

(F) Uniformity

When concrete is produced, have present during all batching operations a Certified Concrete Batch Technician. During batching and placement, the sole duty of this employee is to supervise the production and control of the concrete, perform moisture tests, adjust mix proportions of aggregates for free moisture, complete and sign approved delivery tickets and assure quality control of the batching.

Two samples of sufficient size to make the required tests will be taken after discharge of approximately 15% and 85% of the load. Each of the two samples of concrete will be separately tested for the properties listed in Table 1000-6. Tests will be conducted in accordance with the test procedures specified in Table 1000-6 or procedures established by the Materials and Tests Unit. The Engineer may recheck mixer performance at any time when, in his opinion, satisfactory mixing is not being accomplished.

SECTION 1002**SHOTCRETE PRODUCTION AND DELIVERY****1002-1 DESCRIPTION**

This section addresses shotcrete to be used for temporary support of excavations and other applications in accordance with the contract. Produce shotcrete by either the dry-mix or wet-mix process composed of Portland cement, fine and/or coarse aggregates, water and at the Contractor's option, supplementary cementitious materials. Include chemical admixtures as required or needed for shotcrete produced by the wet-mix process. Ground granulated blast furnace slag, fly ash or silica fume may be substituted for a portion of the Portland cement. Type IL, IS, IP or IT blended cement may be used instead of Portland cement.

Mixes for all shotcrete shall be designed by a Certified Concrete Mix Design Technician or an engineer licensed by the State of North Carolina. Shotcrete shall be applied by a nozzelman certified as an ACI Shotcrete Nozzelman in accordance with *ACI Certification Publication CP-60*. Nozzlemen shall be certified in either dry-mix or wet-mix shotcrete based on the process to be used for the work.

1002-2 MATERIALS

Refer to Division 10.

Item	Section
Chemical Admixtures	1024-3
Coarse Aggregate	1014-2
Fine Aggregate	1014-1
Fly Ash	1024-5
Ground Granulated Blast Furnace Slag	1024-6
Portland Cement	1024-1
Silica Fume	1024-7
Type IL Blended Cement	1024-1
Type IP Blended Cement	1024-1
Type IS Blended Cement	1024-1
Type IT Blended Cement	1024-1
Water	1024-4

1002-3 SHOTCRETE FOR TEMPORARY SUPPORT OF EXCAVATIONS**(A) Composition and Design**

Submit proposed shotcrete mix designs for each shotcrete mix to be used in the work. Mix proportions shall be determined by a testing laboratory approved by the Department. Submit shotcrete 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.

Section 1002

1 Changes in the saturated surface dry mix proportions will not be permitted unless revised
2 shotcrete mix designs have been submitted to the Engineer and approved.

3 The Engineer will review the shotcrete mix design for compliance with the contract and
4 notify the Contractor as to its acceptability contingent upon compressive strength test
5 results for cores from preconstruction test panels. Do not use a shotcrete mix until
6 written notice has been received. Acceptance of the shotcrete mix design does not relieve
7 the Contractor of his responsibility to furnish a product that meets this contract. Upon
8 written request from the Contractor, a shotcrete mix design accepted and used
9 satisfactorily on any Department project may be accepted for use on other projects.

10 (B) Chemical Admixtures

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

13 (C) Strength of Shotcrete

14 Provide shotcrete with a compressive strength at 3 and 28 days of at least 2,000 psi and
15 4,000 psi, respectively. The compressive strength of the shotcrete will be considered the
16 average compressive strength test results of 3 cores from the same test panel at each age.

17 (D) Preconstruction Test Panels

18 Before beginning construction, provide one preconstruction test panel for each shotcrete
19 mix design and nozzlemen using the same equipment that will be used for the work. Use
20 3 feet x 3 feet forms at least 3.5 inches thick for preconstruction test panels.

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

26 (E) Mixing and Delivery

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

33 (F) Shooting Requirements

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

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

45 (G) Production Test Panels

46 Provide one production test panel for every 33 cy of shotcrete with at least one test panel
47 for each day shotcreting occurs. Use 18 inch x 18 inch forms at least 3.5 inches thick for
48 production test panels. Make production test panels with forms in a vertical position from

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.