	-	< 2"	-

Section 1005

- 1 **A.** Applicable to Type 1 through 4 grouts.
- 2 **B.** Applicable to Type 5 grout.
- 3 **C.** Not applicable to Type 2 grout
- 4 **D.** ASTM C1107.
- 5 **E.** Minimum compressive strength at 3 days is only required to approve Type 3 grout mix
- 6 designs or evaluate Type 3 packaged grouts for the NCDOT APL.
- 7 **F.** Add mixing water to Type 3 packaged grout at the manufacturer’s recommended rate to
- 8 produce grout with the designed consistency and required 3 day strength.
- 9 **G.** Use Type 4 grout with proportions by volume of 1 part cement and 3 parts fly ash.

10 **1003-5 TEMPERATURE REQUIREMENTS**

11 When using an approved packaged grout, follow the manufacturer’s instructions for grout and
12 air temperature at the time of placement. Otherwise, the grout temperature at the time of
13 placement shall be not less than 50°F nor more than 90°F. Do not place grout when the air
14 temperature measured at the location of the grouting operation in the shade away from
15 artificial heat is below 40°F.

16 **1003-6 ELAPSED TIME FOR PLACING GROUT**

17 Agitate grout continuously before placement. Regulate the delivery so the maximum interval
18 between the placing of batches at the work site does not exceed 20 minutes. Place grout
19 before exceeding the times in Table 1003-3. Measure the elapsed time as the time between
20 adding the mixing water to the grout mix and placing the grout.
21

TABLE 1003-3 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

22 **1003-7 MIXING AND DELIVERY**

23 Use grout free of any lumps and undispersed cement. When using an approved packaged
24 grout, mix grout in accordance with the manufacturer’s instructions. Otherwise, comply with
25 Articles 1000-8 through 1000-12 to the extent applicable for grout instead of concrete.

26 **SECTION 1005**
27 **GENERAL REQUIREMENTS FOR AGGREGATE**

28 **1005-1 GENERAL**

29 Obtain aggregates from sources participating in the Department’s Aggregate QC/QA Program
30 as described in Section 1006. Obtain aggregates from pre-approved sources, or have the
31 source approved before use. Approval of such sources is based not only on the quality of the
32 aggregate, but also on satisfactory production facilities and procedures. A list of approved
33 aggregate sources participating in the Department’s Aggregate QC/QA Program in North
34 Carolina and adjoining states is available from the Materials and Tests Unit. This list includes
35 aggregates meeting Specification requirements but whose use is restricted due to history of
36 unsatisfactory service performance. Use of aggregates is allowed in the work provided they
37 have been properly stockpiled in units of not less than 300 tons, tests of representative
38 samples of these aggregates indicate satisfactory compliance with the Specifications and the
39 source meets all the requirements of the Aggregate QC/QA Program.