

1 The volumetric mixer shall be capable of measurement of cement, pozzolan (if required),
2 liquids and aggregate being introduced into the mix.

3 **(D) Calibration**

4 Volume-weight relationships will be based on calibration. The proportioning devices
5 shall be calibrated by the contractor before the start of each NCDOT job and
6 subsequently at intervals recommended by the equipment manufacturer. Calibrations
7 will be performed in the presence of the Department and subject to approval from the
8 Department. Calibration of the cement and aggregate proportioning devices shall be
9 accomplished by weighing (determining the mass of) each component. Calibration of the
10 admixture and water proportioning devices shall be accomplished by weight (mass) or
11 volume. Tolerances in proportioning the individual components will be as follows:

TABLE 1000-7 VOLUMETRIC MIXED CONCRETE CALIBRATION TOLERANCES	
Item	Tolerance
Cement, Weight (Mass) percent	0 to +4
Fine Aggregate, Weight (Mass) percent	± 2
Coarse Aggregate, Weight (Mass) percent	± 2
Admixtures, Weight (Mass) or Volume percent	± 3
Water, Weight (Mass) or Volume percent	± 1

12 Each volumetric mixer must be accompanied at all times by completed calibration
13 worksheets and they shall be made available to the Department upon request.

14 **(E) Verification of Yield**

15 Verification of the proportioning devices may be required at any time by the Department.
16 Verification shall be accomplished by proportioning the rock and sand based on the
17 cement meter count for each concrete mobile mixer. Once the count (revolutions) for
18 94 lb of cement has been determined then delivery of the correct amount of rock and sand
19 can be verified.

20 **(F) Uniformity**

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

26 Two samples of sufficient size to make the required tests will be taken after discharge of
27 approximately 15% and 85% of the load. Each of the 2 samples of concrete will be
28 separately tested for the properties listed in Table 1000-7. Tests will be conducted in
29 accordance with the test procedures specified in Table 1000-7 or procedures established
30 by the Materials and Tests Unit. The Engineer may recheck mixer performance at any
31 time when, in his opinion, satisfactory mixing is not being accomplished.

32 **SECTION 1002**
33 **SHOTCRETE PRODUCTION AND DELIVERY**

34 **1002-1 DESCRIPTION**

35 This section addresses shotcrete to be used for temporary support of excavations and other
36 applications in accordance with the contract. Produce shotcrete by either the dry-mix or
37 wet-mix process composed of Portland cement, fine and/or coarse aggregates, water and at the
38 Contractor's option, pozzolans. Include chemical admixtures as required or needed for
39 shotcrete produced by the wet-mix process. Ground granulated blast furnace slag, fly ash or

Section 1002

1 silica fume may be substituted for a portion of the Portland cement. Type IS, IP or IT blended
2 cement may be used instead of Portland cement.

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

8 **1002-2 MATERIALS**

9 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 IP Blended Cement	1024-1
Type IS Blended Cement	1024-1
Type IT Blended Cement	1024-1
Water	1024-4

10 **1002-3 SHOTCRETE FOR TEMPORARY SUPPORT OF EXCAVATIONS**

11 **(A) Composition and Design**

12 Submit proposed shotcrete mix designs for each shotcrete mix to be used in the work.
13 Mix proportions shall be determined by a testing laboratory approved by the Department.
14 Submit shotcrete mix designs in terms of saturated surface dry weights on Materials and
15 Tests Form 312U at least 35 days before proposed use. Adjust batch proportions to
16 compensate for surface moisture contained in the aggregates at the time of batching.
17 Changes in the saturated surface dry mix proportions will not be permitted unless revised
18 shotcrete mix designs have been submitted to the Engineer and approved.

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

26 **(B) Chemical Admixtures**

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

29 **(C) Strength of Shotcrete**

30 Provide shotcrete with a compressive strength at 3 and 28 days of at least 2,000 psi and
31 4,000 psi, respectively. The compressive strength of the shotcrete will be considered the
32 average compressive strength test results of 3 cores from the same test panel at each age.

33 **(D) Preconstruction Test Panels**

34 Before beginning construction, provide one preconstruction test panel for each shotcrete
35 mix design and nozzlemen using the same equipment that will be used for the work. Use
36 3 ft x 3 ft forms at least 3.5" thick for preconstruction test panels.

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

6 **(E) Mixing and Delivery**

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

13 **(F) Shooting Requirements**

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

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

25 **(G) Production Test Panels**

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

31 **SECTION 1003**

32 **GROUT PRODUCTION AND DELIVERY**

33 **1003-1 DESCRIPTION**

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

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

43 **1003-2 MATERIALS**

44 Refer to Division 10.

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