**GROUT PRODUCTION AND DELIVERY:**

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| (3-17-15) | 1003 | SP10 R20 |

Revise the *2012* *Standard Specifications* as follows:

Replace Section 1003 with the following:

**SECTION 1003**

**GROUT PRODUCTION AND DELIVERY**

**1003-1 DESCRIPTION**

This section addresses cement grout to be used for structures, foundations, retaining walls, concrete barriers, embankments, pavements and other applications in accordance with the contract. Produce non-metallic grout composed of Portland cement and water and at the Contractor’s option or as required, aggregate and pozzolans. Include chemical admixtures as required or needed. Provide sand cement or neat cement grout as required. Define “sand cement grout” as grout with only fine aggregate and “neat cement grout” as grout without aggregate.

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

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

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

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

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

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

**1003-2 MATERIALS**

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 |

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. Use packaged grouts that are on the NCDOT Approved Products List.

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

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

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| **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 |

**1003-3 COMPOSITION AND DESIGN**

When using an 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. Mixes for all grout shall be designed by a Certified Concrete Mix Design Technician or an Engineer licensed by the State of North Carolina. Mix proportions shall be determined by a testing laboratory approved by the Department. Base grout mix designs on laboratory trial batches that meet Table 1003-2 and this section. With permission, the Contractor may use a quantity of chemical admixture within the range shown on the current list of approved admixtures maintained by the Materials and Tests Unit.

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 compressive strength, density and flow or slump and if applicable, aggregate gradation, durability and height change. 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**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 |

1. Applicable to grout with aggregate.
2. Applicable to Neat Cement Grout.
3. American National Standards Institute/American Petroleum Institute Recommended Practice.
4. Procedure A (Rapid Freezing and Thawing in Water) required.
5. Moist room storage required.

**1003-4 GROUT REQUIREMENTS**

Provide grout types in accordance with the contract. Use grouts with properties that meet Table 1003-2. 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.

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| **TABLE 1003-2**  **GROUT REQUIREMENTS** | | | | | |
| **Type of Grout** | **Minimum Compressive Strength at** | | **Height Change**  **at 28 days** | **FlowA/SlumpB** | **Minimum Durability Factor** |
| **3 days** | **28 days** |
| 1 | 3,000 psi | – | – | 10 – 30 sec | – |
| 2 | Table 1**C** | | | Fluid Consistency**C** | – |
| 3 | 5,000 psi | – | 0 – 0.2% | Per Accepted  Grout Mix Design/  Approved  Packaged Grout | 80 |
| 4**D** | 600 psi | 1,500 psi | – | 10 – 26 sec | – |
| 5 | – | 500 psi | – | 1 – 3" | – |

1. Applicable to Type 1 through 4 grouts.
2. Applicable to Type 5 grout.
3. ASTM C1107.
4. Use Type 4 grout with proportions by volume of 1 part cement and 3 parts fly ash.

**1003-5 TEMPERATURE REQUIREMENTS**

When using an approved packaged grout, follow the manufacturer’s instructions for grout and air temperature at the time of placement. Otherwise, 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.

**1003-6 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 1003-3. Measure the elapsed time as the time between adding the mixing water to the grout mix and placing the grout.

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| **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 |

**1003-7 MIXING AND DELIVERY**

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