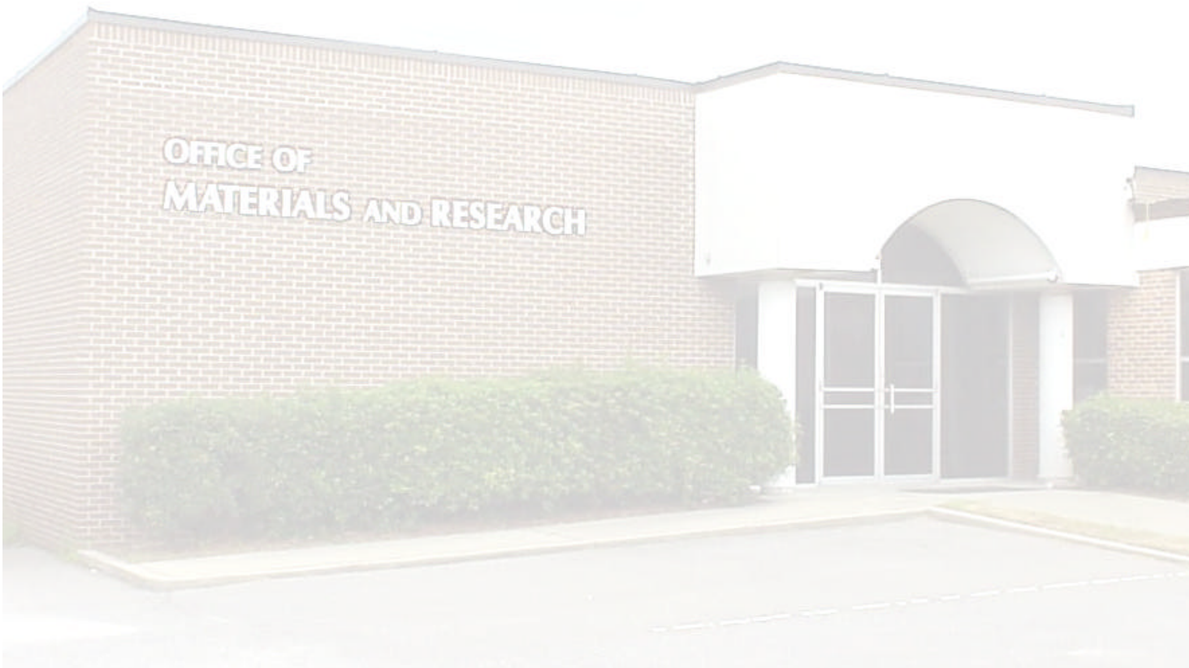
Laboratory Procedures Manual



South Carolina Department of Transportation
Office of Materials and Research

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Laboratory Procedures Manual

Table of Contents

Soils

Included in this section of the *Laboratory Procedures Manual* are all soils and soils-related testing procedures. Most of these procedures are laboratory tests commonly used to characterize soils and determine their strength properties.

Classification of Soil and Soil-Aggregate Mixtures for Highway Construction Purposes

AASHTO M 145

This procedure is conducted in accordance with AASHTO M 145 without exception.

Results are reported on Lab Form SO119, SO120, SO123, SO124, SO125, SO126, or SO127.

Materials Finer than 75-mm (No. 200) Sieve in Mineral Aggregates by Washing

AASHTO T 11

This test is conducted in accordance with AASHTO T 11 without exception.

Results are reported on Lab Form SO114, SO115, or SO128.

Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test

AASHTO T 87

This test is conducted in accordance with AASHTO T 87 without exception.

Test results are not reported.

Particle Size Analysis of Soils

AASHTO T 88

This test is conducted in accordance with AASHTO T 88 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Determining the Liquid Limit of Soils

AASHTO T 89

This test is conducted in accordance with AASHTO T 89 without exception.

Results are reported on Lab Forms SO114, SO117, SO119, SO120, SO121, SO123, SO124, SO125, SO126, SO127, SO128, or AGG211.

Determining the Plastic Limit and Plasticity Index of Soils

AASHTO T 90

This test is conducted in accordance with AASHTO T 90 without exception.

Results are reported on Lab Form SO114, SO117, SO119, SO120, SO121, SO123, SO124, SO125, SO126, SO127, SO128, or AGG211.

**The Moisture-Density Relations of Soils Using a
2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop**

AASHTO T 99

This test is conducted in accordance with AASHTO T 99 without exception.

Test results are reported on Lab Form SO114, SO120, SO122, SO123, or SO124.

Specific Gravity of Soils

AASHTO T 100

This test is conducted in accordance with AASHTO T 100 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Moisture-Density Relations of Soil-Cement Mixtures

AASHTO T 134

This test is conducted in accordance with AASHTO T 134 without exception.

Test results are reported on Lab Form SO127 or SO130.

The Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AASHTO T 180

This test is conducted in accordance with AASHTO T 180 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

The California Bearing Ratio

AASHTO T 193

This test is conducted in accordance with AASHTO T 193 without exception.

Test results for soil are cited in a Soil Support Value report. Test results for coquina are reported on Lab Form SO128.

Direct Shear Test of Soils Under Consolidated Drained Conditions

AASHTO T 236

This test is conducted in accordance with AASHTO T 236 without exception.

Test results are reported on Lab Form SO114.

Laboratory Determination of Moisture Content of Soils

AASHTO T 265

This test is conducted in accordance with AASHTO T 265 without exception.

Results are used in other test procedures.

Determination of Organic Content in Soils by Loss on Ignition

AASHTO T 267

This test is conducted in accordance with AASHTO T 267 without exception.

Test results are reported on Lab Form SO114, SO124, or SO126.

Determining Minimum Laboratory Soil Resistivity

AASHTO T 288

This test is conducted in accordance with AASHTO T 288 without exception.

Test results are reported on Lab Form SO114.

Determining pH of Soil for Use in Corrosion Testing

AASHTO T 289

This test is conducted in accordance with AASHTO T 289 without exception.

Test results are reported on Lab Form SO114, SO115, or SO116.

Determining Water-Soluble Sulfate Ion Content in Soil

AASHTO T 290

This test is conducted in accordance with AASHTO T 290 without exception.

Test results are reported on Lab Form SO114.

Determining Water-Soluble Chloride Ion Content in Soil

AASHTO T 291

This test is conducted in accordance with AASHTO T 291 without exception.

Test results are reported on Lab Form SO114.

Classification of Soils for Engineering Purposes

ASTM D 2487

This procedure is conducted in accordance with ASTM D 2487 without exception.

Results are not reported. This test is completed for the AASHTO Accreditation Program only.

Methods of Reducing Size of Aggregate Sample

SC T 3

1. Scope

In most instances, aggregate samples, when taken, are too large in size and must be reduced before testing. Aggregate samples that are too large for testing are to be reduced by one of the methods in this procedure.

2. Referenced Documents

None

3. Apparatus

3.1 For quartering method:
- 3.1.1 Clean, smooth surface free from cracks
- 3.1.2 Shovel, trowel or other acceptable device for mixing aggregate and dividing the material

3.2 For riffle splitter method:
- 3.2.1 Riffle splitter
- 3.2.2 Pans to distribute material over splitter and collect material coming through splitter

4. Test Specimens

The size of the test specimen required after reduction will be given in the procedure for that particular test.

5. Procedure

5.1 Quartering Method
- 5.1.1 Place sample on a hard, clean, smooth surface that is free from cracks. Mix thoroughly and pile in a cone. Materials that tend to segregate should be dampened.
- 5.1.2 Flatten cone with a shovel or trowel, spreading the material into a circular layer of uniform thickness. Divide into quarters by two (2) lines intersecting at right angles at the center of the pile.
- 5.1.3 Discard the two (2) diagonally opposite quarters. Sweep clean the space occupied by the discarded quarters.
- 5.1.4 The remaining quarters should be thoroughly mixed and further reduced by quartering, if desired. "Quartering" may be performed any number of times to obtain the required sample size.

5.2 Riffle Splitter Method

5.2.1 The openings in the splitter device must be wide enough to let the largest particle easily pass through yet not so wide that a non-representative separation is obtained. (In general, the opening size should be approximately 50 percent greater than the largest particle size.)

5.2.2 Thoroughly mix the aggregate sample. Spread the material evenly across a rectangular pan having the proper width to allow equal portions of the material to be fed to each individual chute.

5.2.3 Dump the aggregate into the splitter device so that the sample is uniformly and simultaneously fed over the entire length of the splitter. Discard the material caught on one side of the splitter. This method of reducing a sample size may be repeated as many times as are necessary to obtain the appropriate sample size.

6. Calculations

None

7. Report

None

Determination of Combined Silt and Clay
(Total Passing the 75-mm Sieve)

SC T 5

1. Scope

This method addresses the procedure for determining the combined silt and clay (total material passing the 75-µm sieve) in a local sand passing the 4.75-mm sieve.

2. Referenced Documents

None

3. Apparatus

3.1 4.75-mm sieve
3.2 75-µm sieve
3.3 Pan (approximately 280 mm in diameter and 75 mm in depth)
3.4 Balance or electronic scales
3.5 Wetting agent

4. Test Specimens

The sample shall consist of approximately 1000 grams of material. Larger samples shall be reduced to this size by the procedures in SC T 3.

5. Procedure

5.1 The material should be screened through a 4.75-mm sieve and the material retained on this sieve shall be discarded.
5.2 Approximately 300 grams of the material passing the 4.75-mm sieve shall be weighed and placed in a pan approximately 280 mm in diameter and 75 mm deep. The sample shall be covered with water containing a sufficient amount of wetting agent to ensure a thorough separation of the material finer than the 75-µm sieve from the coarser particles, and allowed to stand for approximately 15 minutes.
5.3 The contents of the pan should be stirred vigorously with a trowel or spoon and allowed to settle for about a minute. The wash water shall then be poured down a 75-µm sieve. Care should be taken to avoid spilling any of the contents. The operations shall be repeated until the wash water is clear. Do not leave the material on the spoon used for stirring. Any material that is retained on the 75-µm sieve shall then be washed back into the pan and the material in the pan dried

to a constant weight. This material shall then be weighed.

6. Calculations

6.1 To determine the percentage of material passing the 75-µm sieve, divide the weight of the sample lost during washing by the original dry weight of the sample as follows:

Original dry weight of sample = 427.4 grams
Dry weight of sample after washing = 401.5 grams
Total material lost through washing = 427.4 - 401.5 = 25.9 grams

$$\text{Percentage passing the 75-}\mu\text{m sieve} = \frac{25.9 \text{ grams}(100)}{427.4 \text{ grams}} = 6.1\ \%$$

7. Report

Report the percentage of the sample passing the 75-µm sieve to the nearest 0.1 percent. Test results are reported using Lab Form 930. Data and Calculations are recorded on worksheet SO 108W.

Determination of Calcium Carbonate Equivalence of Coquina and Other Soil Samples

SC T 6

1. Scope

This method covers a procedure for determining the calcium carbonate equivalence of a dried sample.

2. Referenced Documents

2.1 SC Standard Specifications for Highway Construction (Edition of 2000), Section 304.04

3. Apparatus

3.1 Ointment can
3.2 Oven maintained at 105-110°C
3.3 Desiccator
3.4 250-mL Erlenmeyer flask
3.5 Balance or electronic scales capable of weighing to two decimal places
3.6 25-mL pipette
3.7 Infrared hot plate
3.8 Steam bath
3.9 Weighing spatula
3.10 Reagents
- 3.10.1 Prestandardized 1.0 N HCl (Hydrochloric Acid)
- 3.10.2 Prestandardized 1.0 N NaOH (Sodium Hydroxide)
- 3.10.3 Distilled water (reagent water meeting ASTM D 1193 is considered satisfactory)
- 3.10.4 1% Phenolphthalein solution

4. Test Specimens

The sample shall consist of approximately 200 grams of material. Larger samples shall be reduced to this size by the procedures in SC T 3.

5. Procedure

5.1 The sample should be dried in an open ointment can placed in a 105-110°C oven overnight.
5.2 The sample is allowed to cool for 2-3 hours in a dessicator in the closed ointment can.
5.3 Place 1.00 g weighed to the nearest 0.1 mg into a 250-mL Erlenmeyer flask.

5.4 Add 25 mL of 1.0 N HCl by pipette.
5.5 Swirl the suspension to mix.
5.6 Heat almost to boiling on a hot plate.
5.7 Place flask on a steam bath for 5 to 45 seconds to complete the reaction to dissolve all of the lime that will dissolve with dilute acid.
5.8 Dilute to 100 mL with distilled water.
5.9 Boil for 1 minute.
5.10 Cool sample to room temperature.
5.11 Add 5 drops of 1% phenolphthalein indicator.
5.12 Back titrate with 1.0 N NaOH to a pink color which lasts at least 15 seconds upon mixing while swirling.

6. Calculations

6.1 Determine the calcium carbonate equivalence of the sample as follows:

$$\%CaCO_3 \text{ equivalence} = \frac{(V - T) \times 5}{S} \times 100$$

Where: V = mL of HCl originally added
T = mL of NaOH added
S = the lime sample weight in grams

7. Report

Report the Percent Total Calcium Carbonate Equivalence of the sample to the nearest 0.1 percent. Test results are reported on Lab Form 957.

Mechanical Analysis of Soils (Elutriation Method)

SC T 34

1. Scope

This method covers a procedure for the quantitative determination of the distribution of particle sizes in soils.

2. Referenced Documents

None

3. Apparatus

3.1 Sieves (sizes 63-mm, 37.5-mm, 19-mm, 9.5-mm, 4.75-mm, 2-mm, 850-µm, 425-µm, 250-µm, 150-µm, 75-µm)
3.2 Electronic scales or balance accurate to 0.1 grams
3.3 500-ml glass bottle
3.4 4% solution of hexametaphosphate (calgon)
3.5 Water
3.6 Timer
3.7 Siphon
3.8 Convection oven (optional)
3.9 Riffle splitter (optional)

4. Test Specimens

Soil sample weighing approximately 500 grams, obtained by quartering or by the use of a riffle splitter. Soil should be thoroughly mixed, lumps pulverized.

5. Procedure

5.1 The sample of soil shall be thoroughly mixed, lumps pulverized, and while the material is damp, reduced to approximately 500 grams by quartering or the use of a riffle splitter as outlined in SC T 3.

5.2 The 500-gram portion shall be air dried or dried in an oven having a maximum temperature of 60°C so that it will pass the 2-mm sieve without clogging. All lumps of soil retained on the 2-mm sieve shall be pulverized until all particles smaller than the 2-mm sieve will pass the sieve. The portion passing the 2-mm sieve shall be weighed. The aggregate retained on this sieve shall be graded through the following sieves: 63 mm, 37.5 mm, 19 mm, 9.5 mm, and 4.75 mm. These fractions shall be weighed and calculations made based on a total percent passing basis.

5.3 The portion passing the 2-mm sieve shall be reduced by quartering or splitting to a 50-gram sample. This sample is placed in a 500-ml bottle which has been premeasured and marked 4 cm and 12 cm from the bottom. It is then covered to a depth of approximately 25 mm with a 4% solution of hexametaphoshate (calgon) and allowed to stand for at least one hour. If the sample has been air dried for this test, another 50-gram sample should be taken from the remaining soil, dried to a constant weight, and the percent of hygroscopic moisture determined.

5.4 If water under pressure is available, the material in the bottle should then be agitated vigorously with a jet of water, care being taken not to splash any of the contents over the edge of the bottle. The bottle should be filled to the 12-cm mark. The material in the bottle is then allowed to settle for 30 minutes after which time the liquid is siphoned off, refilled to the 12-cm mark, and the material allowed to settle for 15 minutes; after which time the liquid is siphoned off, refilled to the 12-cm mark, and settlement time allowed for 8 minutes. If the liquid is siphoned off before the 30, 15, or 8 minute siphoning time, some of the silt will be siphoned off with the clay and incorrect results will be obtained. This operation of washing, settling, and siphoning is continued for the 8 minute time limit until the water above the 4-cm mark is clear at the end of the settling period. If water under pressure is not available, the bottle should be filled to the 12-cm mark, stoppered, and shaken vigorously for 3 minutes. The 30, 15, and 8 minute wash procedures are followed as when using water under pressure.

5.5 Carefully transfer the material remaining in the bottle to a pan and dry. Weigh the material remaining and determine the weight of material lost during the washing process. The soil that is siphoned off from the bottle is classified as clay and is reported as "Clay by Elutriation." Screen the material remaining through 850-µm, 425-µm, 250-µm, 150-µm, and 75-µm sieves using a bottom pan under the 75-µm sieve. Material passing the 75-µm sieve is classified as silt. Calculate the percentage of each size based on the dry weight of the sample; however, if an air-dried sample has been used, dry weight should be determined before calculations are made. For example, an air-dried sample is used weighing 50 grams, hygroscopic moisture determined from the same sample is 2.5 grams. The dry weight of the sample to be used for calculation shall be 47.5 grams.

6. Calculations

6.1 The weight of material retained on each sieve is used to calculate the percentage of the sample retained on that sieve as follows:

Wt. of material retained on 75-µm sieve = 3.7 grams
Dry wt. of sample = 49.3 grams
% retained on 75-µm sieve = 3.7 grams/49.3 grams = 8%

6.2 The percent of material lost during the washing process is calculated as follows:

wt. of material after drying = 45.3 grams
wt. of dry sample = 48.7 grams
% clay by elutriation = (48.7 g - 45.3 g)/48.7 g x 100% = 7%

7. Report

Report the percentage of material passing each sieve to the nearest whole percent. Report the percentage of clay to the nearest whole percent as % Clay by Elutriation. The percentage of material passing the 75-µm sieve is reported as % silt. The percentage of material passing the 2-mm sieve and retained on the 75-µm sieve is reported as Total Sand. Use form titled "Determination of Clay Content by Elutriation with Correction for Hygroscopic Moisture" to record data and calculations. Test results are reported on Lab Form 930. Data and calculations are recorded on lab worksheets 930W, SO 101W, and SO 105W.

Procedure for Determining % Ignition Loss of Inorganic Soils

SC T 36

1. Scope

This procedure is intended as an indicator of the amount of coarse (+75-µm sieve) mica present in inorganic soils such as the residual soils of the SC Piedmont. The water of crystallization contained within the mica is driven off by ignition at approximately 1000° C. The loss in mass of the sample is an index to the amount of mica present.

2. Referenced Documents

2.1 AASHTO Standards
T 88 Particle Size Analysis of Soils
2.2 SC Test Methods
SC T 34 Mechanical Analysis of Soils (Elutriation Method)

3. Apparatus

3.1 High temperature porcelain crucibles
3.2 Muffle furnace capable of maintaining a temperature of 1000° C ± 50° C
3.3 Desiccator
3.4 AASHTO Class B Analytical Balance

4. Test Specimens

This test is normally performed in conjunction with a particle size analysis (SC T 34 or AASHTO T 88). The sample is prepared by recombining and mixing thoroughly the material above the 75-µm sieve from the sieve analysis performed on the portion of the sample passing the 2-mm sieve.
If the test is to be run on a specimen other than material from a particle size analysis, the sample is to be prepared as follows:

4.1 The sample should be dried to a constant mass at 110° C ± 5° C.
4.2 Reduce the sample to approximately 100 grams by quartering or by the use of a riffle splitter. Weigh the sample and record the mass to the nearest 0.1 gram.
4.3 Place the sample in a glass beaker or jar. Add enough 4% hexametaphosphate (calgon) solution to cover the sample. Agitate the sample to assure thorough wetting and allow to stand at least one hour.
4.4 Wash the sample over a nested set of 2-mm and 75-µm sieves. Continue to wash the material by agitating the sieves under running water until all the material that will pass the 2-mm sieve has done so. Remove the 2-mm sieve, dry the material retained on the 2-mm sieve to a constant mass at 110° C and record the mass to

the nearest 0.1 gram. Continue washing the material remaining on the 75-µm sieve until all the material that will pass the 75-µm sieve has done so. Transfer the material retained on the 75-µm sieve to a pan and dry to a constant mass at 110° C. Weigh this material and record the weight to the nearest 0.1 gram.

4.5 Calculate the percentage of material that is retained on the 75-µm sieve in the material passing the 2-mm sieve.

%+75-µm = $w_3 /(w_1-w_2)$
w_1 = weight of whole sample
w_2 = weight of material retained on the 2-mm sieve
w_3 = weight of material retained on the 75-µm sieve

5. Procedure

5.1 The sample of soil shall be reduced in size (if necessary) to approximately 20 grams by quartering or use of a riffle splitter. If a visual inspection of the sample indicates that a large amount of mica is present, it may be necessary to reduce the sample size to less than 20 grams to prevent the material from expanding over the sides of the crucible.
5.2 Clean and weigh the crucible. Record the weight to the nearest 0.01 gram.
5.3 Place the sample in the crucible and determine the weight of the sample and crucible to the nearest 0.01 gram.
5.4 Before placing the crucible in the oven, let the temperature reach 1000° C (± 50° C). Place the crucible in the oven and allow the temperature to again reach 1000° C (± 50° C). Allow the samples to remain at 1000° C (± 50° C) for 45 minutes.
5.5 Remove the crucible from the oven and place in the desiccator to cool. Allow the sample to cool to room temperature in the desiccator prior to weighing.
5.6 Weigh the crucible and sample and record the weight to the nearest 0.01 gram.
5.7 Calculate the loss on ignition as:

loss (L) = mass (grams) of crucible and sample prior to ignition - mass of crucible and sample after ignition.
Calculate the % Ignition Loss for the material passing the 2-mm sieve as:

$$\% \, Ig = (P \times L)/ M \times 100$$

where: P = percentage of material above the 75-µm sieve in the material passing the 2-mm sieve. This corresponds to the percentage of Total Sand in the material passing the 2-mm sieve shown on the soil test report.

L = loss on ignition (grams)

M = mass of sample prior to ignition. This procedure calculates the % ignition loss as a percentage of the material passing the 2- mm sieve. If the % ignition loss of the sample as a whole is desired, multiply the value for % ignition loss calculated in step 5.7 by the percentage of material passing the 2-mm sieve in the sample as a whole.

6. Calculations

The loss on ignition is calculated as follows:

wt. of sample = 19.73 grams
wt. of crucible = 175.60 grams
wt. of crucible and sample after ignition =194.05 grams
wt. of crucible and sample prior to ignition = 195.33 grams
percentage of material passing 75-µm sieve in material passing the 2-mm sieve = 15%

then:

P = 100% - 15% = 85%
L = 195.33 grams - 194.05 grams = 1.28 grams
M = 19.73 grams
% Ig = (1.28g x.85)/19.73g x 100 = <u>5.5%</u>

7. Report

Report the ignition loss as a percentage of the material passing the 2-mm sieve expressed to the nearest 0.1%. Test results are reported on Lab Form 930. Data and calculations are recorded on worksheet SO 111W.

Method of Making, Curing and Testing of Soil-Cement Compression Specimens in the Laboratory

SC T 38

1. Scope

This test method outlines the procedure for preparing and testing of soil-cement specimens for the purpose of designing cement-modified soils. This test is normally conducted in conjunction with maximum density testing (AASHTO T 134) on identical material. The curing and testing procedures are also performed on specimens molded in the field to monitor the construction process.

Dry preparation (AASHTO T 87) should be performed on the remainder of original samples if not done during dry preparation for density testing (AASHTO T 134). Samples weighing 2000 grams are required for each set of 3 cores made.

2. Referenced Documents

2.1 AASHTO Standards
- T 87 Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test
- T 134 Moisture-Density Relations of Soil-Cement Mixtures
- T 265 Laboratory Determination of Moisture Content of Soils

3. Apparatus

3.1 2-inch x 2-inch cylindrical molds with drop tamper and accessories
3.2 Trowel
3.3 Scoop
3.4 Moisture cups
3.5 Cloth
3.6 250-ml graduated cylinder
3.7 100-ml graduated cylinder
3.8 Oven (air dry) 60°C
3.9 Oven (drying) 110°C
3.10 Electronic scales or balance (440-gram capacity)
3.11 Slotted pan

4. Test Specimens

A set of test specimens consists of either three (3) laboratory-prepared 2-inch x 2-inch cylindrical specimens compacted to 95% of the maximum dry density as determined by AASHTO T 134 or two (2) field-prepared 4 inch x 4 inch cylindrical specimens. Sets of laboratory-prepared specimens are prepared for varying cement contents. 2000 grams of soil are required to prepare a set of three specimens.

4.1 Select a cement content for each sample and determine the amount of cement required in grams. Determine the amount of water required based on the optimum water content of the soil cement mixture as determined by AASHTO T 134 including the amount of cement in the weight of the soil. Place oven-dried sample on a non-absorbent surface, add cement, and mix dry until thoroughly blended.

5. Procedure

5.1. Determine the amount of material needed to mold a 2-inch diameter x 2-inch height specimen molded to 95 % of maximum dry density as follows:

$$0.95\ \gamma_{DRY\ Max} \times \frac{100 + OMC}{100} = \gamma_{WET}$$

$$\frac{\gamma_{WET} \times 103}{\gamma_{WATER}} = \text{amount of material required to mold 1 specimen.}$$

Add an additional gram for material lost during molding.

5.2 Add water to the specimen to bring it to optimum moisture content and mix thoroughly using trowel and hands.
5.3 Tamp the soil-cement mixture, cover, and allow to stand for 5 to 10 minutes to aid in dispersion of the moisture and permit absorption by the soil-cement mixture.
5.4 Break up mixture until it passes a No. 4 sieve and then remix.
5.5 Take an initial representative moisture sample from the mixture according to AASHTO T 265.
5.6 Weigh the amount of material determined in 5.1, place in the mold, and using the hand tamper, compact the material to produce a 2-inch high specimen (usually 3-6 blows).
5.7 Remove the specimen from the mold and determine the height. If the height is below 2 inches, mold another specimen reducing the number of blows. If the height is above 2 inches, mold another specimen increasing the number of blows. Continue until the required height is obtained.
5.8 Once the specimen meets the size requirement, weigh the specimen and record the height and weight. Calculate γ_{WET} for the specimen as follows:

$$\gamma_{WET} = \frac{\text{weight of specimen (grams)}}{\text{height of specimen (in.)}} \times 1.212$$

5.9 Take a final representative moisture sample from the mixture according to AASHTO T 265.
5.10 Repeat steps 5.2 through 5.9 to mold two more specimens.

5.11 All specimens should be kept covered with a damp cloth on a slotted tray until all work is completed on this material.

5.12 Place all moisture specimens in a drying oven (110°C) for 12 hours or until a constant mass is obtained. Average the moisture contents and determine the dry density of the material as follows:

$$\gamma_{DRY} = \frac{\gamma_{WET}\ x100}{100 + \%\ moisture}$$

The dry density should be within 2 lb/ft^3 of the maximum value determined by AASHTO T 134 and the average moisture content should be within 1% of optimum.

5.13 Repeat steps 5.1 through 5.12 for each additional set of specimens made at varying cement contents.

5.14 Curing: Soil-cement specimens should be stored in a moist curing room undisturbed for seven (7) days. Upon removing from the curing room, the specimens are soaked overnight in water.

5.15 Testing: After the over night water soak, test the specimens for unconfined compressive strength. Specimens molded from fine-grained sandy soils should be capped with a sulfur compound prior to compressive strength testing due to non-uniform stresses near the surface of the specimen.

5.16 Plot the average compressive strength of the material vs. the cement content of the set of specimens. From this graph, determine the cement content based on the desired compressive strength. The corresponding spread rate for cement application in the field can be determined by:

$$\%\ cement\ x\ \gamma_{DRY}\ x\ \%\ compaction\ required\ in\ field\ x\ depth\ (feet)\ x\ 9$$

6. Calculations

6.1 Calculate the amount of material required to mold a specimen as follows:

From AASHTO T 134, $\gamma_{DRY\ MAX}$ = 104.0 pcf, OMC = 19.6%

Therefore, $\gamma_{WET} = \frac{0.95\ (104.0pcf)\ 100+19.6}{100} = 118.2$ pcf

Amount of material required to mold one sample =

$$\frac{118.2pcf\ (103)}{62.4\ pcf} + 1\ gram = 196\ grams\ of\ material\ per\ core.$$

6.2 After molding specimen to the required dimensions, compute the wet density of each specimen as follows:

$$\gamma_{WET} = \underline{weight\ of\ specimen\ (grams)\ x\ 1.212} = \underline{195\ g(1.212)} = 118.2\ pcf.$$

height of specimen (inches) 2 inches

6.3 After compressive strength testing, the strength of each sample should be computed as follows:

$$\text{Compressive strength} = \frac{\text{Load (lbs.)}}{\text{Area (in}^2)} = \frac{776 \text{ lb.}}{3.1416 \text{ in}^2} = 246 \text{ psi.}$$

6.4 For laboratory-prepared specimens, plot the average compressive strength of the set of cores versus the cement content at which they were molded. The recommended cement content is determined from the plot based on the desired compressive strength of the material. The corresponding spread rate in pounds per square yard for use in the field is computed as follows:

Recommended cement content = 7%
Spread Rate = % cement x γ_{DRY} x % compaction required x 9 ft^2/yd^2 x depth (ft)
= 7% (109.0 pcf) (95%) (9) (0.5 ft) = 33 psy.

7. Report

For laboratory-prepared specimens, report the recommended cement content to the nearest 0.5 percentage. If a spread rate for use in the field is to be recommended, report the rate to the nearest 0.1 pound per square yard. For field prepared specimens, report the individual compressive strengths of the specimens to the nearest pound per square inch. Report test results and recommended spread rates for laboratory-prepared specimens on Lab Form SO127. Report test results for field-molded specimens on Lab Form SO112.

Method for Determining the Unconfined Compressive Strength of Intact Rock Core Specimens

SC T 39

1. Scope

This method specifies the apparatus, instrumentation, and procedures for determining unconfined compressive strength of intact rock core specimens. This procedure is identical to ASTM D 2938 except that the cores are tested after cutting without grinding, and neoprene caps are used on the specimen ends.

2. Referenced Documents

2.1 ASTM Standards

- C 1231 Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders
- D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock
- D 2938 Standard Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens
- D 4543 Practice for Preparing Rock Core Specimens and Determining Dimensional and Shape Tolerances
- E 4 Practices for Load Verification of Testing Machines

3. Apparatus

3.1 Loading Device, of sufficient capacity to apply load at a rate conforming to the requirements set forth in subsection 7.3 of this procedure. It shall be verified at suitable time intervals in accordance with the procedures given in ASTM E 4, and comply with the requirements prescribed therein. The loading device may be equipped with a displacement transducer that can be used to advance the loading ram at a specified rate.

3.2 Platens, two steel platens are used to transmit the axial load to the ends of the specimen. They shall have a hardness of not less than 58 HRC. The bearing faces shall not depart from a plane by more than 0.32 in. (0.0125 mm) when the platens are new and shall be maintained within a permissible variation of 0.64 in. (0.025 mm). One of the platens should be spherically seated and the other a plain rigid platen. The center of the sphere in the spherical seat shall coincide with the center of the loaded end of the specimen. The spherical seat shall be lubricated to ensure free movement. The moveable portion of the platen shall be held closely in the spherical seat, but the design shall be such that the bearing face can be rotated and tilted through small angles in any direction.

4. Safety Precautions

4.1 Many rock types fail in a violent manner when loaded to failure in compression. A protective shield should be placed around the test specimen to prevent injury from flying rock fragments.

5. Sampling

5.1 The specimen should be selected from the cores to represent a valid average of the type of rock under consideration. This can be achieved by visual observations of mineral constituents, grain sizes and shape, partings and defects such as pores and fissures, or by other methods such as ultrasonic velocity measurements.

6. Test Specimen

6.1 Prepare the specimen in accordance with the following steps. These steps are essentially ASTM D 4543 with the exception that the straightness and flatness tolerances are not checked, and the ends are not ground smooth.

6.1.1 Test specimens shall be cut as carefully as possible to right cylinders. The cuts shall be parallel to each other and at right angles to the longitudinal axis.

6.1.2 Determine the diameter of the test specimen to the nearest 0.01 in. (0.1 mm) by averaging two diameters measured at right angles to each other at about mid-height of the specimen. Use this average diameter for calculating the cross-sectional area. Determine the length of the test specimen to the nearest 0.01 in. (0.1 mm) at the centers of the end faces. *Note: when working in Standard Units, this length will also need to be converted to the nearest 0.001 ft by dividing by 12.*

6.1.3 The specimen shall have a length-to-diameter ratio (L/D) of 2.0 to 2.5 and a diameter of not less than 1.85 in. (47 mm). When cores of diameter smaller than the specified minimum must be tested because of the unavailability of larger diameter core, suitable notation of this fact shall be made in the report.

6.1.4 Determine the mass of the specimen to the nearest 0.01 lb. (0.01 kg)

6.1.5 The rock cores shall be capped with a neoprene cap conforming to the requirements of ASTM C 1231.

6.2 Optional – If the moisture content of the specimen is to be determined, follow the procedures in ASTM D 2216.

6.3 Optional - If the moisture condition is to be maintained, seal the specimen using a flexible membrane or apply a plastic or silicone rubber coating to the specimen sides.

7. Procedure

7.1 Check the ability of the spherical seat to rotate freely in its socket before each test.

7.2 Place the lower platen on the base or actuator rod of the loading device. Wipe clean the bearing faces of the upper and lower platens and of the test specimen, and place the test specimen on the lower platen. Place the upper platen on the specimen and align properly. A small axial load, approximately 25 lbf (100 N), may be applied to the specimen by means of the loading device to properly seat the bearing parts of the apparatus.

7.3 Apply axial load continuously and without shock until the load becomes constant, reduces, or a predetermined amount of strain is achieved. Apply the load in such a manner as to produce either a stress rate or a strain rate as constant as feasible throughout the test. Do not permit the stress rate or strain rate at any given time to deviate by more than 10 percent from that selected. The stress rate or strain rate selected should be that which produces failure in a test time between 2 and 15 minutes. The selected stress rate or strain rate for a given type shall be adhered to for all tests in a given series of investigation. Record the maximum load sustained by the specimen.

8. Calculations

8.1 Calculate the cross-sectional area of the specimen to the nearest 0.01 ft^2 (0.01 m^2) as follows:

$$A = (\pi D^2) / 4$$

Where: A = cross-sectional area, in^2 (mm^2) – *then convert to ft^2 or m^2*
D = average specimen diameter, in (m)

8.2 Calculate the volume of the specimen to the nearest 0.001 ft^3 (0.001 m^3) as follows:

$$V = A (L)$$

Where: V = volume, ft^3 (m^3)
A = cross-sectional area, ft^2 (m^2)
L = specimen length, ft (m)

8.3 Calculate the specimen unit weight to the nearest 1.0 lb/ft^3 (1.0 kg/m^3) as follows:

$$UW = M / V$$

Where: UW = specimen unit weight, lbs/ft^3 (kg/m^3)
M = specimen mass, lbs (kg)
V = volume, ft^3 (m^3)

8.4 Calculate the compressive strength in the test specimen from the maximum compressive load on the specimen and the initial computed cross-sectional area as follows:

$$\sigma = P / A$$

Where: σ = compressive strength, lbs/in^2 (kN/m^2)
P = maximum load, lbf (kN)
A = cross sectional area, in^2 (m^2)

9. Report

9.1 Source of sample including project name and location (often the location is specified in terms of the drill hole number and depth of specimen from the collar of the hole)
9.2 Date
9.3 Description of the rock (optional)
9.4 Moisture condition of specimen before test (optional)
9.5 Specimen diameter (optional)
9.6 Specimen height (optional)
9.7 Specimen unit weight
9.8 Unconfined compressive strength
9.9 Type and location of failure (optional)
9.10 Sketch of fractured specimen (optional)
9.11 Any variations in the requirements of the test method.

10. Example Calculations

10.1	Given:	Average diameter = 2.15 in.
		Length = 4.43 in.
		Mass = 763.3 gms = 1.683 lbs.
		Maximum load = 88,777 lbf.
10.2	Calculation:	L/D = 4.43 in. / 2.15 in. = 2.1 (ok - between 2.0 and 2.5),
		$A = \pi \times (2.15 \text{ in.})^2 / 4 = 3.63 \text{ in}^2$
		$V = 3.63 \text{ in}^2 \times 4.43 \text{ in} = 16.1 \text{ in}^3 \rightarrow \times (1 \text{ ft}^3/1728 \text{ in}^3) = 0.009 \text{ ft}^3$
		$UW = 1.683 \text{ lbs} / 0.009 \text{ ft}^3 = 187 \text{ lbs/ft}^3$
		$\sigma = 88{,}777 \text{ lbf} / 3.63 \text{ in}^2 = \underline{24, 456 \text{ psi}}$

Test results are reported on Lab Form SO113.

Moisture-Density Relations of Soils or Soil-Aggregate Mixture Using a 10 lb. Rammer and 18 in. Drop

SC T 140

1. Scope

This method of test is intended for determining the relationship between moisture content and density of soils when compacted in a 6 inch diameter mold with a 10 pound rammer dropped from a height of 18 inches.

2. Referenced Documents

2.1 AASHTO Standards

T 180 Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

T 265 Laboratory Determination of Moisture Content of Soils

3. Apparatus

3.1 6 inch diameter Proctor mold and 10 pound hammer, ¾ in sieve, No. 4 sieve, balance or electronic scales, metal straightedge, drying oven, mixing tools, drying containers with tight fitting lids.

4. Test Specimens

4.1 Select a representative sample having a mass of approximately 25 pounds. If the material is of a fragile nature such that it may break down when compacted, then a separate sample should be used for each point. Sieve the test specimens over the ¾ inch sieve and weigh the material retained on the ¾ inch sieve. Discard the material retained on the ¾ in sieve and replace it with an equal mass of material passing the ¾ inch sieve and retained on the No. 4 sieve.

5. Procedure

5.1 Determine the weight of a 6 inch diameter proctor mold.

5.2 Place the 6 inch diameter proctor mold (with base plate and collar attached) on a block of concrete of sufficient size to afford a uniform, rigid foundation.

5.3 Thoroughly mix the selected representative sample with sufficient water to bring the moisture content to approximately 4 percentage points below optimum moisture content.

5.4 Form a specimen by compacting the prepared sample in the 6 inch diameter mold in five approximately equal layers to give a total compacted depth of about 5 inches. Prior to compaction, place the loose material into the mold and spread into a layer of uniform thickness. Lightly tamp the material prior to compaction until it is not in a loose or fluffy state, using either a manual compaction rammer or similar device having a face diameter of approximately 2 inches. Following compaction of the first four layers, any soil adjacent to the mold walls that has not been compacted or extends above the compacted surface shall be trimmed using a knife or other suitable device and evenly distributed on the top of the layer. Compact each layer by 56 uniformly distributed blows from the 10 pound rammer dropping free from a height of 18 inches above the elevation of the material.

5.5 Following compaction, remove extension collar, carefully trim the compacted material even with the top of the mold by means of a straightedge. Holes developed in the surface by removal of coarse particles shall be patched with smaller sized material.

5.6 Determine the weight of the mold and compacted specimen to the nearest 5 grams. Divide the mass in grams of the compacted specimen and mold minus the mass of the mold by 453.6 to convert grams to pounds. Divide the mass in pounds by the volume of the mold (0.075 cubic feet) and record the results as the wet density in pounds per cubic foot of compacted material.

5.7 Remove the material from the mold and slice vertically through the center. Take a representative sample of material from one of the cut faces, determine the mass immediately and dry in accordance with AASHTO T 265, Laboratory Determination of Moisture Content of Soils, to determine moisture content, and record the results.

5.8 Thoroughly break up the remainder of the material until it will pass a ¾ inch sieve and 90 percent of the soils aggregations will pass a No. 4 sieve as judged by eye, and add to the remaining portion of the sample being tested. Add water in sufficient amounts to increase the moisture content of the material by approximately two percentage points and repeat the above procedure for each increment of water added.

5.9 Continue this series of determinations until there is either a decrease or no change in the wet unit per cubic foot of the compacted sample.

6. Calculations

6.1 Weight of Mold and Aggregate = 11,198 grams

6.2 Weight of Mold = 6584 grams

6.3 Weight of Aggregate = 6.1 - 6.2=11,198 g - 6584 g = 4422 grams

6.4 Wet Density of Aggregate =6.3x453.6x0.075 = 130.0 pcf

6.5 Percent Moisture (AASHTO T 265) = 4.2%

6.6 Dry Density=Wet Density/(100+mc)=130.0pcf/(100+4.2) = 124.7 pcf

6.7 Plot moisture contents versus dry density for each point and connect with a smooth curve.

6.8 Select the optimum moisture content and maximum dry density values corresponding to the peak of the curve.

7. Report

7.1 Report the optimum moisture content of the aggregate to the nearest 0.1 percent and the maximum dry density to the nearest 0.1 pound per cubic foot. Perform calculations and draw graph on worksheet 6W. Report on Lab Form SO128 or SO129.

Making, Curing and Testing of Cement Stabilized Base Compression Specimens in the Laboratory

SC-T-142

1. Scope

This test method outlines the procedure for preparing and testing of cement treated graded aggregate base specimens for the purpose of designing Cement Stabilized Aggregate Base (CSAB) courses. This test is normally conducted in conjunction with maximum density testing (SC-T-140) on identical material. Samples weighing 14,000 grams are required for each set of 2 cores made.

SCDOT specifications require that the cement content of CTAB mixes be between 2.5 percent and 5 percent by SSD weight. Therefore, sets of specimens are normally molded with 2.5 percent, 3.5 percent and 5 percent cement. The maximum density test is normally conducted on a sample containing 3.5 percent cement.

2. Referenced Documents

2.1 AASHTO Standards:

T 180	Moisture Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18 In.) Drop
T 248	Reducing Samples of Aggregate to Testing Size
T 265	Laboratory Determination of Moisture Content of Soils
M 92	Wire-Cloth Sieve for Testing Purposes
M 231	Weighing Devices Used in the Testing of Materials
M 201	Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes

2.2 SCDOT Standards:

SC-T-140	Moisture Density Relations of Soils or Soil-Aggregate Mixtures Using a 10-lb Rammer and an 18-in. Drop

3. Apparatus

3.1 Drying Ovens – Thermostatically controlled, preferably of the forced-draft type, capable of being heated continuously at a temperature of 60±5°C (140±9°F) or 110±5° (230±9°F), as required.

3.2 Sieves – No. 4 and 3/4–inch sieves conforming to AASHTO M 92
3.3 Molds – 6-in. diameter molds meeting the requirements of AASHTO T 180.
3.4 Manually-Operated Rammer- Nominal 10-lb sector-faced rammer meeting the requiremens of AASHTO T 180.
3.5 Mold Accessories – Sample extruder, straightedge, Mixing Tools, Pans, Cloths as described in AASHTO T 180.
3.6 Containers – Suitable containers with close fitting lids for determination of moisture content. One container is required for each moisture content determination.
3.7 Glass Graduates – One glass graduate of 100 mL to 150 mL capacity and one glass graduate of 200 mL to 300 mL capacity is required. The 100 mL glass graduate shall be subdivided to the nearest 1.0 mL. The 250 mL glass graduate shall be subdivided to the nearest 2.0 mL. The main graduation lines shall extend at least three-quarters of the way around the graduate and shall be numbered.
3.8 Balances and Scales – A balance or scale conforming to the requirements of AASHTO M 231, Class G 20. Also, a balance or scale conforming to AASHTO M 231, Class G 2.
3.9 Disposable Gloves – Latex or other rubber gloves to prevent skin contact with portland cement.

4. Test Specimens

4.1 A set of test specimens consists of 2 cylindrical specimens nominally 6 inches in diameter and 4.58 inches in height compacted to 100 percent of the maximum dry density as determined by SC-T-140. Sets of specimens are prepared for varying cement contents. To prepare a set of test specimens., a minimum base sample of 14-kg (31-lbs) is required.

4.2 *Specimen Preparation*

4.2.1 Determine the optimum moisture content of the base material by performing SC-T-140.

4.2.2 Dry the bulk sample of base for cement modification at 60°C to a constant weight to achieve a saturated surface dry (SSD) condition.

4.2.3 Reduce the bulk sample into samples of appropriate size for molding test specimens according to AASHTO T 248.

4.2.4 Sieve each sample through a ¾-inch sieve and determine the mass of material retained. After weighing, discard the material retained on the ¾-inch sieve.

4.2.5 From the material left over from the splitting of the bulk sample, obtain an equivalent mass of material passing the ¾ inch sieve but retained on the

No. 4 sieve.

4.2.6 Replace the + ¾ inch material that was discarded with an equivalent mass of material obtained in 4.2.4, thoroughly mixing the material to obtain a homogeneous sample.

4.2.7 Select the desired cement content for each sample and determine the amount of cement required in grams based on the total SSD weight of the bulk sample. Place the air-dried sample on a non-absorbent surface and mix dry until thoroughly blended, noting the time.

4.2.8 Mold the sample within 2 hours of the time the cement is introduced.

5. Procedure

5.1 Determine the amount of material needed to mold each of 5 layers in a 6-inch diameter by 4.58-in. height specimen molded to 100 percent of maximum dry density as obtained from SC-T-140 as follows:

$$\text{Mass in each layer} = \text{Max Density} \times (1 + \text{OMC}/100\%) \times 6.7192$$

5.2 Add sufficient water to the specimen to bring it to OMC and mix thoroughly using trowel and gloved hands. Include the weight of the cement in the specimen as well as the base material when determining the amount of water required

5.3 Tamp the aggregate-cement mixture, cover with a damp cloth to prevent moisture loss, and allow to stand for 5 to 10 minutes to aid in dispersion of the moisture and permit absorption by the aggregate-cement mixture.

5.4 Break up mixture and then remix.

5.5 Take an initial representative moisture sample from the mixture according to AASHTO T 265.

5.6 Weigh the amount of material determined in 5.1, place in the mold, and using the sector faced 10 pound rammer, compact the material using 56 blows with an 18 inch drop.

5.7 Repeat step 5.6 for each of the 5 layers.

5.8 Take a final representative moisture sample from the mixture according to AASHTO T 265.

5.9 Repeat steps 5.2 through 5.9 to mold the second of two specimens for a set.

5.10 Keep all specimens covered with a damp cloth on a slotted tray until all work is completed on this material.

5.11 Place all moisture specimens in a drying oven (110°C) for 12 hours or until a constant mass is obtained. Average the moisture contents and determine the dry density of the material as follows:

$$\gamma_{DRY} = \frac{\gamma_{WET} \text{ x}100}{100 + \%\text{ moisture}}$$

The dry density should be within 2 pcf of the maximum value determined by SC-T-140 and the average moisture content should be within 1 percent of optimum.

5.13 Repeat steps 5.1 through 5.11 for each additional set of specimens made at varying cement contents.

5.14 CSAB specimens should be stored in a moist curing room undisturbed for seven (7) days. Upon removing from the curing room, soak the specimens overnight in water and test for unconfined compressive strength.

5.15 Plot the average unconfined compressive strength of the material vs. the cement content of the set of specimens. From this graph, determine the cement content based on the desired compressive strength.

6. Calculations

6.1 Calculate the amount of material required to mold a specimen as follows:

From SC-T-140, $\gamma_{DRY\ MAX}$ = 131.8 pcf, OMC = 8.3%

Amount of material required to mold one layer = $g_{DRY\ MAX}$ * (1+ OMC) * 6.7192

= 131.8pcf *1.083*6.7192 =959 grams

After compressive strength testing, compute the strength of each sample as follows:

$$\text{Compressive strength} = \frac{\text{Load (lbs.)}}{\text{Area (in}^2\text{)}} = \frac{18{,}378\text{ lb.}}{28.274\text{ in}^2} = 650\text{ psi.}$$

Plot the average unconfined compressive strength of the set of cores versus the cement content at which they were molded. Determine the recommended cement content from the plot based on the desired compressive strength of the material.

7. Report

7.1 Report the recommended cement content to the nearest one half percentage. Density test results and recommended cement content are reported on Lab Form SO129.

Method of Preparing Coarse Aggregate Sample for pH and Resistivity Testing in the Laboratory

SC T 143

1. Scope

This test method outlines the procedure for preparing a sample of coarse aggregate for the purpose of testing pH and resistivity when used as backfill for MSE walls. A sample weighing 2000 grams is required.

2. Referenced Documents

2.1 ASTM Standards
- D1125 Standard Test Method for Electrical Conductivity and Resistivity of Water
- D1293 Standard Test Method for pH of Water

3. Apparatus

3.1 One gallon (3.8 litres) wide-mouth plastic jug with lid
3.2 Coarse filter paper (Fisher Q8 or equivalent)
3.3 Electronic scales or balance

4. Test Specimens

4.2 Select a representative sample of coarse aggregate weighing approximately 2000 grams.

5. Procedure

5.1. Weigh the coarse aggregate sample to the nearest gram.
5.2 Place the coarse aggregate sample into the 1-gallon jug. Add an equal weight of deionozed or distilled water to the sample and let stand for 30 minutes.
5.3 At the end of the 30 minute period, place the lid on the jug and agitate the mixture for 3 minutes.
5.4 Repeat this agitation at the 2 and 4 hour intervals.
5.5 Upon completion of the 4 hour interval agitation, allow the sample to stand for 20 hours so the solids will settle out.
5.6 At this time, remove a sufficient quantity of the solution and filter through a coarse filter paper to obtain the supernate to be tested for pH according to ASTM D1293 and resistivity according to ASTM D1125.

6. Calculations

None.

7. Report

None.

Aggregates

This section of the *Laboratory Procedures Manual* describes those tests performed on aggregates used in bituminous surfacing, hot mix asphalt, Portland cement concrete, aggregate bases, and various soil-aggregate mixtures of base and subbase materials. The physical characteristics of aggregates as determined using these procedures are critical for ensuring a quality product.

Materials Finer than 75-mm (No. 200) Sieve in Mineral Aggregates by Washing

AASHTO T 11

This test is conducted in accordance with AASHTO T 11 without exception.

Test results are reported on Lab Forms AGG212, AGG214, AGG215, or SO128.

Bulk Density ("Unit Weight") and Voids in Aggregate

AASHTO T 19

This test is conducted in accordance with AASHTO T 19 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Organic Impurities in Fine Aggregates for Concrete

AASHTO T 21

This test is conducted in accordance with AASHTO T 21 without exception.

Test results are reported on Lab Form AGG203, AGG212, or AGG214.

Sieve Analysis of Fine and Coarse Aggregates

AASHTO T 27

This test is conducted in accordance with AASHTO T 27 without exception.

Test results are reported on Lab Forms AGG203, AGG204, AGG211, AGG212, AGG214, AGG215, MSC005, SO114, SO115, or SO128.

Effect of Organic Impurities in Fine Aggregate on Strength of Mortar

AASHTO T 71

This test is conducted in accordance with AASHTO T 71 without exception.

Test results are reported on Lab Form AGG203, AGG212, or AGG214.

Specific Gravity and Absorption of Fine Aggregate

AASHTO T 84

This test is conducted in accordance with AASHTO T 84 without exception.

Test results are reported on Lab Form AGG214.

Specific Gravity and Absorption of Coarse Aggregate

AASHTO T 85

This test is conducted in accordance with AASHTO T 85 without exception.

Test results are reported on Lab Form AGG208, AGG215, or AGG216.

Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

AASHTO T 96

This test is conducted in accordance with AASHTO T 96 without exception.

Test results are reported on Lab Form AGG206, AGG215, or AGG216.

Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

AASHTO T 104

This test is conducted in accordance with AASHTO T 104 without exception.

Test results are reported on Lab Form AGG207, AGG214, or AGG215.

Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

AASHTO T 176

This test is conducted in accordance with AASHTO T 176 without exception.

Test results are reported on Lab Form AGG209, AGG215, or AGG216.

Reducing Samples of Aggregate to Testing Size

AASHTO T 248

This test is conducted in accordance with AASHTO T 248 without exception.

Test results are not generated.

Total Moisture Content of Aggregate by Drying

AASHTO T 255

This test is conducted in accordance with AASHTO T 255 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Uncompacted Void Content of Fine Aggregate

AASHTO T 304

This test is conducted in accordance with AASHTO T 304 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Resistance to Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

AASHTO T 327

This test is conducted in accordance with AASHTO T 327 without exception.

Test results are not reported.

Effect of Organic Impurities in Fine Aggregate on Strength of Mortar

ASTM C 87

This test is conducted in accordance with ASTM C 87 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Potential Expansion of Aggregates from Hydration Reactions

ASTM D 4792

This test is conducted in accordance with ASTM D4792 without exception.

Test results are not generated.

Test to Determine the Moh's Hardness Number for Natural Coarse Aggregate

SC T 7

1. Scope

In order to obtain accurate results with the Windsor Probe System, it is necessary to know the hardness of the coarse aggregate, as expressed in "Mohs." This test method covers the determination of the scratch hardness of natural coarse aggregates using the Moh's Hardness Scale. This involves the physical testing of the aggregate by comparing it to the nine Moh's minerals for scratch resistance.

2. Referenced Documents

2.1 Windsor Probe Test System Operating Instructions, NDT Windsor Systems Inc, Chicago, Illinois
2.2 On-Site Concrete Testing, NDT Windsor System Inc.
2.3 James Non-Destructive Testing Systems, Chicago, Illinois
2.4 Moh's Mineral Test Kit Documentation.

3. Apparatus

Moh's Hardness Test Kit: Kit contains nine mineral stones numbered from nine to one, the number nine mineral stone is the hardest and the number one mineral stone is the softest. The other mineral stones in descending order are from hard to soft.

4. Test Specimens

Test specimens will be natural aggregates coming from the source in question. These aggregates should be clean and free from foreign materials and be representative of the source. It is preferred that a smooth surface be present somewhere on the test specimen to aid in the ease of the testing.

5. Procedure

5.1 Obtain a natural aggregate that would be representative of the source in question. This aggregate should be collected by finding one with as smooth a surface as possible. This will aid in the ease of the testing procedure. Ideally, when planning to test a concrete that is in question for compressive strength, it is best to obtain aggregate samples directly from the mix or the actual concrete matrix whenever possible. When evaluating old concrete where a Moh's value has not been previously determined, it will be necessary to locate a piece of exposed aggregate, or to expose one if none is showing.

5.2 Starting with the number nine mineral in the Moh's Hardness Kit, scratch the mineral aggregate being tested and visually inspect the aggregate being tested for a scratch mark made by the Moh's mineral. If this mark cannot be rubbed off, go to the number eight mineral and repeat this procedure. Continue in descending order of the other minerals until a mineral is found that the scratch on the surface of the aggregate rubs off. The number of the stone that allows the scratch to be rubbed off will be the Moh's Hardness Scale Value. This number will be used to aid in the estimation of the in-situ compressive strength of hardened concrete using the Windsor Probe.

5.3 Record the Moh's Value determined in the previous step of this procedure.

6. Calculations

None

7. Report

The Moh's Value will be reported on the Form AGG215 or AGG216.

Method for Determining Flat and Elongated Particles in Coarse Aggregate

SC T 77

Scope

This method will be used to determine the percentage of flat and elongated particles in coarse aggregate.

2. Referenced Documents

2.1 ASTM Standards
D 4791 Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
2.2 SC Test Methods
T 1 Methods of Sampling Coarse Aggregates
T 4 Sieve Analysis of Fine and Coarse Aggregates

3. Apparatus

3.1 Proportional Caliper – The proportional caliper device is illustrated in ASTM D 4791 and will be used in the 1:5 ratio setting.
3.2 Sieves – Standard ASTM sieve stack.

4. Test Specimen

4.1 Sample the coarse aggregate in accordance to SC T 1.
4.2 Reduce sample to obtain a suitable amount for testing. A suitable amount for testing is outlined in the following chart.

Nominal Maximum Size, mm (in.)	Minimum Mass of Test Sample, kg. (lb.)
9.5 ($^3/_8$)	1 (2)
12.5 (½)	2 (4)
19.0 (¾)	5 (11)
25.0 (1)	10 (22)
37.5 (1½)	15 (33)

5. Procedure

5.1 Sieve the sample to be tested in accordance to SC T 4. Reduce and group each size fraction larger than the 9.5 mm (3/8") sieve until approximately 100 particles of each group are obtained.
5.2 Test each of the particles in each size fraction and place into one of two groups:

(1) flat and elongated or (2) not flat and elongated.

5.2.1 Set the larger opening equal to the particle's maximum dimension. Keep the arm in the same location and place the particle's minimum dimension into the device's smaller opening. DO NOT move the device's arm. The particle is flat and elongated if the minimum dimension can be placed in the device's smaller opening.

5.2.2 After each particle has been classified, determine the proportion (by count) of the sample in each group.

6. Calculations

6.1 Calculate the proportions (by count) of flat and elongated particles.

$$\% = \frac{A}{B} \times (100)$$

Where: A = The number of particles in the flat and elongated group.
B = The total number of particles.

6.2 After calculating the number of flat and elongated particles in each size group, take an average of the percentages. This will be the percentage of flat and elongated particles.

7. Report

None.

8. Example Calculations

See below calculations for example:

Sieves to be tested	9.5 mm ($^3/_8$")	12.5 mm(½")	19.0 mm(¾")
Flat and Elongated	9	12	10
Not Flat and Elongated	91	102	95
Total Particles	100	114	105
Percentage for each sieve	9.0%	10.5%	9.5%
Percentage of Flat and Elongated Particles		9.7%	Average

Asphalt Materials

This section of the *Laboratory Procedures Manual* consists of those tests performed on asphalt materials such as asphalt binder, cutback asphalt, emulsions, etc.

Accelerated Aging of Asphalt Binder Using A Pressurized Aging Vessel (PAV)

AASHTO R 28

This test is conducted in accordance with AASHTO R 28 without exception.

Test results are reported on Lab Form ASP908.

Preformed Expansion Joint Filler for Concrete Construction

AASHTO T 42

This test is conducted in accordance with AASHTO T 42 without exception.

Test results are reported on Lab Form ASP907.

Solubility of Bituminous Materials

AASHTO T 44

This test is conducted in accordance with AASHTO T 44 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Flash and Fire Points by Cleveland Open Cup

AASHTO T 48

This test is conducted in accordance with AASHTO T 48 without exception.

Test results are reported on Lab Form ASP908.

Penetration of Bituminous Materials

AASHTO T 49

This test is conducted in accordance with AASHTO T 49 without exception.

Test results are reported on Lab Forms ASP902 or ASP906.

Water in Petroleum Products and Bituminous Materials by Distillation

AASHTO T 55

This test is conducted in accordance with AASHTO T 55 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Testing Emulsified Asphalts

AASHTO T 59

This test is conducted in accordance with AASHTO T 59 without exception.

Test results are reported on Lab Form ASP905 or ASP906.

Saybolt Viscosity

AASHTO T 72

This test is conducted in accordance with AASHTO T 72 without exception.

Test results are reported on Lab Forms ASP901, ASP902, ASP905, or ASP906.

Distillation of Cut-Back Asphaltic (Bituminous) Products

AASHTO T 78

This test is conducted in accordance with AASHTO T 78 without exception.

Test results are reported on Lab Form ASP 901 or ASP902.

Flash Point with Tag Open-Cup Apparatus for Use with Material Having a Flash Less than 93.3 ^{o}C (200 ^{o}F)

AASHTO T 79

This test is conducted in accordance with AASHTO T 79 without exception.

Test results are reported on Lab Form ASP902.

Recovery of Asphalt from Solution by Abson Method

AASHTO T 170

This test is conducted in accordance with AASHTO T 170 without exception.

Test results are reported on Lab Form ASP902.

Kinematic Viscosity of Asphalts (Bitumens)

AASHTO T 201

This test is conducted in accordance with AASHTO T 201 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Viscosity of Asphalt by Vacuum Capillary Viscometer

AASHTO T 202

This test is conducted in accordance with AASHTO T 202 without exception.

Test results are reported on Lab Form MD419.

Specific Gravity of Semi-Solid Bituminous Materials

AASHTO T 228

This test is conducted in accordance with AASHTO T 228 without exception.

Test results are reported on Lab Form ASP908.

Effect of Heat and Air on a Moving Film of Asphalt
(Rolling Thin-Film Oven Test)

AASHTO T 240

This test is conducted in accordance with AASHTO T 240 without exception.

Test results are reported on Lab Form ASP908.

Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)

AASHTO T 313

This test is conducted in accordance with AASHTO T 313 without exception.

Test results are reported on Lab Form ASP908.

Determining the Rheological Properties of Asphalt Binder Using A Dynamic Shear Rheometer (DSR)

AASHTO T 315

This test is conducted in accordance with AASHTO T 315 without exception.

Test results are reported on Lab Form ASP904 or ASP908.

Viscosity Determination of Asphalt Binder Using Rotational Viscometer

AASHTO T 316

This test is conducted in accordance with AASHTO T 316 without exception.

Test results are reported on Lab Form ASP903, ASP904, or ASP908.

Recovery of Asphalt Binder from Hot Mix Asphalt by Means of the Rotovapor Apparatus

SC T 95

1. Scope

This method covers the recovery of asphalt binder from Hot Mix Asphalt (HMA) samples used to determine the absolute viscosity of the asphalt binder.

Safety Notice: This procedure involves temperatures in the range of (100-163°C), as well as the handling of asphalt binder and solvents. The procedure will require the technician to wear appropriate safety protection during portions of the testing. Some steps in the procedure, which are known to involve high temperatures, are in bold print to make the technician aware of the need for proper safety equipment. The absence of a warning does not necessarily mean that all material and equipment are safe to handle. The technician should use caution during each step of the procedure.

2. Referenced Documents

2.1 AASHTO Standards
T 170
T 202

2.2 SC Test Methods
T 64
T 72
T 75

3. Summary of Test Method

3.1 The asphalt binder is recovered from HMA samples in accordance to this procedure. Asphalt binder is extracted and is separated by means of a distillation process using the Rotavapor apparatus. The asphalt binder recovered is tested to determine the absolute viscosity.

4. Significance and Use

4.1 The purpose of this procedure is to recover the asphalt binder from HMA by means of the Rotavapor apparatus.

5. Apparatus

5.1 A Rotavapor apparatus, complete with vacuum system capable of reducing the ambient pressure to below 30mm of Hg. Digital manometer and vacuum controller that maintains consistent vacuum and an oil bath capable of maintaining temperatures of up to 180 degrees C. The rotavapor apparatus must be capable of rotating the flask with speeds up to 100 rev / min. A complete apparatus must include all necessary glass parts such as one or more recovery flasks, one or more rotational flasks, and a main distillation assembly. The apparatus must have a 2000 ml flask to store recovered solution from the extraction, complete with an in-line valve to assist in the slow transfer of solution to the rotavapor apparatus.

5.2 One 2000 ml glass flask to store extracted solution for test.

5.3 One 100 ml glass beaker to collect recovered asphalt binder.

5.4 One pair of high-temperature resistant gloves.

5.5 One or more cloth rags for cleaning oil residue.

5.6 Wash bottle full of trichloroethylene solvent for cleaning flasks, etc.

6. Test Specimen

6.1 Obtain the sample through normal sampling procedures and reduce it to testing size of no greater than 1500 gms. Ensure that test method SC-T-64 is strictly followed until step 5D; then transfer the sample to the 2000 ml flask attached to the Rotavapor apparatus.

Test Specimen	Suggested mass of sample, gms
HMA Sample, RAP Sample, or Roadway Core Sample	1200 - 1500

7. Procedure

7.1 Pre-heat Rotavapor oil bath to 100º C

7.2 Insert Distillation flask and rotational flask onto Rotavapor apparatus. Lower the rotovapor instrument so approximately half of the rotational flask is in the oil bath. Begin rotation of the rotational flask at a rate of 30-40 rev/min.

7.3 Begin cold-water (<25º C) flow through the rotavapor instrument at a rapid flow rate.

7.4 Set vacuum on vacuum controller to 400 mm of Hg. Begin vacuum process and allow the vacuum to reach set point.

7.5 Gradually adjust the transfer value and begin allowing solution to transfer from the 2000 ml flask to the rotational flask at a rate of 20-40 ml/min. Transfer the solution very slowly to ensure that no foaming or back pressure builds in the distillation flask. Transfer the solution so that no more than half of the distillation flask is full at any time. Continue to distillate until no more solution is left in the 2000 ml flask. After all solution is removed from the flask, close in-line valve and continue to distill until approximately 150 -200 ml of solution remain in the distillation flask.

7.6 Stop the rotation on the Rotavapor instrument, allowing the rotational flask to drip oil back into the bath.

7.7 Remove rotational flask from Rotavapor and wipe any excess oil from outside of flask. Increase oil bath temperature to 163º C.

7.8 Pour contents out of rotational flask into 250ml centrifuge bottle; wash out any residue left in rotational flask with a trichloroethylene wash bottle and fill centrifuge bottle to top of neck of bottle.

7.9 Place bottle in centrifuge and counter-balance the centrifuge with another bottle of trichloroethylene to level the load. Centrifuge samples at 3500 rpm for 30 minutes.

7.10 Transfer solution from centrifuge bottle to a clean rotational flask. Clean the centrifuge bottle with a trichloroethylene wash bottle to get the residue out, being careful to not disturb the separated fines in the bottom of the centrifuge bottle.

7.11 Place rotational flask onto rotavapor apparatus and lower into the preheated oil bath to the same level as before. Begin rotation at 60-80 rev/min. Be sure to check and see that the water flow is still maintained through the rotavapor coils, and set vacuum to 400 mm of Hg.

7.12 Begin vacuum and continue to do distillation until 1-2 drops per minute are witnessed in the recovery flask. The vacuum must be increased to 200 mm of Hg (1-2 drops), and then to increased to 75 mm of hg and distill for 15 minutes.

7.13 Discontinue distillation process by increasing pressure (decreasing vacuum) to ambient pressure, cutting water supply off, and stop rotation. Lift the rotavapor apparatus, and allow the rotational flask to drip oil back into the bath briefly. Wipe all oil residues from the flask, and immediately pour recovered binder sample into a 100 ml beaker. Transfer the beaker to a 135º C oven for 10 minutes.

7.14 Take the recovered binder sample out of the warming oven and stir the sample to a homogenous state. Immediately pour the samples into the appropriate absolute viscosity tubes as per AASHTO T 202.

8. CALCULATION

None

9. REPORT

None

Hot Mix Asphalt

This section of the *Laboratory Procedures Manual* describes those tests performed on hot mix asphalt. These tests are critical for producing an asphalt pavement that is safe, durable and economical.

Mechanical Analysis of Extracted Aggregate

AASHTO T 30

This test is conducted in accordance with AASHTO T 30 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

AASHTO T 164

This test is conducted in accordance with AASHTO T 164 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Bulk Specific Gravity of Compacted Hot-Mix Asphalt Mixtures
Using Saturated Surface-Dry Specimens

AASHTO T 166

This test is conducted in accordance with AASHTO T 166 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Theoretical Maximum Specific Gravity and Density of Hot-Mix Asphalt Paving Mixtures

AASHTO T 209

This test is conducted in accordance with AASHTO T 209 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

AASHTO T 245

This test is conducted in accordance with AASHTO T 245 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Percent Air Voids in Compacted Dense and Open Asphalt Mixtures

AASHTO T 269

This test is conducted in accordance with AASHTO T 269 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens

AASHTO T 275

This test is conducted in accordance with AASHTO T 275 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage

AASHTO T 283

This test is conducted in accordance with AASHTO T 283 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Note: *The laboratory routinely performs SC T 70 in determining moisture susceptibility based on retained strength of asphalt concrete mixture.*

Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method

AASHTO T 308

This test is conducted in accordance with AASHTO T 308 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

AASHTO T 312

This test is conducted in accordance with AASHTO T 312 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Determination of Percent Air Voids and Percent Voids In **Mineral Aggregate in Compacted Marshall Specimens**

SC T 68

1. Scope

This test method outlines the procedure for determining the percent air voids and voids in mineral aggregate (VMA) in compacted Marshall specimens.

2. Referenced Documents

2.1 AASHTO Standards
M 231 Weighing Devices Used in the Testing of Materials
2.2 SC Test Methods
SC T 62 Sampling of Bituminous Mixtures
SC T 66 Field Determination of Stability of Bituminous Mixtures by Marshall Method.

3. Apparatus

3.1 Balance, meeting the requirements of AASHTO M 231, 3 kg or greater capacity, sensitive to 0.1 gm., equipped with suitable suspension apparatus and holder to permit weighing the specimen while suspended from the center of the scale pan of balance.
3.2 Water bath for immersing the specimen in water while suspended under the balance, capable of maintaining temperature of 25 ± 1°C.

4. Test Specimens

4.1 Obtain asphalt sample from truck in accordance with SC T 62 and prepare a minimum of 2 Marshall specimens according to the method outlined in SC T 66.

5. Procedure

5.1 Cool the specimens to room temperature (25 ± 1°C), weigh, and record the dry mass in grams (designated as *A*).
5.2 Immerse each specimen in water for a minimum of 1 minute on the suspended scale pan, weigh, and record the immersed mass in grams (designated as *C*).
5.3 Remove the specimens from the water, surface dry by blotting with a damp towel, weigh, and record the saturated surface-dry (SSD) mass in grams

(designated as *B*).

6. Calculations

6.1 Calculate the bulk specific gravity (BSG) of each specimen as follows:

$$D = \text{Bulk Specific Gravity} = \frac{A}{B - C}$$

Where:
A = mass (gms) of specimen in air
B = mass (gms) of specimen SSD in air
C = mass (gms) of specimen in water

6.2 Calculate the Maximum Rice Specific Gravity (MSG) for each specimen as follows:

$$E = \text{MSG} = \frac{100}{\frac{F}{G} + \frac{100 - F}{ESG}}$$

Where:
F = %AC in sample (from extraction)
G = specific gravity of AC in sample (from job mix information sheet)
ESG = Effective Specific Gravity (from job mix information sheet)

6.3 Calculate the percent air voids as follows:

$$\text{\% air voids} = \left(1 - \frac{D}{E}\right) \times 100\%$$

Where:
D = Bulk Specific Gravity
E = Maximum Rice Specific Gravity

6.4 Calculate the %AC by volume as follows:

$$\text{\% AC by volume} = \frac{F \times D}{G}$$

Where:
D = Bulk Specific Gravity
F = %AC in sample (from extraction)
G = specific gravity of AC in sample (from job mix information sheet)

6.5 Calculate the percent voids in mineral aggregate as follows:

% VMA = % AC by volume + % air voids

6.6 Example calculations

6.6.1 Given:
Wt. (gms) in air = 1206
Wt. (gms) SSD = 1210
Wt. (gms) Water = 699

% AC of sample = 5.7% (from extraction)
Specific gravity of AC = 1.031 (from job mix)
Effective Specific Gravity (from job mix) = 2.738

Find: % Air voids and % VMA

6.6.2 Calculations:

$$\text{Bulk Specific Gravity} = D = \frac{A}{B - C} = \frac{1206}{1210 - 699} = 2.360$$

$$\text{MSG} = E = \frac{100}{\frac{F}{G} + \frac{100 - F}{ESG}} = \frac{100}{\frac{5.7}{1.031} + \frac{94.3}{2.738}} = 2.502$$

$$\%\ \text{air voids} = \left(1 - \frac{D}{E}\right) \times 100\% = \left(1 - \frac{2.360}{2.502}\right) \times 100\% = \underline{\mathbf{5.7\%}}$$

$$\%\ \text{AC by volume} = \frac{F \times D}{G} = \frac{5.7 \times 2.360}{1.031} = 13.0\%$$

% VMA = % AC by Volume + % air voids = 13.0 + 5.7 = **<u>18.7%</u>**

7. Report

None.

Note: Bulk specific gravity, maximum specific gravity, percent air voids, percent AC by volume, and VMA are included on the asphalt mix design information sheet Form MD 416.

Method of Determining the Effectiveness of Anti-Stripping Additives in Hot Asphalt Mixtures

SC T 69

1. Scope

This test method outlines the procedure for evaluating the effectiveness of anti-stripping additives in asphalt hot mixtures.

2. Referenced Documents

None

3. Apparatus

3.1 1000 ml stainless steel beaker
3.2 Stainless steel mesh to fit the bottom of the 1000 ml beaker
3.3 Stainless steel rod 8 inches in length
3.4 Scales (2610 gram scales)
3.5 Bunson Burner
3.6 Tripod
3.7 Metal plate 6" x 6" (1/8" to 1/4" in thickness)
3.8 Aluminum Foil
3.9 Paper towels
3.10 Water (Water should be potable)

4. Test Specimens

4.1 Bituminous material should be used for this test.

5. Procedure

5.1 Obtain a representative sample of the material to be tested. Sample size should be approximately 300 grams.
5.2 Transfer the mixture to aluminum foil and allow 2 hours for sample to cool to room temperature.
5.3 Heat a 1000 ml stainless steel beaker, one-half full with water, until it boils. Place a stainless steel mesh approximately 1/2 inch from the bottom of the
5.4 beaker. Spacers will be required on the bottom of the mesh.
5.5 Add the mixture to the boiling water. Apply heat at a rate, which the water will reboil, not less than 2 nor more than 3 minutes.

5.6 Maintain the water at a medium boil for 10 minutes, stirring with a stainless steel rod 3 times (at intervals of 2.5, 5 and 7.5 minutes) for 60 seconds each time. In addition, during boiling dip a paper towel into the beaker to skim any stripped asphalt cement from the surface of the water.

5.7 Drain water from the beaker and empty the wet mix onto a paper towel and allow to dry.

5.8 Examine the dried mix carefully to determine if any of the aggregate has lost its coating of asphalt cement. The allowable stripping of asphalt mixes shall not exceed 20%. Uncoated aggregate (coarse or fine) is an indication that the anti-stripping additive is not effective. Determine the percent visual stripping.

6. Calculations

None.

7. Report

None.

Laboratory Determination of Moisture Susceptibility Based on Retained Strength of Asphalt Concrete Mixture

SC T 70

1. Scope

This procedure is to measure moisture susceptibility of asphalt concrete specimens tested in indirect tension following special conditioning procedures.

2. Referenced Documents

2.1 AASHTO Standards
T 209 Maximum Specific Gravity of Bituminous Paving Mixtures

3. Apparatus

3.1 Balance, with ample capacity and sufficient sensitivity
3.2 Underwater weighing holder
3.3 Thermometers – Calibrated liquid-in-glass
3.4 Vacuum pump or water aspirator
3.5 Water bath

4. Test Specimens

4.1 Prepare at least 4 Marshall test specimens using the same blend of aggregates as the mix design for dry and wet testing. Compaction of the test specimens shall be completed using a mechanical Marshall impact compactor. Compaction effort for specimens to be used for measuring moisture susceptibility shall be adjusted so there will be 7 ± 1% air voids.* The compaction temperature for making the specimens shall be between 145 and 150 °C (290 and 295 °F).

* NOTE: Usually 20 compactive blows per face will yield 7 ± 1% air voids.

5. Procedure

5.1 Indirect Tension Test for Dry Specimens
5.1.1 Measure and record the height in inches and weight in grams of each specimen after specimens have attained room temperature 25 °C (77 °F). Specimens usually attain room temperature in about one hour after being extracted from the Marshall molds.

5.1.2 Submerge each specimen in water for 3 minutes and record the submerged weight to the nearest 0.1 gram. Remove each specimen from the water bath and blot the excess water with a damp cloth. Then record the surface-dry weight in air to the nearest 0.1 gram. Compute the bulk volume of the specimen as follows:

Bulk Volume, $cm^3 = A - B$

Where:
A = mass in grams of surface-dry specimen in air
B = mass in grams of specimen in water

5.1.3 After 24 hours measure the dry indirect tensile strength of 2 randomly selected specimens at 25 °C (77 °F). Apply a load using a Marshall testing machine with a rate of 2 inches per minute through two 0.5 inch-wide metal strips. Compute the indirect tensile strength of each specimen as follows:

$$\text{ITS, psi} = \frac{2\,(L)}{(\pi)\,(H)\,(D)}$$

Where:
L = maximum load applied in pounds
H = height of specimen in inches
D = diameter of specimen in inches

5.2 Indirect Tension Test for Wet-Conditioned Specimen

5.2.1 Measure and record height, dry air weight, submerged weight and surface dry weight of the 2 remaining specimen according to the procedures stated in 5.1.1 and 5.1.2.

5.2.2 Determine the percent air voids as follows:

$$\%\ \text{Air Voids} = \frac{F - E}{F} \times 100\%$$

Where:
F = maximum specific gravity of the uncompacted bituminous mixture
E = bulk specific gravity of the compacted bituminous mixture

5.2.3 Compute the volume of air voids as follows:

$$\text{Volume of Air Voids, cm}^3 = \frac{G \times V}{100\%}$$

Where:

G = % air voids
V = bulk volume of specimen in cm^3

5.3.4. Figure the surface-dry weight for 55 and 80 percent saturation:

$$\text{Surface-dry weight, grams} = \frac{[S \times I]}{[100\%]} + J$$

Where:

S = percent saturation
I = volume of air voids in cm^3
J = dry mass of specimen in air in grams before saturation

5.3.5. Place each specimen in a distilled water bath at 25 °C (77 °F) and vacuum saturate for 3 minutes at 20" hg vacuum.

5.3.6. Obtain the surface-dry weight of each specimen to the nearest 0.1 gram and calculate percent saturation as follows:

$$\% \text{ Saturation} = \frac{[K - L]}{[M]} \times 100\%$$

Where:

K = surface-dry weight after saturation in grams
L = dry air mass before saturation in grams
M = volume of air voids in cm^3, (calculated in 5.B.3)

NOTE: The surface-dry weight has to be between the calculated surface-dry weights for 55 and 80 percent saturation. Vacuum saturation should be continued if the surface-dry weight is less than 55 percent. A specimen is considered damaged if saturation is greater than 80 percent.

5.3.7. Place the wet conditioned specimens in a 60 °C (140 °F) distilled water bath for 24 hours and then in a 25 °C (77 °F) distilled water bath for at least 1 hour before conducting indirect tensile strength tests.

5.3.8. Determine the indirect tensile strength of the wet conditioned specimens at 25 °C (77 °F) using the procedure and equation in 5.1.3.

NOTE: The wet and dry cores should be tested at the same time.

6. Calculations

Calculate the Tensile Strength Ratio (TSR).

$$TSR = \frac{N}{P} \times 100$$

Where:

N = average indirect tensile strength of wet conditioned specimens.
P = average indirect tensile strength of dry specimens.

7. Report

None.

Note: Average indirect tensile strength of wet conditioned specimens and the Tensile Strength Ratio are included on the asphalt mix design information sheet Form MD416.

Method of Quartering Bituminous Mixtures

SC T 72

1. Scope

This method is for use in obtaining the required size bituminous mixture sample for testing. In most instances, bituminous mixtures are too large in size and must be reduced to obtain proper quantity for testing.

2. Referenced Documents

2.1 SC Test Method
- T 62 Sampling of Bituminous Materials
- T 100 Random Method of Sampling Highway Construction Materials

3. Apparatus

3.1 Clean, smooth, metal table
3.2 Trowel
3.3 5-gallon pail or sample bag

4. Test Specimen

4.1 5-gallon pail or sample bag of asphalt mixture

5. Procedure

5.1 Obtain sample of bituminous mixture for a random location determined by SC T 100, and by following the sample method in SC T 62.
5.2 Invert sample bucket (or bag) with mixture on a clean, smooth, metal table.
5.3 Using a trowel, gently slice into the mixture so the mixture spreads into a near circular layer with uniform thickness and with as little segregation as possible. Divide into quarters by two lines intersecting at right angles at the center.
5.4 Place the diagonally opposite quarters (i.e., 2 and 3 or 1 and 4) in a sample bag immediately or discard as required. Clean and discard all fines from trowel.
5.5 The remaining opposite quarters should be pulled together. (DO NOT remix to avoid segregation). “Quarter” again until required sample size is obtained.
5.6 Once sample size is obtained, clean both sides of the trowel with the edge of the table or a straight edge, and place a quarter of the fines in the sample to be tested.

6. Calculation - None
7. Report - None

Testing the Detrimental Effects of Asphalt Release Agents on Asphalt Mixtures

SC T 74

1. Scope

This test method covers the testing and acceptance of truck bed release agents and determines whether or not a release agent is detrimental to an asphalt mixture.

2. Referenced Documents

2.1 AASHTO Standards
M 231
T73

3. Apparatus

3.1 500 ml glass beaker
3.2 Balance - conforming to the requirements of AASHTO M231, class G2.

4. Test Specimen

4.2 Diluted asphalt release agent.

5. Procedure

5.1 Obtain approximately 150 grams of 121°C-135°C(250°F-275°F) asphalt mixture meeting the requirements of a Surface Type C. Obtain approximately 200 ml of truck bed release agent diluted to its specified working concentration.

5.2 Pour the diluted release agent into the glass beaker. Carefully submerge the hot asphalt into the release agent. Make sure the asphalt is completely covered and allow the asphalt to remain in the agent for 2 hr ± 10 min. Decant the release agent into an approved container. Pour the asphalt mixture onto a piece of paper and set aside. With a clean white paper towel, wipe the inside of the beaker making sure to completely remove all residue. Examine the paper towel. If an excessive amount of asphalt residue is noted, the release agent will be considered detrimental to asphalt mixtures.

5.3 Test a sample of the undiluted release agent with the Pensky-Martens Closed Cup Flash Point procedure (AASHTO T 73). The undiluted release agent must have a flash point greater than 60°C (140°F).

6. Calculations

None.

7. Report

None.

Determination of Asphalt Binder Content for Asphalt Paving Mixtures by the Ignition Oven

SC T 75

1. Scope

This method covers the determination of asphalt binder content of hot-mixed paving mixtures by ignition of the asphalt binder in a furnace.

Safety Notice: This procedure involves temperatures in the range of 650°C (1200°F) and will require the technician to wear appropriate safety protection during portions of the testing. Some steps in the procedure, which are known to involve high temperatures, are highlighted with a notice concerning the use of proper safety equipment. The absence of a warning does not necessarily mean that all material and equipment is safe to handle. The technician should use caution during each step of the procedure.

2. Referenced Documents

2.1 AASHTO Standards
- M 231 Weighing Devices Used in Testing of Materials

2.2 SC Test Methods
- T 62 Sampling of Bituminous Mixtures
- T 72 Method of Quartering Bituminous Mixtures
- T 76 Determination of Washed Aggregate Gradation of Extracted Aggregates

3. Apparatus

3.1 A forced air ignition furnace, capable of maintaining 650°C (1200°F), with an internal balance or load cell thermally isolated from the furnace chamber and accurate to 0.1 gm. The balance shall be capable of weighing a 3,500 gm sample in addition to the sample baskets. If needed, the furnace shall calculate a temperature compensation factor for the change in weight of the sample baskets (**See note*). The furnace shall provide a printed ticket with the initial specimen weight, specimen weight loss, temperature compensation (if needed), aggregate correction factor, correct asphalt binder content (%), test time and test temperature. The furnace chamber internal volume shall be at least 34,000 cm^3 (1.2 ft^3). A method for reducing furnace emissions shall be provided. The furnace shall provide an audible alarm and indicator light when the sample weight loss does not exceed 0.2 grams for two (2) consecutive minutes. The furnace door shall be locked until the completion of the test procedure.

** Note: Not all ovens may require the use of a temperature compensation factor. Check with the oven manufacturer to determine if this factor is necessary.*

3.2 Two (2) or three (3) tempered stainless steel 2.36 mm (No. 8) mesh or otherwise perforated baskets, dimensioned to properly fit inside the oven. The baskets shall be nested and shall be provided with screening on the legs to confine the aggregate.
3.3 One (1) stainless steel catch pan with dimensions slightly wider and longer than the stainless steel baskets and approximately 2.6 cm (1.0 in.) in height.
3.4 Oven capable of maintaining 125±5°C (257±9°F), inside volume of at least 70,800 cm^3 (2.5 ft^3).
3.5 Balance, 8 kg or greater capacity, sensitive to 0.5 gm for weighing sample in baskets, meeting the requirements of AASHTO M 231.
3.6 Miscellaneous Equipment: Pan dimensions (cm) 38L x 38W x 5D (15 x 15 x 2 in.) minimum for transferring samples after ignition, spatulas, bowls and wire brushes.
3.7 Safety equipment: Safety glasses, face shield, high temperature gloves, long sleeve jacket or apron. Additionally, a heat resistant surface capable of withstanding 650°C (1200°F) and a protective cage capable of surrounding the sample baskets shall be provided.

4. Test Specimen

4.1 The sample shall be the end result of quartering a larger sample taken in accordance with SC T 62, except that the sample size which will be determined from Table 1 below. The sample will be properly quartered to the required testing size following SC T 72.

When the mass of the test specimen exceeds the capacity of the equipment used, the test specimen may be divided into suitable increments, tested and the results appropriately combined for calculation of the asphalt binder content (weighted average). It is recommended the sample sizes should not be more than 400 gms greater than the minimum recommended sample mass. Large samples of fine mixes may result in incomplete ignition of the asphalt binder.

Table 1. Size of Sample

Nominal Maximum Aggregate Size, mm	Minimum Mass of Sample, gms
4.75 (No. 4)	1200
9.5 (3/8 in.)	1200
12.5 (1/2 in.)	1500
19.0 (3/4 in.)	2000
25.0 (1.0 in.)	3000
37.5 (1.5 in.)	4000

4.2 If the mixture is not sufficiently soft to separate with a spatula or trowel, place it in a large flat pan and warm it to 125±5°C (257±9°F) for 25 minutes. The sample shall not be heated for more than 1 hour.

4.3 A specimen for moisture determination may be made as deemed necessary. This specimen may not be used for asphalt binder content determination.

5. Procedure

5.1 Mixture Calibration - *General:* Before testing may be performed on an asphalt mixture, the oven must be calibrated using the mixture. The mixture shall be calibrated following this procedure using the entire mixture. The use of aggregate-only calibration will not be permitted.

RAP Mixtures: For mix designs containing RAP, a sufficient quantity of RAP should be sampled such that the binder content of the RAP may be estimated and to provide for the RAP to be used in the mix calibration. The binder content of the RAP will be estimated from the average of four (4) samples (RAP only) burned in the furnace. The portions of RAP should be obtained using a sample splitter.

5.1.1 This ignition procedure may be affected by the type aggregate in the mixture. Therefore, to optimize accuracy, a calibration factor will be established by testing a set of calibration samples for each mix. This procedure must be performed before any acceptance testing is completed.

5.1.2 Calibrated specimen conforming to the mass requirements of Table 1 shall be prepared at the design asphalt binder content and at ± 0.5% of the design asphalt binder content for a total of three (3) specimens. A butter mix shall be prepared at the design asphalt binder content, mixed and discarded prior to mixing any of the calibration specimens.

Aggregate, hydrated lime and asphalt binder used for the calibration specimens shall be representative of the material used in the mix. This may require the use of aggregate sampled from current stockpiles located at the plant for which the mix is, or will be produced.

Any method may be used to combine the aggregates, however, an additional "blank" specimen with no asphalt binder shall be batched and tested according to SC T 76. The washed gradation shall fall within the Job Mix allowable tolerances.

5.1.3 Preset the ignition furnace to 538±10°C (1000±18°F)**. Record the furnace temperature prior to the initiation of the test (set point).

***Note: The temperature listed above is to be used on most mixes, however, some mixes may have more aggregate breakdown at this high temperature than others. If it is determined during calibration that the mix is breaking down excessively, a lower ignition temperature may be used. If a lower temperature is used for calibration, then this temperature shall be recorded and used on any future tests involving that* *mix. Using a lower temperature will cause the time for complete burning to increase.*

5.1.4 Place the freshly mixed specimens directly into the sample baskets. If the specimens were allowed to cool, preheat them in an oven at 125±5°C (257±9°F) for 25 ± 5 minutes. Do not preheat the sample baskets.

5.1.5 Enter the correction factor of *0.0* in the ignition furnace. Weigh and record the weight of the sample baskets and batch pan (with guards in place) as W_b.

5.1.6 Place the sample basket into the catch pan. Evenly distribute the calibration specimen in the baskets taking care to keep the material away from the edges of the basket. Evenly distribute the specimen in the baskets using a spatula or trowel to level the specimen. Weigh and record the total weight of the sample, baskets, catch pan and basket guards (W_T). Calculate (Eqn. 1) and record the initial weight of the sample specimen (W_i).

$$W_i = W_T - W_b \quad \text{.......... Eqn. (1)}$$

5.1.7 Input the initial weight of the sample specimen (W_i) into the ignition furnace controller. Verify the correct weight has been entered.

5.1.8 ***For this next step, appropriate safety gear should be worn.*** Open the chamber door and place the sample baskets in the furnace. Be careful not to slide the basket on the floor of the furnace. Close the chamber door and verify that the total sample weight displayed on the furnace scale or load cell equals the total weight recorded as W_T (Eqn. 1), within ± 5 gms. A difference greater than 5 gms or failure of the furnace scale to stabilize may indicate that the sample baskets are contacting the furnace wall.
Initiate the test by pressing the start/stop button. At this point the chamber door will lock and will not open until the test is complete. The printer will begin recording the test results. Allow the test to continue until the stable light and audible stable indicator indicates the test is complete. The final weight of the sample will be denoted W_f.

5.1.9 ***Wearing protective gear***, open the chamber door and remove the sample baskets using the proper tool and place on a temperature resistant block. Cover the baskets with a protective cage and allow to cool to room temperature (approx. 30 minutes).

5.1.10 Once all of the calibration specimens have been burned, determine the difference ($\%AC_{DIFF}$) between the actual ($\%AC_{ACT}$) and measured ($\%AC_{MEAS}$) asphalt binder contents for each sample (Eqn. 2). The mix correction factor (C_F) is the average of the measured differences (Eqn. 3).

$$\%AC_{DIFF} = \%AC_{ACT} - \%AC_{MEAS} \quad \text{.......... Eqn. (2)}$$

$$C_F = [\%AC_{DIFF}(1) + \%AC_{DIFF}(2) + \%AC_{DIFF}(3)]/3 \quad \text{.......... Eqn. (3)}$$

Note: The correction factor (C_F) is the number (either + or -) that will bring the tested asphalt binder content back to the original amount entered. If the oven consistently gives a higher $\%AC_{MEAS}$, then the correction factor will be a negative number and will be subtracted from the final test result.

5.2 Verification and Update of Calibration Correction Factor

5.2.1 The mix calibrations should be checked and updated on a routine basis, or as often as is required. The following steps indicate how to properly verify and update the mix calibration factor:

5.2.2 Prepare a specimen at the optimum asphalt binder content in the same manner in which specimens were prepared in the mixture calibration. Instead of three (3) calibration specimens there will only be one (1).

5.2.3 Preset the ignition furnace to 538 ± 10°C (1000 ± 18°F). Record the furnace temperature prior to the ignition of the test (set point). If a lower oven temperature was used for calibration, record and use that temperature for verification testing as well.

5.2.4 Place the freshly mixed specimen directly into the sample baskets. If the specimen was allowed to cool, preheat it in an oven at 125 ± 5°C (257 ± 9°F) for 25 ± 5 minutes. Do not preheat the sample baskets.

5.2.5 Enter a correction factor of *0.0* in the ignition furnace. Weigh and record the weight of the sample baskets and catch pan (with guards in place) as W_b.

5.2.6 Follow the same steps as outlined in the mixture calibration procedure to completely burn the specimens. When the test is complete use the following formula to calculate the % AC difference ($\%AC_{DIFF\ (Verify)}$).

$$\%AC_{DIFF\ (Verify)} = \%AC_{ACT} - \%AC_{MEAS} \quad \text{.................................Eqn. (2)}$$

5.2.7 The % AC difference between Eqn. 2 is to be factored into the current correction factor being used for the mix design as a weighted average using the following method:

Add the new % AC difference (from Eqn. 2) to three (3) times the current correction factor and divide the total by four (4). See Eqn. 4 for more detail. This product becomes the new correction factor to be used for that mix design.

$$C_{F\ (New)} = [\%AC_{DIFF\ (Verify)} + (3 \times C_{F\ (CURRENT)})\ ] / 4 \quad \text{...............Eqn. (4)}$$

Each time the correction factor is verified, the new correction factor should be averaged into the previous correction factor using Eqn. 4.

5.3 Asphalt Binder Content Determination Test Procedure

5.3.1 Allow ignition furnace to preheat to 538 ± 10°C (1000 ± 18°F). Record the furnace temperature (set point) prior to the initiation of the test. If needed, the temperature correction factor will be denoted T_{CF}. If a lower oven temperature was used for calibration, record and use that temperature for sample testing as well. At room temperature, weigh the sample baskets and catch pan (with guards in place). Record this weight as W_b.

5.3.2 Prepare the sample as described in "Section 4, Test Specimen," by heating for 25 ± 5 minutes in an oven at 125 ± 5°C (257 ± 9°F). Place the sample basket in the catch pan. Evenly distribute the sample in the baskets taking care to keep the material away from the edges of the baskets. Use a spatula or trowel to level the specimen.

5.3.3 Weigh the sample, baskets, catch pan and basket guards and record weight as W_T. Calculate and record the initial weight of the sample specimen (W_i) using Eqn. 1.

$W_i = W_T - W_b$ .... Eqn. (1)

5.3.4 Input the initial weight of the sample specimen (W_i) into the ignition furnace controller. Verify that the correct weight has been entered.

5.3.5 ***For this next step, appropriate safety gear should be worn***. Open the chamber door and place the sample baskets in the furnace. Close the chamber door and verify that the total sample weight displayed on the furnace scale or load cell equals the total weight recorded in Eqn. 1 as W_T, within ± 5 gms. A difference greater than 5 gms or failure of the furnace scale to stabilize may indicate that the sample baskets are contacting the furnace wall.

Initiate the test by pressing the start/stop button. At this point the chamber door will lock and will not open until the test is complete. The printer will begin recording the test results. Allow the test to continue until the stable light and audible stable indicator indicates that the test is complete. The final weight of the sample will be denoted W_f.

5.3.6 ***Wearing protective gear,*** open the chamber door and remove the sample baskets using the proper tool and place on a temperature resistant block. Cover the baskets with a protective cage and allow to cool to room temperature (approx. 30 minutes). If a gradation analysis is desired, empty the contents of the baskets into a flat pan (be sure all fines are removed) and perform the gradation analysis.

6. **Calculation -** Asphalt Binder Content

6.1 The ignition oven shall automatically calculate the corrected asphalt binder content of the sample based on Eqn. 5 and Eqn. 6. ***Be sure to use the correct sign (+ or -) when using the correction factors.***

$\%AC_{UNCORRECTED} = [(W_i - W_f)/W_i] \times 100\%$.................................... Eqn. (5)

$\%AC_{CORRECTED} = \%AC_{UNCORRECTED} + C_F + T_{CF}$ (if needed)...............Eqn. (6)

6.2 Example Calculation

6.2.1 Example Mixture Calibration (3 Specimens), All weights in grams.

Sample No.		1	2	3
Test Temperature	T (°C)	535	537	538
Known % AC	AC_{ACT}	5.7	6.2	6.7
Wt. Basket	W_b	3326.2	3326.1	3324.3
Wt. Basket + Sample	W_T	4518.7	4519.2	4518.4
Wt. Sample	$W_i = W_T - W_b$	1192.5	1193.1	1194.1
Measured % AC	AC_{MEAS}	5.60	6.15	6.67
Difference	$AC_{DIFF} = AC_{ACT} - AC_{MEAS}$	0.10	0.05	0.03
Correction Factor	C_F = [Avg. AC_{DIFF}] /3	**0.06**		

6.2 Example Test Procedure (Unknown Specimen)

Calibration Factor	C_F	0.06
Test Temperature	T (°C)	538
Temperature Compensation Factor	T_{CF}**	0.01
Wt. Basket	W_b	3325.8
Wt. Basket + Sample	W_T	4516.5
Wt. Sample (Initial)	$W_i = W_T - W_b$	1190.7
Wt. Sample (Final)	W_f	1117.9
Uncorrected % AC	% $AC_{UNCORRECTED}$ = [(W_i - W_f)/W_i] x 100%	6.11
Corrected % AC	% $AC_{CORRECTED}$ = % $AC_{UNCORRECTED}$ = + C_F **	6.18

***Note: Use T_{CF} only if needed*

7. Report

Information to be reported: Corrected asphalt binder content, mix correction factor, temperature compensation factor (if needed), total percent loss, sample mass and test temperature. Attach the original printed ticket to the report. Test results are reported on Lab Form MD418, MD419, MD420.

Determination of Washed Aggregate Gradation of Hot Mix Asphalt Extracted Aggregates

SC T 76

1. Scope

This method covers the determination of combined silt and clay material passing the 75-µm (No. 200) sieve and the mechanical analysis of hot mix asphalt extracted aggregate.

2. Referenced Documents

2.1 AASHTO Standards
M 231 Weighing Devices Used in Testing of Materials

3. Apparatus

3.1 Sieves: Standard sieves with square openings. For the washing: A 600-µm (No. 30) sieve nested on a 75-µm (No. 200)
3.2 Balance, of sufficient capacity and accuracy meeting the requirements of AASHTO M 231
3.3 Wetting/disbursing agent (eg. Calgon)
3.4 Container (bowl) of sufficient capacity to hold the entire sample
3.5 Oven, capable of maintaining 125±5°C (257±9°F)
3.6 Miscellaneous items: Brush, trowel or spoon
3.7 Potable water
3.8 Mechanical shaker (e.g. Rotap)

4. Test Specimen

4.1 The sample size used for conducting this test will be based on the amount of material remaining after a solvent extraction or ignition oven test has been performed. Unless otherwise indicated, this test will use the entire sample remaining after performing one of the aforementioned tests.

5. Procedure

5.1 Place the entire sample at room temperature into a container. Use a brush to be sure that all of the fine material is transferred into the container. Material which has been allowed to sit for several hours, or has been obtained through solvent extraction, shall be heated in an oven at 125±5°C (257±9°F) until it is dried to constant weight. The sample and pan shall be weighed and the weight recorded to the nearest 0.1 gm as W_{Ti}. The weight of the empty container shall be recorded as W_C.

5.2 Cover the sample completely with water. Add a sufficient amount of wetting agent to assure a thorough separation of fine material from the coarser particles. Immediately stir the contents of the container vigorously with a trowel or spoon or approximately 10 to 15 seconds. Allow the material to sit and soak for a total of 5 minutes. Stir the sample once more in the middle of this time period and again at the end of the time period for a total of 3 stirrings.

5.3 At the end of the time period, after the material has been stirred for the final time, immediately pour the wash water through a nest of sieves consisting of a 600-µm (No. 30) sieve nested on a 75-µm (No. 200) sieve. Care should be taken to avoid spilling any of the larger particles onto the sieve nest.

5.4 An additional amount of water should be added to the container to again cover the sample completely. The sample should be immediately stirred and then decanted through the same nest of sieves. The sample should not be allowed to sit and soak. Repeat this rinsing and decanting until the wash water becomes clear.

5.5 Any material which is retained on the nest of sieves shall be carefully washed back into the container. The sample and container shall be placed in an oven at 125±5°C (257±9°F) and dried to constant weight. After drying, the material will be removed from the oven and immediately weighed before any moisture can be absorbed. The total weight of the sample and pan is designated as W_{TF}.

6. Calculations

6.1 Fine Aggregate Wash

Table 1 indicates the calculations necessary to compute the total amount of material passing through the 75-µm (No. 200) sieve. All weights are in grams.

Table 1. Aggregate Wash Calculations

Original Sample		**Example Calculations**
Initial Wt. Sample & Container	W_{Ti}	1645.0
Wt. Of Container	W_C	500.0
Initial Sample Wt.	$W_i = W_{Ti} - W_C$	1145.0
Material Dried		
Wt. Sample & Container After Drying	W_{Tf}	1635.0
Wt. Of Container	W_C	500.0
Final Sample Wt.	$W_f = W_{Tf} - W_C$	1135.0
Total Loss Thru 75-µm (No. 200) sieve	$W_L = W_i - W_f$	10.0

6.2 Mechanical Analysis of Extracted Aggregate

6.2.1 The aggregate sample shall be introduced into a nested set of sieves corresponding to the required fraction sizes. Be sure to brush all fine material from the container. The sample shall be subjected to mechanical shaking for a period of 15 ± 1 minutes.

Note: If the sample size is greater than that allowed for the nest of sieves, the sample shall be split into smaller portions and subjected to shaking separately. When complete, the weight passing a given sieve size for each sample shall be added to each corresponding sieve size. The total amount of material from all sets of sieves shall be used in determining the percent passing each individual sieve.

6.2.2 Invert the nest of sieves by removing the top size sieve and using it as the bottom. Remove the individual sieves and stack them on top of each until the pan is on top. Begin weighing and recording the amount of material contained in each sieve starting with the pan and proceeding cumulatively to the largest sieve containing material. Record the cumulative weight for the entire sample.

6.3 Mechanical Analysis Calculations

6.3.1 Add the amount of material washed through the 75-µm (No. 200) sieve (W_L) back to each individual sieve fraction as shown in Table 2. Calculate the percentage of material passing each individual sieve as a portion of the entire sample with the washed material added back. Table 2 shows an example of these calculations.

Table 2. Example Mechanical Analysis Calculations

Sieve Size	Wt. Passing (gms.)	+ W_L (gms.)	= Total Wt. Passing (gms.)	Total % Passing
19.0-mm	1135	10	1145	100.0
12.5-mm	1079	10	1089	95.1
9.5-mm	908	10	918	80.2
4.75-mm	646	10	656	57.3
2.36-mm	443	10	453	39.6
600-µm	261	10	271	23.7
150-µm	136	10	146	12.8
75-µm	85	10	95	8.30

7. Report

Total percent passing of required sieves. Test results are reported on Forms MD418 or MD420.

Preparation, Verification and Approval of Asphalt Mix Designs

SC T 80

1. Scope

This method outlines the procedure for submitting asphalt mix designs to the Research and Materials Laboratory for preparation, verification and approval.

2. Referenced Documents

2.1 AASHTO Standards
- T 245 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

2.2 SC Test Methods
- SC T 68 Determination of Percent Air Voids and Percent Voids in Mineral Aggregate in Compacted Marshall Specimens
- SC T 83 Determination of Maximum Theoretical Specific Gravity

3. Apparatus

3.1 Refer to reference documents for a listing of equipment needed to complete a Marshall mix design.

4. Test Specimens

4.1 A SCDOT certified HMA Design Technician (Level 2S) must submit the following items for verification of each Asphalt Mix Design along with the appropriate form and all Marshall, moisture susceptibility and maximum gravity data. These tests must be performed in an SCDOT certified mix design lab.

4.1.1 Two Marshall specimens, at each point, prepared just above and below optimum binder content. (i.e. – Optimum is set at 4.8%, submit specimens at 4.5% and 5.0%.)

4.1.2 One Maximum Theoretical Specific Gravity sample. Usually prepared at highest binder content and made at same batch weight of Marshall cores.

4.1.3 Three blended aggregate samples at Marshall batch weight, for check samples.

4.1.4 Two blended aggregate samples at 4500 grams batch weight.

5. Procedure

5.1 These steps will be performed by the Materials and Research Office.

5.1.1 Determine the Bulk Specific Gravities (BSG) of the Marshall specimens using SC T 68. The average BSG of each set of cores must compare within 0.020 of the contractor's BSG.

5.1.2 Perform SC T 83 to calculate the Maximum Theoretical Specific Gravity (MSG). The Departments test results must compare to the contractor's MSG within 0.018.

5.1.3 If either sets of Marshall cores, or the MSG, do not compare, then the Department will use the blended aggregate samples to check specimens. If the specimens still do not compare to the contractor's tests the contractor will be required to redesign the mix. If the check specimen compares to the contractor's original specimen, then the original data will be used.

5.1.4 Moisture susceptibility, stability and other test reports will be reviewed and may require verification.

6. Calculations

As per AASHTO T 245 and SC T 83

7. Report

None.

Note: The Department will prepare an information sheet with the contractor's name, plant location, and volumetric data, along with approval and expiration dates and other information. The information sheet will be kept on file at the Department and a copy will be sent to the contractor. The information sheet is Form MD416.

Determination of Maximum Theoretical Specific Gravity

SC T 83

1. Scope

This method covers the determination of the maximum specific gravity of uncompacted bituminous paving mixtures.

2. Referenced Document

2.1 SC Test Methods
T 80 Preparation, Verification and Approval of Asphalt Mix Designs

3. Apparatus

3.1 All equipment shall be calibrated at appropriate intervals and records keep in laboratory for review.

3.1.1 Balance – 12 K electronic balance with a suitable suspension apparatus. Suspension wire should be the smallest practical size to minimize any possible effects of a variable immersed length.

3.1.2 Metal container or a volumetric metal flask - Having a capacity of at least 1000-ml. The container must have a cover fitted with a rubber gasket and a hose connection. The hose opening shall be covered with a small piece of No. 200 wire mesh to minimize the possibility of loss of fine material.

3.1.3 Thermometer – Calibrated liquid-in-glass, total immersion type, 77 °F Mercury thermometer with gradations at every 0.2 °F minimum.

3.1.4 Vacuum pump - Capable of pulling a vacuum of 27-mm Hg absolute pressure continuously for at least 15 minutes. The assembly shall have a calibrated gauge or a manometer to show actual pressure.

3.1.5 Water Bath – Capable of maintaining a constant temperature of 77 ± 1.8°F (25 ± 1 °C) throughout the entire area of the bath. The bath shall have a method of continuously circulating the water and controlling water temperature.

4. Test Specimen

4.1 For Field Testing - The sample should be obtained in accordance with AASHTO T-168, Sampling Bituminous Paving Mixtures. The size will be governed by the nominal maximum aggregate size of the mixture and conform to the table below.

Nominal Maximum Size of Aggregate *		Minimum Mass of Sample
mm.	inches	Kg.
25.0	1	2.5
19.0	¾	2.0
12.5	½	1.5
9.5	?	1.0
4.75	No. 4	0.5

Figure SC-T-83-A – Nominal aggregate size

* NOTE – Nominal Maximum Aggregate Size is defined as one sieve size larger than the first sieve to retain more than 10%

For Laboratory Testing – Weigh and mix Maximum Theoretical Specific Gravity samples as per SC-T-80.

5. Procedure

5.1 Before obtaining the sample, determine which metal container will be used and obtain a dry weight (A) to the nearest 0.1 gm. Submerge the container in the 77 °F water bath for 10 min. and record the submerged weight (D) to the nearest 0.1 gm. Thoroughly dry the container when finished weighing.

5.2 Separate the particles of the sample, taking care not to fracture the mineral particles, so that the particles of fine aggregate portion are not larger than 6.5 mm (1/4 in.). If needed, slightly heat material in a flat pan to ensure separation.

5.3 Cool the samples to room temperature and place in the metal container. Determine the mass of the sample and the metal container (B) to the nearest 0.1 gm.

5.4 Add sufficient 77 ± 1.8 °F (25 ± 1 °C) potable water to cover the sample. To aid in the release of entrapped air, add a suitable wetting agent such as Aerosol OT in concentration of 0.01 percent.

5.5 Remove entrapped air by subjecting the contents to a vacuum of at least 27 mm Hg absolute pressure continuously for 15 ± 2 minutes. Agitate the container and contents by mechanical device or manually by vigorous shaking at minimum intervals of 2 minutes.

5.6 Suspend the container and sample in water at 77 ± 1.8 °F (25 ± 1 °C) and record its mass (E) to the nearest 0.1 gm. after 10 ± 1 minutes.

6. Calculations

6.1 Wt. of sample (C) = Wt. of sample and container (B) – Wt. of container (A)

6.2 Wt. of submerged sample (F) = Wt. of sample and container in water (D) – Wt. of container in water (E)

6.3 Maximum Theoretical Specific Gravity = C/(C - F)

7. Report

7.1 Record the Maximum Theoretical Specific Gravity (to the nearest 0.001), which will be used in the calculation of the percent air voids after the Bulk Specific Gravity is obtained. Test results are recorded on Form MD418.

Inspection and Approval of Asphalt OGFC Mix Designs

SC T 88

1. Scope

This method outlines the procedure for submitting asphalt open graded friction course mix designs to the Research and Materials laboratory for preparation, verification, and approval.

2. Referenced Documents

2.1 AASHTO Standards
T11
T27
T245

2.3 SC Test Methods
SC T 90 Method for Determining the Drain-Down Characteristics in an Uncompacted Bituminous Mixture
SC T 91 Method for Determining the Optimum Binder Content in an Uncompacted Bituminous Mixture
SC T 88 Inspection and Approval of Asphalt OGFC Mix Designs

3. Apparatus

3.1 Refer to reference documents for a listing of equipment needed for Marshall mix design, and Superpave design.

4. Test Specimens

4.1 A SCDOT certified HMA Design Technician (Level 2S) must submit the following items for verification of each OGFC along with the appropriate form and all OGFC data, including optimum asphalt content, and drain down test information. These tests must be performed in an SCDOT certified mix design lab.

4.1.1 Three test specimens, each specimen blended with binder, weighing approximately 1000 grams total. The specimens should be mixed at the optimum asphalt binder content, one 0.5 % above, and one 0.5 % below optimum asphalt binder content.

4.1.2 One asphalt drain down specimen blended with binder, weighing approximately 350 grams total. This will be used to see if asphalt binder drain down is excessive.

4.1.3 One 1000 grams batch, without asphalt binder, to be used for a check sample.

4.1.4 Containers of Polymer Modified Asphalt Binder, and mineral fibers need to be submitted, if individual contracts state use of these products.

5. Procedure

5.1 These steps will be performed by the Office of Materials and Research.

5.1.1 Verify and determine the optimum asphalt content of the OFGC asphalt blend. The mixtures are place into clear pyrex dishes, and allowed to stand inside an calibrated oven at mixing temperature for 2 hrs. The optimum asphalt content is determined by judging the appearance of the asphalt through the pyrex dishes.

5.1.2 Perform SC-T-90 to determine the amount of drain down at optimum asphalt binder content. This will eliminate the use of excessive binder content in the OFGC.

5.1.3 If either OGFC blends do not compare, then the Department will use the blended aggregate sample to check, or verify contractor's test results as deemed necessary by the Office of Materials and Research personal.

6. Calculations

6.1 As per AASHTO T-11, AASHTO T-27, and SC-T-90

7. Report

None.

Note: The department will prepare an information sheet with the contractor's name; plant location, and OGFC data, along with approval and expiration dates and other information. The information will be kept on file at the Department and a copy will be sent to the contractor. The information sheet is Form MD416.

Method For Determining Drain-Down Characteristics
In An Uncompacted Bituminous Mixture

SC T 90

1. Scope

This test method covers the determination of the amount of drain-down in an uncompacted bituminous mixture. This test is applicable to Open Graded Friction Course (OGFC) and Stone Matrix Asphalt (SMA) mixtures.

2. Referenced Documents

2.1 AASHTO Standards
M 92 Wire-Cloth Sieves for Testing Purposes
2.2 SC Test Methods
SC T 62 Sampling of Bituminous Mixtures
SC T 72 Method of Quartering Bituminous Mixtures

3. Apparatus

3.1 Oven capable of maintaining a temperature of 400 $\pm$ 5°F.

3.2 9-inch paper plated capable of withstanding test temperatures of 350 $\pm$ 5°F.

3.3 Standard basket meeting the dimensions shown in Figure A. The basket shall be constructed of standard 6.3-mm (0.25-inch) wire sieve cloth as specified in AASHTO M92.

3.4 Spatulas, trowels, mixer, and bowls as needed

3.5 4000 gram balance accurate to 0.1 grams.

4. Test Specimens

4.1 Laboratory Prepared Samples

4.1.1 Two samples are required for this test.

4.1.2 Dry aggregate to a constant mass. Sieve to appropriate size fractions as indicated in the job mix formula.

4.1.3 Select a mixing temperature of the binder using the temperature-viscosity curve or as recommended by supplier.

4.1.4 Weigh into separate pans for each test sample the amount of each size aggregate fraction required by the job mix formula to produce sample having a total mass of approximately 1200 grams. Place the samples in an oven and heat to a temperature not to exceed the mixing temperature of the binder by more than 50^{o}F.

4.1.5 Heat the binder to mixing temperature as determined in 4.1.3

4.1.6 Place the heated aggregate in the mixing bowl. Add stabilizing fibers and/or other dry admixtures as specified to the dried aggregate. Thoroughly mix the dry components before the addition of the binder. Form a crater in the aggregate and add the required amount of binder as established in SC-T-90. At this point, the temperature of the aggregate and binder shall be within the limits established in 4.1.3. Mix until aggregate is thoroughly coated.

4.2 Plant Produced Samples

4.2.1 Two samples shall be required from plant-produced mixture.

4.2.2 Sampling shall be in accordance to SC-T-62. Quarter mixture in accordance to SC-T-72 until a total mass of 1000 – 1500 grams are obtained.

5. Procedure

5.1 Transfer the laboratory or plant-produced loose mixture to the tared test basket. Do not consolidate or otherwise disturb the sample. Determine the mass of the sample to the nearest 0.1-gram. (W)

5.2 Record the mass of a paper plate to the nearest 0.1-gram. (P_i) Place the basket on the paper plate and transfer the assembly into the oven set at 350 $\pm$ 5^{o}F.

5.3 After the sample has been in the oven for 1 hour, remove the basket and paper plate. Record the mass of the paper plate plus the drained binder to the nearest 0.1-gram. (P_f)

6. Calculations

6.1 Calculate the percentage of mixture that drained by subtracting the initial paper plate mass from the final paper plate mass and divide this by the initial sample mass. Multiply the result by 100 to obtain a percentage.

$$D = \frac{(P_f - P_i)}{W} * 100$$

Where:

P_i = Initial paper plate mass (grams)
P_f = Final paper plate mass (grams)
W = Mixture mass (grams)
D = % Drain-down

7. Report

None.

Note: The average percentage drain-down to the nearest 0.01% is included on the asphalt mix design information sheet Form MD416.

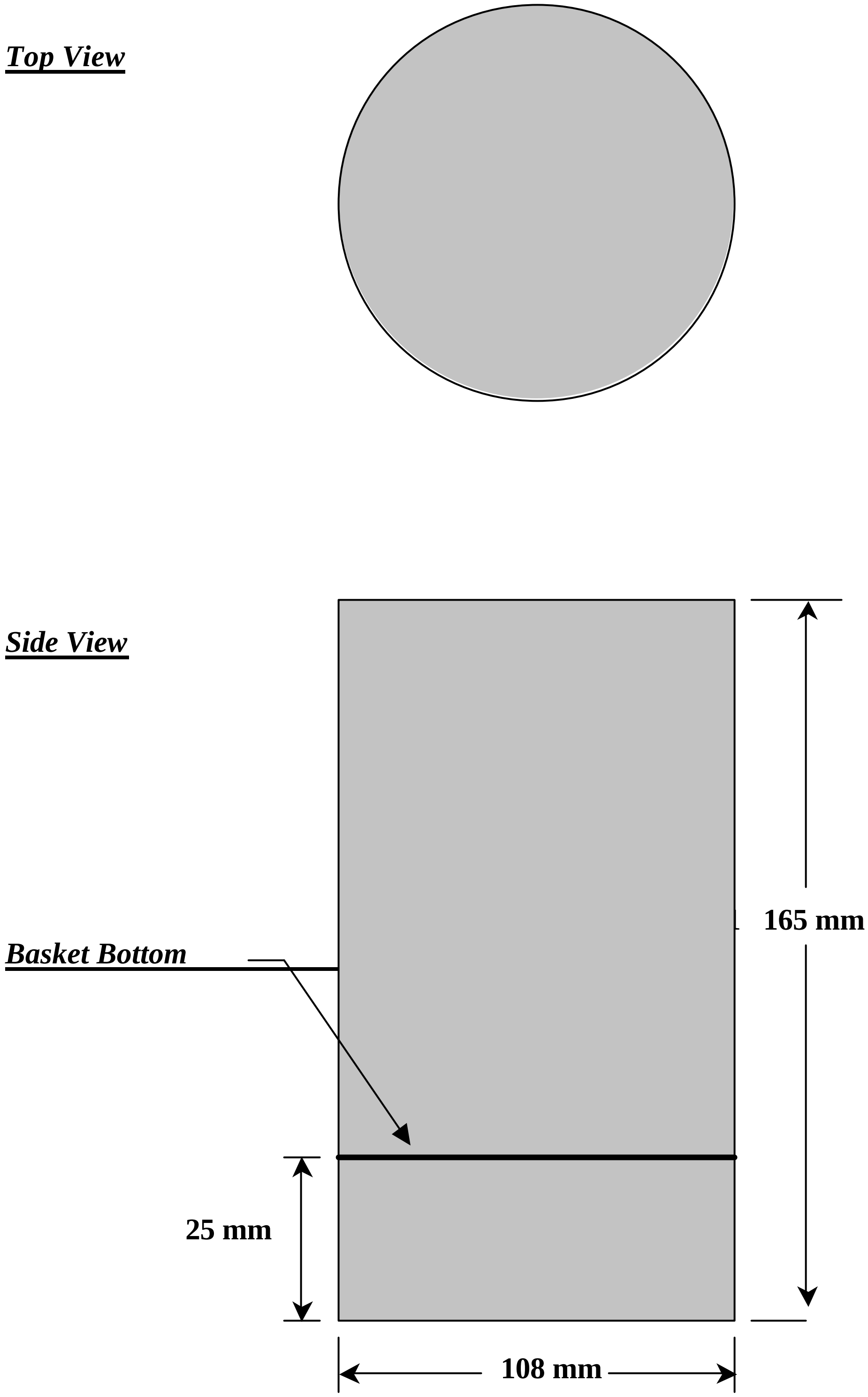


Figure A – Wire basket assembly

Method Of Determining The Optimum Binder Content In An Uncompacted Bituminous Mixture

SC T 91

1. Scope

This method outlines the procedure for designing and preparing an uncompacted bituminous mixture (OGFC) composed of crushed mineral aggregate, polymer modified binder, mineral fiber stabilizing additives, and hydrated lime to determine optimum binder content.

2. Referenced Documents

2.1 AASHTO Standards
T-11
T-27
T-245

2.2 SC Test Methods
SC T 88 Inspection and Approval of Asphalt OGFC Mix Designs
SC T 90 Method for Determining Drain-Down Characteristics in an Uncompacted Bituminous Mixture

3. Apparatus

3.1 Refer to reference documents for a listing of equipment needed for Marshall mix design, and Superpave design.

4. Test Specimens

4.1 A SCDOT certified HMA Design Technician (Level 2S) must prepare the uncompacted mixture design, and submit the appropriate form and all design data, including optimum asphalt content, and drain down test information.

4.1.1 Six test specimens, three sets of two specimens each should be blended with binder, weighing approximately 1000 grams total. The first set of two OGFC specimens should be mixed at the optimum asphalt binder content, two 0.5 % above, and two 0.5 % below optimum asphalt binder content.

4.1.2 One asphalt drain down specimen must be blended with binder at optimum binder content, weighing approximately 350 grams total. This will be used to see if there is enough asphalt binder retained.

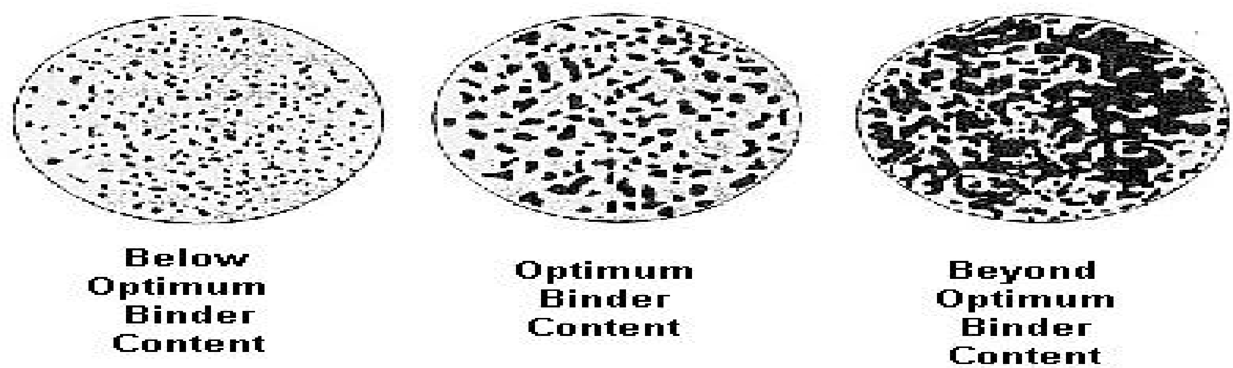
4.1.3 One 1000 grams batch, without asphalt binder, to be used for the SCDOT verification-check sample.

4.1.4 Containers of Polymer Modified Asphalt Binder, and mineral fibers need to be obtained and proportioned to the correct amounts.

5. Procedure

5.1 These steps will be performed by the Contractor's Level 2S technician.

5.1.1 Verify and determine the optimum asphalt content of the uncompacted asphalt blend. The mixtures should be placed into clear pyrex type dishes, which have minimum surface areas of at least 100 sq. in., and a minimum of 1 ½ in. of depth. The mix is allowed to stand inside a calibrated oven at mixing temperature for 2 hrs. The optimum asphalt content is determined by judging the appearance of the asphalt through the pyrex dishes. The optimum binder content should be determined by observing the excessive mixture draindown, or filling of un-compacted air voids through the pyrex dish. The technician must be careful not to allow the mixture to slide, or move while observing the uncompacted mixture.



5.1.2 Perform SC-T-90 to determine the amount of binder retention at optimum asphalt binder content. This will eliminate the use of excessive binder content in the OFGC. Adjustment of optimum binder content or dosage rate of mineral fibers may be required, in order to meet retention coating of the uncompacted mixture.

5.1.3 If either of the uncompacted blends do not compare, the technician must redesign a new mixture to meet SCDOT specifications.

5.1.4 Submit to the Office of Materials and Research the mix design results and at least one verification sample for mix verification and asphalt mix design approval.

6. Calculations

As per AASHTO T-11, AASHTO T-27, and SC-T-90

7. Report

None.

Concrete

Portland cement concrete is a hard, strong and durable material composed of aggregates, Portland cement, water, and various other admixtures and pozzolans. This section of the *Laboratory Procedures Manual* describes those tests performed on plastic and hardened concrete. Tests conducted on the various materials that are used in making concrete are included in the section titled "Concrete Constituents."

AASHTO T 24

This test is conducted in accordance with AASHTO T 24 without exception.

Test results are reported on Lab Form CON510.

Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

AASHTO T 97

This test is conducted in accordance with ASTM C 78 without exception.

Test results are reported on Lab Form CON511.

Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials

AASHTO T 260

This test is conducted in accordance with AASHTO T 260 without exception.

Test results are reported on Lab Form CON506.

Concrete Pipe, Manhole Section, or Tile

AASHTO T 280

This test is conducted in accordance with AASHTO T 280, Section 7.0 only.

Test results are reported on Lab Form CON509.

Compressive Strength of Cylindrical Concrete Specimens

ASTM C 39

This test is conducted in accordance with AASHTO T 22 without exception.

Test results are reported on Lab Form CON505.

Practice for Making and Curing Concrete Test Specimens in the Laboratory

ASTM C 192

This test is conducted in accordance with ASTM C 192 without exception.

There are no test results or calculations for this procedure.

Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes

ASTM C 511

This standard is followed in accordance with ASTM C 511 without exception.

There are no test results or calculations for this standard.

Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders

ASTM C 1231

This test is conducted in accordance with ASTM C 1231 without exception.

There are no test results or calculations for this procedure.

Method for Determining the Rebound Number of Hardened Concrete

SC T 49

1. Scope

This test method covers the determination of a rebound number of hardened concrete using a spring-driven steel hammer. The values stated in SI units are to be regarded as the standard.This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards
E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

3. Summary of Test Method

3.1 A steel hammer impacts with a predetermined amount of energy, a steel plunger in contact with a surface of concrete, and the distance that the hammer rebounds is measured.

4. Significance and Use

4.1 This test method may be used to assess the in-place uniformity of concrete, to delineate regions in a structure of poor quality or deteriorated concrete, and to estimate in-place strength development.

4.2 To use this test method to estimate strength requires establishing a relationship between strength and rebound number. The relationship shall be established for a given concrete mixture and given apparatus. The relationship shall be established over the range of concrete strength that is of interest. To estimate strength during construction, establish the relationship by performing rebound number tests on molded specimens and measuring the strength of the same or companion molded specimens. To estimate strength in an existing structure, establish the relationship by correlating rebound numbers measured on the structure with the strengths of cores taken from corresponding locations.

4.3 For a given concrete mixture, the rebound number is affected by factors such as moisture content of the test surface, the method used to obtain the test surface (type of form material or type of finishing), and the depth of carbonation. These factors need to be considered in preparing the strength relationship and interpreting test results.

5. Apparatus

5.1 Rebound Hammer, consisting of a spring-loaded steel hammer which when released strikes a steel plunger in contact with the concrete surface. The spring-loaded hammer must travel with a consistent and reproducible velocity. The rebound distance of the steel hammer from the steel plunger is measured on a linear scale attached to the frame of the instrument.

NOTE 1—Several types and sizes of rebound hammers are commercially available to accommodate testing of various sizes and types of concrete construction.

5.2 Abrasive Stone, consisting of medium-grain texture silicon carbide or equivalent material.

5.3 Test Anvil, Approximately 150-mm (6-in.) diameter by 150-mm (6-in) high-carbon tool steel cylinder with an impact area hardened to Rockwell 65-67 C. An instrument guide is provided to center the rebound hammer over impact area and keep the instrument perpendicular to the surface.

6. Test Area

6.1 Selection of Test Surface—Concrete members to be tested shall be at least 100 mm (4 in.) thick and fixed within a structure. Smaller specimens must be rigidly supported. Areas exhibiting honeycombing, scaling, or high porosity should be avoided. Troweled surfaces generally exhibit higher rebound numbers than screeded or formed finishes. If possible, structural slabs should be tested from the underside to avoid finished surfaces.

6.2 Preparation of Test Surface—A test area shall be at least 150 mm (6 in.) in diameter. Heavily textured, soft, or surfaces with loose mortar shall be ground smooth with the abrasive stone described in 5.2 Smooth-formed or troweled surfaces do not have to be ground prior to testing.

6.2.1 Ground and unground surfaces should not be compared.

6.3 Other factors that may affect the results of the test are as follows:

6.3.1. Concrete at 0°C (32°F) or less may exhibit very high rebound values. Concrete should be tested only after it has thawed.

6.3.2 The temperatures of the rebound hammer itself may affect the rebound number.

NOTE 2—Rebound hammers at -18^{0}C (0°F) may exhibit rebound numbers reduced by as much as 2 or 3.

6.3.3 For readings to be compared the direction of impact, horizontal, downward, upward, etc., must be the same or established correction factors shall be applied to the readings.

6.3.4 Different hammers of the same nominal design may give rebound numbers differing from 1 to 3 units and therefore, tests should be made with the same hammer in order to compare results. If more than one hammer is to be used, a sufficient number of tests must be made on typical concrete surfaces so as to determine the magnitude of the differences to be expected.

6.3.5 Rebound hammers shall be serviced and verified semiannually and whenever there is reason to question their proper operation. Test anvils described in 5.3 are recommended for verification.

NOTE 3—Verification on an anvil will not guarantee that the hammer will yield repeatable data at other points on the scale. Some users compare several hammers on concrete or stone surfaces encompassing the usual range of rebound numbers encountered in the field.

7. Procedure

7.1 Hold the instrument firmly so that the plunger is perpendicular to the test surface. Gradually push the instrument toward the test surface until the hammer impacts. After impact, maintain pressure on the instrument and, if necessary, depress the button on the side of the instrument to lock the plunger in its retracted position. Estimate the rebound number on the scale to the nearest whole number and record the rebound number. Take twenty readings from each test area. No two-impact tests shall be closer together than 25 mm (1 in.). Examine the impression made on the surface after impact, and if the impact crushes or breaks through a near-surface air void disregard the reading and take another reading.

8. Calculation

8.1 Discard readings differing from the average of 20 readings by more than 6 units and determine the average of the remaining readings. If readings appear to be erroneous due to extremely high or extremely low rebound numbers, discard these readings without recording them. Extreme high and low readings are generally due to air-voids, steel reinforcement, or coarse aggregates close to the surface. The average rebound number can then be applied to the proper rebound number chart to get an estimated compressive strength.

9. Report

None.

Note: A letter is typically sent to the RCE with the following information.

- *Date*
- *Identification of location tested*
- *Design strength of concrete tested*
- *Hammer identification*
- *Orientation of hammer during test*
- *Average rebound number*
- *Strength, PSI (MPa)*
- *Remarks regarding unusual conditions*

Process for Compressive Strength Testing of Portland Cement Concrete Cylinders

SC T 50

1. Scope

This process covers determination of compressive strength of cylindrical concrete specimen such as molded cylinders, drilled cores, and cylinders which are in sets of three that are typically obtained from Department projects. Each cylinder is cured and tested following established ASTM and AASHTO procedures.

This procedure is also intended to address the selection of cylinders for testing and the formatting of test results. Intermediate strength tests, such as early breaks, are reported as "Information Only" and would not have to adhere strictly to this procedure.

2. Referenced Documents

2.1 ASTM Standards

C 39 Guidelines for compressive Strength Testing of Portland Cement Concrete Cylinders

3. Apparatus - None

4. Test Specimens

4.1 Portland cement concrete cylinders

5. Procedure

5.1 Selection of Cylinders to test following ASTM C39

5.1.1 Test at least two cylinders from every set of three.
5.1.2 Do not test any damaged cylinders.
5.1.2.1.1 The only exception will be if more than one cylinder is damaged. If this is the case, test all three cylinders and use the average of the highest two compressive strengths.
5.1.2.1.2 Make a note on the test report indicating the damaged cylinders.

6. Calculations

6.1 Determining compressive strength

6.1.1 If both of the tested cylinders meet or exceed the minimum required compressive strength, use the average of the two strengths.

6.1.2 If one of the tested cylinders does not meet or exceed the minimum required compressive strength, test the third cylinder and use the average of the two highest strengths.

6.1.3 If both of the tested cylinders do not meet or exceed the minimum required compressive strength, test the third cylinder and use the average of the highest two strengths.

7. Report

None.

Note: When testing is performed on a group of related cylinder samples, adhere to the following instructions:

- *Note only the cylinder strengths used for the final calculations.*
- *Round each strength to the nearest 10 psi or 0.1 mpa.*
- *When the strengths are averaged, round the average to the nearest whole number.*

Concrete Constituents

With the exception of aggregates, which are covered in another part of the manual, this section of the *Laboratory Procedures Manual* includes those tests conducted on the various materials that go into the batching of Portland cement concrete. These materials consist of water, Portland cement and other cementitious materials and admixtures.

Quality of Water to be used in Concrete

AASHTO T 26

This test is conducted in accordance with AASHTO T 26 without exception.

Test results are reported on Lab Form CON507.

Chemical Analysis of Hydraulic Cement

AASHTO T 105

This test is conducted in accordance with AASHTO T 105 without exception.

Test results are reported on Lab Form CEM606 or CEM607.

Test Method for Compressive Strength of Hydraulic Cement Mortars

ASTM C 109

This test is conducted in accordance with ASTM C 109 without exception.

Test results are reported on Lab Form CEM606, CEM608, or CON507.

Test Method for Autoclave Expansion of Portland Cement

ASTM C 151

This test is conducted in accordance with ASTM C 151 without exception.

Test results are reported on Lab Form CEM606, CEM608, or CON507.

Test Method for Normal Consistency of Hydraulic Cement

ASTM C 187

This test is conducted in accordance with ASTM C 187 without exception.

Test results are reported on Lab Form CEM606 or CEM608.

Test Method for Time of Setting of Hydraulic Cement by Vicat Needle

ASTM C 191

This test is conducted in accordance with ASTM C 191 without exception.

Test results are reported on Lab Form CEM606, CEM608, or CON507.

Test Method for Fineness of Hydraulic Cement by Air Permeability

ASTM C 204

This test is conducted in accordance with ASTM C 204 without exception.

Test results are reported on Lab Form CEM606 or CEM608.

Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles

ASTM C 266

This test is conducted in accordance with ASTM C 266 without exception.

Test results are not reported. This test is completed for the AASHTO Accreditation Program only.

Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete

ASTM C 311

This test is conducted in accordance with ASTM C 311 without exception.

Test results are reported on Lab Form CEM605.

Test Method for Fineness of Hydraulic Cement by the 45-mm (No. 325) Sieve

ASTM C 430

This test is conducted in accordance with ASTM C 430 without exception.

Test results are reported on Lab Form CEM605.

Determination of Cement Sample Contamination By Use of Phenolphthalein Indicator

SC T 52

1. Scope

1.1. This test method outlines the procedure for determining whether cement is present in a sample. This procedure is to be used when contamination is suspected due to abnormally low or high fineness, high insoluble residue, or evidence of visible contamination during sieving.

2. Referenced Documents

2.1. Lange's Handbook of Chemistry

3. Apparatus

3.1. Weighing Paper or suitable container
3.2. Dropping Bottle or plastic disposable pipette
3.3. Phenolphthalein Indicator Solution

4. Test Specimens

4.1. Representative sample of cement

5. Procedure

5.1. Stir or hand shake sample of cement.
5.2. Using a spatula, place one or two scoops of cement on a weighing paper or in a suitable container.
5.3. Using a dropping bottle or disposable pipette, drop 2-3 drops of the phenolphthalein indicator solution on the sample.
5.4. Wait 2-3 seconds. If cement is present, the treated material will turn fuchsia.
5.5. If this color change does not occur, the material will be considered something other than cement. No further testing will be performed. If the color change does occur, the cement will be tested in the normal manner.

6. Report

6.1. Report presence of contamination on Lab Form CEM606 or CEM607.

Determination of Fly Ash Sample Contamination By Use of Phenolphthalein Indicator

SC T 53

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1. Scope

This test method outlines the procedure for determining whether a fly ash sample is contaminated with cement. This procedure is to be used when contamination is suspected due to abnormally low or high fineness, evidence of visible contamination during testing, or failure to turn beige, red, or brown during loss on ignition.

2. Referenced Documents

2.1. Lange's Handbook of Chemistry

3. Apparatus

3.1. Weighing Paper or suitable container
3.2. Dropping Bottle or plastic disposable pipette
3.3. Phenolphthalein Indicator Solution

4. Test Specimens

4.1. Representative sample of fly ash

5. Procedure

5.1. Stir or hand shake sample of fly ash.
5.2. Using a spatula, place one or two scoops of fly ash on a weighing paper or.in a suitable container.
5.3. Using a dropping bottle or disposable pipette, drop 2-3 drops of the phenolphthalein indicator solution on the sample.
5.4. Wait 2-3 seconds. If cement is present, the treated material will turn fuchsia.
5.5. If this color change does not occur, the material is classified as not being contaminated with cement and the material will be tested as normal for a fly ash sample. If the color does occur, no further testing will be performed.

6. Report

6.1. Report presence of contamination on Lab Form CEM605.

Metals and Coatings

This section of the *Laboratory Procedures Manual* describes methods used to test metallic products such as reinforcing steel, wire mesh, corrugated sheet steel, chain link fencing and other similar metals. Also included are tests for different coatings and paints that are applied to the surface of some of the metals.

Zinc Coating (Hot-Dip) on Iron and Steel Hardware

AASHTO M 232

This test is conducted in accordance with AASHTO M 232 without exception.

Test results are reported on Lab Form MET719.

Mass (Weight) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

AASHTO T 65

This test is conducted in accordance with AASHTO T 65 without exception.

Test results are reported on Lab Form MET710, MET715, MET716, or MET717.

Mass (Weight) of Coating on Aluminum-Coated Iron or Steel Articles

AASHTO T 213

This test is conducted in accordance with AASHTO T 213 without exception.

Test results are reported on Lab Form MET710, MET715, MET716, or MET717.

Mechanical Testing of Steel Products

AASHTO T 244

This test is conducted in accordance with AASHTO T 244 without exception.

Test results are reported on Lab Form MET704, MET705, MET706, MET707, MET710, or MET714.

Zinc (Hot-Dip Galvanizated) Coatings on Iron and Steel Products

ASTM A 123

This test in conducted in accordance with ASTM A123 without exception.

Test results are reported on Lab Form MET708, MET709, MET710, MET711, or MET712.

Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 325

This test in conducted in accordance with ASTM A325 without exception.

Test results are reported on Lab Form MET713.

Test Methods and Definitions for Mechanical Testing of Steel Products

ASTM A 370

This test in conducted in accordance with ASTM A370 without exception.

Test results are reported on Lab Form MET703, or MET718.

Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM E 18

This test is conducted in accordance with ASTM E 18 without exception.

Test results are reported on Lab Form MET713.

Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

ASTM F 606

This test is conducted in accordance with ASTM F 606 without exception.

Test results are reported on Lab Form MET713.

Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

ASTM F 959

This test is conducted in accordance with ASTM F 959 without exception.

Test results are reported on Lab Form MET713.

Field Determination of Weight of Zinc Coating On Guardrail

SC T 139

1. Scope

This method of test covers a field procedure for the determination of the weight of zinc coating on guardrail.

2. Referenced Documents

2.1 AASHTO Standards
M 180 Corrugated Steel Beams for Highway Guardrail
T 65 Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
2.2 South Carolina Calibration Procedures
SC CL 10 Calibration Procedure for Magnetic Coating Thickness Gages

3. Apparatus

3.1 Magnetic coating thickness gauge.

4. Field Calibration

4.1 Each gauge shall be calibrated in accordance with SC CL 10 at the test site prior to testing and at intervals during use, if necessary.

5. Test Specimens

5.1 Beam elements shall be selected at random from each shipment.

6. Procedure

6.1 Foreign materials such as dirt, grease and corrosion products should be removed by cleaning without removing any coating material. Areas on specimens having visible defects that are difficult to remove such as flux, acid spots, dross, and oxide, should be avoided in making measurements.

6.2 Operate each instrument in accordance with the manufacturer's instructions. Readings should not be made closer than 13mm (1/2 in.) from edges, holes, inside corners, etc. Due to coating variations, readings shall be taken at three (3) sites on a given beam.

6.3 The three (3) test sites shall be at points 2 to 4 feet from each end and at the approximate middle of the beam. (See Figure 1).

6.4 Three (3) spot tests shall be taken at each of the three test sites. (See Figure 2).

6.5 The readings at the three (3) sites shall be averaged to establish a value for a field test. The average shall be a minimum of 4.0 oz./sq. ft. with no spot test less than 3.6 oz./sq. ft.

6.5.1 Procedure for retesting failing spot test.

6.5.1.1. When a spot test is less than 3.6 oz./sq. ft., additional testing shall be performed. (See Figure 3).

6.5.1.2 Six (6) additional spot tests shall be selected, three (3) on either side of the spot test in question, at six inch intervals, aligned on the same plane.

6.5.1.3 The average of these additional spot tests, excluding the original spot test, shall have a minimum coating of 3.6 oz./sq. ft.

7. Disputes

7.1 In the event a dispute occurs as to the validity of these test results, a specimen shall be taken from the beam area in question and tested in accordance with AASHTO T 65.

8. Calculations

8.1 The readings from the magnetic gauges will be in mils. Average the two readings in mils at each spot. Convert the average readings to oz./sq. ft. by dividing each average by 1.7.

9. Report

Test results are reported on Lab Form MET708.

Rotational Capacity of High Strength Long Steel Bolt Assemblies

SC-T-150

1. **SCOPE**

1.1. This method covers the procedure for determining the rotational capacity of long ASTM A 325 structural steel bolts.

2. REFERENCED DOCUMENT

2.1. ASTM A 325

3. SIGNIFICANCE AND USE

3.1. The purpose of this procedure is to verify the rotational capacity of structural steel bolts and to evaluate the compatibility of assemblies selected for testing.

4. APPARATUS

4.1. Calibrated Tension Measuring Device (TMD) of size required for bolts to be tested.

4.2. Calibrated torque wrench that has the capability to measure the torque produced by the particular bolt assembly being tested.

4.3. Spacers and/or washers with hole size no larger than 1/16 inch greater than bolt being tested.

4.4. Steel section to mount TMD. The flange of the girder or the cross frame accessible from the ground is satisfactory.

5. PROCEDURE

5.1. Install the nut on the bolt and measure the stick out of the bolt when 3 to 5 threads of the bolt are located between the bearing face of the nut and the bolt head. Measure the bolt length, the distance from the end of the threaded shank to the underside of the bolt head.

5.2. Install the bolt into the TMD and install the required number of shim plates and/or washer (minimally, one washer under the nut must always be used) to produce the thread stick-out.

5.3. As a minimum, tighten the bolt using a hand wrench to the snug tensions listed in the table below:

* Initial Tension Load									
Bolt Diameter (inches)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Initial Tension Min., (kips)	1	2	3	4	5	6	7	9	10
* Approximately 10% of Minimum Installation Tension.									

5.4. Match mark the nut, bolt, and the faceplate of the TMD.

5.5. Using the calibrated manual torque wrench, tighten the bolt to at least the tension listed in the table below. Record the torque required to reach the tension and the value of the bolt tension. Measure torque with the nut in the motion.

* Minimum Installation Tension									
Bolt Diameter (inches)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Tension Min., (kips)	12	19	28	39	51	56	71	85	103
* Installation Tension equals 70% x Min. Tensile Strength.									

5.6. Further tighten the bolt to the rotation listed in the table below. Measure the rotation from the initial marking. Record the bolt tension.

*Rotation			
Bolt Length	4 x bolt diam. or less	Greater than 4 x bolt diam., but not more than 8 x bolt diam.	Greater than 8 x bolt diam.
Required Rotation	2/3	1	1 1/3
*Turn Test Tension equals 1.15 x 70% x Min. tensile Strength.			

5.7. Remove the fastener assembly from the TMD. Ensure that there are no signs of thread shear failure, stripping, or torsion failure of the bolt. Check for stripping by running the nut on the bolt threads to where it was during the test. Accomplish this without the use of tools.

5.8 Note the proof load, the tensions and torques at the required turns, the appearance quality, the lubricant quality, the final bolt tension and torque at the required turn.

6. REPORT

None.

Rotational Capacity of High Strength Short Steel Bolt Assemblies

SC T 151

1. SCOPE

1.1. This method covers the procedure for determining the rotational capacity of ASTM A 325 structural steel bolts too short to fit the Tension Measuring Device.

2. REFERENCED DOCUMENT

2.1. ASTM A 325

3. SIGNIFICANCE AND USE

3.1. The purpose of this procedure is to verify the rotational capacity of structural steel bolts and to evaluate the compatibility of assemblies selected for testing.

4. APPARATUS

4.1. Calibrated torque wrench that has the capability to measure the torque produced by the particular bolt assembly being tested.

4.2. Spacers and/or washers with hole sizes no larger than 1/16 inch greater than the bolt being tested.

4.3. Steel section with a hole large enough to install the bolt.

4.4. A spud wrench or equivalent.

5. PROCEDURE

5.1. Install the nut on the bolt and measure the stick-out of the bolt when 3 to 5 threads of the bolt are located between the bearing face of the nut and the bolt head. Measure the bolt length, the distance from the end of the threaded shank to the underside of the bolt head.

5.2. Install the bolt into the hole and install the required number of shim plates and/or washers (minimally, one washer under the nut must always be used) to produce the thread stick-out determined in 5.1.

5.3. Snug the bolt using a hand wrench. The snug condition is the normal effort applied to a 12 inch long spud wrench.

5.4. Match mark the nut, bolt, and plate. Mark off a vertical line at 1/3 of a turn, 120 degrees; 1/2 of a turn, 180 degrees; and 2/3 of a turn, 240 degrees; from vertical in a clockwise direction on the plate.

5.5. Using the calibrated manual torque wrench, tighten the bolt to the rotation listed in the table below. A second wrench must be used to prevent rotation of the bolt head during tightening. Record the torque required to reach this rotation. Measure the torque with the nut in motion.

Rotation for ASTM A 325 Bolts	
Bolt Length	4 x bolt diameters or less
Required Rotation	1/3 Turn

5.6. Further tighten the bolt to the rotation listed in the table below. Measure the rotation from the initial marking. Record the bolt tension.

Rotation for ASTM A325 Bolts	
Bolt Length	4 x bolt diameters or less
Required Rotation	2/3 Turn

5.7. Remove the fastener assembly from the steel section. Ensure that there are no signs of thread shear failure, stripping, or torsion failure of the bolt. Check for stripping by running the nut on the bolt threads to where it was during the test. Accomplish this without the use of tools.

5.8 Note the torques at the required turns, the appearance quality, the lubricant quality, and the final torque at the required turn.

6. REPORT

None.

Verification of Direct Tension Indicators (DTI) Performance

SC T 152

1. SCOPE

1.1 This method covers the procedure for determining the DTI performance before installation in a working application.

2. REFERENCED DOCUMENT

2.1 ASTM F 959

2.2 ASTM A 325

3. SIGNIFICANCE AND USE

3.1 The purpose of this procedure is to verify that the DTI being tested is capable of indicating the achievement of a specified minimum bolt tension in a ASTM A325 structural bolt.

4. APPARATUS

4.1 Calibrated bolt Tension Measuring Device (TMD) with a special flat insert in place of a normal bolt head holding insert.

4.2 ASTM A325 bolt assembly.

4.3 0.005-inch thick tapered leaf (feeler) gauge.

4.4 Impact wrench or manual wrench.

5. PROCEDURE

5.1 Install bolt, nut, washer and DTI in the Tension Measuring Device with the DTI at the front face of the TMD. Test the fastener assembly with the DTI in the same position on the fastener assembly as it is during erection installation.

5.2 Use a second wrench on the bolt head during testing to prevent rotation of the head against the DTI.

5.3 Tighten the bolt to tension listed in the table below. If an impact wrench is used, tighten to a load slightly below the required load and use a manual wrench to attain the required tension because the load-indicating needle of the TMD cannot be read accurately when an impact wrench is used.

***Bolt Tension**									
Bolt Diameter (inch)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Tension, kips	13	20	29	41	54	59	75	89	108
*Bolt Tension equals 1.05 x Min. Installation Tension									

5.4 Determine and record the number of spaces between the protrusion on the DTI that a 0.005 inch feeler gauge is refused. The total number of spaces in the various sizes and grade of DTI is shown in the table below.

Number of Spaces on DTI									
Bolt Diameter (inches)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
No. of Spaces	4	4	5	5	6	6	7	7	8

5.5 The 0.005 inch feeler gauge should be refused in less than one half of the gaps. If the feeler gauge is refused in one half or more of the gaps, the DTI fails the verification test and no further testing is required.

5.6 If less than one half of the gaps refuse the 0.005 inch feeler gauge, continue with further tightening the bolt to the smallest gap allowed in the working application. Normally, this smallest gap condition is achieved when the gaps at all the spaces are less than 0.005 inch (or a gap size as approved by the BCE), and not all gaps are completely closed. When such a condition is achieved, the 0.005 inch thick feeler gauge is refused at all spaces, but a visible gap exists in at least one space. Record the load in the bolt at the smallest gap. Do not tighten the bolts in this installation verification test nor in the actual installation to a no visible gap condition. The load in the bolt becomes indeterminate when no gap exists.

5.7 Ensure that the bolt load at this smallest gap does not cause excessive permanent inelastic deformation of the fastener. The degree of inelastic deformation is judged by removing the fastener from the test apparatus and turning the nut by hand the full length of the threads on the bolt after the test.

5.8 Remove the bolt from the TMD and turn the nut on the threads of the bolt by hand. Make note of the nut's ability to be turned on the complete length of the threads excluding the thread run-out.

5.9 Note the pretension load, the number of required spaces, the maximum spaces the gauge is refused, the bolt tension, the compression strength of the DTI, and the results of whether the DTI compression meets required specifications or not.

6. REPORT

None.

Traffic Markings

This section of the *Laboratory Procedures Manual* includes those test methods associated with traffic markings. Most of these procedures are for traffic paint; however, tests on reflective sheeting, beads, raised pavement markings, delineators and other related materials are included as well.

AASHTO M 247

This procedure is conducted in accordance with AASHTO M 247 without exception.

Results are reported on Lab Form TM806.

Test Method for Consistency of Paints Using the Stormer Viscometer

ASTM D 562

This test is conducted in accordance with ASTM D 562 without exception.

Test results are reported on Lab Form TM809 or TM810.

Test Method for No-Pick-Up Time of Traffic Paint

ASTM D 711

This test is conducted in accordance with ASTM D 711 without exception.

Test results are reported on Lab Form TM809 or TM810.

Test Method for Roundness of Glass Spheres

ASTM D 1155

This test is conducted in accordance with test method ASTM D 1155 without exception.

Test results are reported on Lab Form TM805 or TM806.

Test Method for Gradation of Glass Spheres

ASTM D 1214

This test is conducted in accordance with test method ASTM D 1214 without exception.

Test results are reported on Lab Form TM804, TM805, TM806, or TM807.

Test Method for Density of Paint, Varnish, Lacquer, and Related Products

ASTM D 1475

This test is conducted in accordance with ASTM D 1475 without exception.

Test results are reported on Lab Form TM809 or TM810.

Test Method for Volatile Content of Coatings

ASTM D 2369

This test is conducted in accordance with ASTM D 2369 without exception.

Test results are reported on Lab Form TM809 or TM810.

Test Method for the Determination of Pigment Content of Solvent-Reducible Paints by High Speed Centrifuging

ASTM D 2698

This test is conducted in accordance with ASTM D 2698 without exception.

Test results are reported on Lab Form TM810.

Test Method for Pigment Content of Water Emulsion Paints by Low-Temperature Ashing

ASTM D 3723

This test is conducted in accordance with ASTM D 3723 without exception.

Test results are reported on Lab Form TM809.

Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects

FHWA FP-96

This test is conducted in accordance with FHWA FP-96 Section 718 without exception.

Test results are reported on Lab Form TM804.

Laboratory Method of Evaluating and Testing Raised Pavement Markers

SC T 111

1. Scope

This test method outlines the procedure for preparing and testing of raised pavement markers.

2. Referenced Documents

2.1. SCDOT Standard Specifications for Highway Construction

3. Apparatus

3.1. Fifty (50) foot long hallway
3.2. Two wooden platforms for light source
3.3. Photometer equipment
- 3.3.1. Spectra Pritchard Photometer
- 3.3.2. Advance Retro Technology-model 980 projection light source
- 3.3.3. SOLA transformer (used in conjunction with light source and photometer)

3.4. Abrasion testing
- 3.4.1. Steel wool (#3 Coarse)

3.5. Compression testing machine 2000 lbs. +cap
3.6. Impact test apparatus (18 inch/45.7 cm drop)
- 3.6.1. 0.42 lb (190 gm) dart weight
- 3.6.2. Convection oven (60°C/140°F) cap
- 3.6.3. 0.25 inch (0.64 cm) radius spherical head

4. Test Specimens

4.1. Typically, twenty-five (25) markers of each type selected at random from each shipment or lot will constitute a representative sample. The face to be tested must be clean and free of marks, scratches, and debris.

5. Procedure

The marker being tested shall be located base down with the center of the reflective face 50 feet from the calibrated light source with a blue/red ratio of 2856° Kelvin. The reflected light and the incident light shall be measured by means of a photometer. The "SI" formula shall be used to determine the specific intensity values for the reflective surface.

5.1. Optical: (Reflectance) Two platforms are set up with light source and photometer equipment 50 feet apart squared against a wall and aligned with each other. Black curtains are used at each end to create a controlled dark setting. The equipment is allowed to warm up for 30 minutes. The photometer is set on Cal.-Open. Zero readings are taken at: (1) Zero Amplifier (2) Auto zoom Dark Control (3) Internal Calibrate (set at 5:00) (4) Range Auto.

5.2. An initial light reading is taken after resetting the photometer to photopic-ND-4 and rechecking zero steps. Then the photometer is relocated back to the platform above the light source at the other end of the hallway. Marker number one is placed level on the test plate on the platform at the opposite end from the test equipment, aligned, and light source and photometer alignment are checked. Set the photometer at 0.2 degrees divergence angle, making sure the marker is level. Test 10 markers for reflectance this way at 0 degrees incidence angle. When these tests are completed, set the turntable to 20 degrees incidence angle and test all markers as above, checking all alignments in between the two angle changes. When testing is completed, remove the marker test plate. Place the photometer back on its platform at the opposite end of the hallway, align it with the light source and take zero readings at the four (4) settings used initially at the beginning of testing. Take a final light reading.

5.3. Abrasion: Form a 1-inch diameter flat pad using #3 coarse steel wool. Place the steel wool pad on the reflector, apply a pressure of 50 ± 0.5 pounds and briskly rub the entire reflective surface at least 50 times.

5.4. Impact: Condition the markers in a convection oven at 130°F for one hour. While at the elevated temperature, impact the reflective face by allowing a 0.42 lb. (190 gm) dart fitted with a 0.25 in. (0.64 cm) radius spherical head to drop 18 in. (45.7 cm) perpendicularly onto the center of the reflective surface. Cracks in the impact area shall be generally concentric in appearance.

5.5. Strength: The marker shall be centered base down over the open end of a vertically positioned hollow metal cylinder. The cylinder shall be one inch high with an internal diameter of three inches and a wall thickness of one-fourth inch. A load shall be applied to the top center of the marker by means of a 1-inch solid steel plug approximately 1 inch high. The rate of loading shall be approximately 2000 pounds per minute. Failure shall constitute either breakage or significant delamination of the shell and the filler material at a load less than 2000 pounds.

6. Calculations

Specific Intensity – The mean candlepower of the reflected light at a given incidence[1] and divergence[2] angle for each foot-candle at the reflector on a plane perpendicular to the incident light.

$$SI = \frac{R_L \times D^2}{I_L}$$

Where:

Where:	SI	=	Specific Intensity (cd fc^{-1})
	R_L	=	Reflected Light
	I_L	=	Incident Light (Light Source)
	D	=	Test Distance

Notes: [1]Angle of Incidence – The angle formed by a ray from the light source to the marker, and the normal to the leasing edge of the marker face.
[2] Angle of Divergence – The angle formed by a ray from the light source to the marker, and the returned ray from the marker to the measuring receptor.

7. Report

7.1 Specific Intensity (nearest 0.1 cd fc^{-1})
7.2 Abrasion resistance (report observation)
7.3 Impact testing:
7.4 Strength (whether less or greater than 2000 pounds)

Test results are reported on Lab Form TM808.

Test Method for Evaluating Degree of Settling of Paint

SC T 114

1. Scope

This test method outlines the procedure for determining the degree of settling of paint. This procedure is based on SCDOT Standard Specifications 604.02A.4.o and ASTM D 869.

2. Referenced Documents

2.1 ASTM Standards
D 869 Test Method for Evaluating Degree of Settling of Paint

3. Apparatus

3.1 Pint Can Lined with an Appropriate Material Designed to be Non-reactive with Waterborne Paints.
3.2 Oven Capable of Maintaining a Temperature of 122°F (±2°F).
3.3 Spatula Weighing 45 ± 1g with Square End Blade 125 mm (4 ¾ in.) in length and Approximately 20 mm (13/16 in.) in width._

4. Test Specimens

4.1 1 Quart Paint

5. Procedure

5.1 Fill the pint can to the bottom of the friction seal lip and seal.
5.2 Place can in an inverted position for 1 hour to insure a complete seal between the cover and the body of the can.
5.3 At the end of 1 hour, the can shall be placed in an upright position for at least 1 hour.
5.4 Place the can in the 122°F oven in a single tier for 5 days.
5.5 At the end of the 5 days, remove the can from the oven and allow it to cool to room temperature for 4 to 5 hours.
5.6 Open the can without stirring or agitation, then, examine the sample without removal of any supernatant vehicle.

5.7 Using the square-end blade spatula, determine the extent and character of portions of the paint that may have separated during storage.

5.7.1 Hold the spatula perpendicular to and in the center area of the paint at a height whereby the bottom edge of the spatula is level with the top of the can.
5.7.2 Drop the spatula from that position.
5.7.3 Rate the condition of the sample as follows:

Rating	Description of Paint Condition
10	Perfect suspension. No change from the original condition of the paint.
8	A definite feel of settling and a slight deposit brought up on the spatula
6	Definite cake of settled pigment. Spatula drops through cake to bottom of container under its own weight. Definite resistance to sidewise motion of spatula. Coherent portions of cake may be removed on spatula.
4	Spatula does not fall to bottom of container under its own weight. Difficult to move spatula through cake sidewise and slight edgewise resistance.
2	When spatula has to be forced through the settled layer it is very difficult to move spatula sidewise. Definite edgewise resistance to movement of spatula. Paint can be remixed to a homogenous state.
0	Very firm cake that cannot be reincorporated with the liquid to form a smooth paint by stirring manually.

5.7.4 The degree of settling shall have a rating of 6 or better when evaluated.

6. Calculations

6.1 None.

7. Report

7.1 Report settlement as an even integer on Lab Form TM809 or TM810.

Miscellaneous Materials

Certain materials used in highway construction and maintenance work cannot be categorized under any of the previous sections of this manual. These miscellaneous materials are tested in accordance with the procedures described in this section.

Corrugated Polyethylene Drainage Pipe

AASHTO M 252

This test is conducted in accordance with AASHTO M 252 without exception.

Test results are reported on Lab Form MSC008 or MSC009.

Class PS46 Poly (Vinyl Chloride) (PVC) Pipe

AASHTO M 278

This test is conducted in accordance with AASHTO M 278 without exception.

Test results are reported on Lab Form MSC007 or MSC110.

Sampling and Testing Brick

AASHTO T 32

This test is conducted in accordance with AASHTO T 32 without exception.

Test results are reported on Lab Form CON514.

Testing Lime for Chemical Constituents and Particle Sizes

AASHTO T 219

This test is conducted in accordance with AASHTO T 219 without exception.

Test results are reported on Lab Form MSC003.

Test Methods of Sampling and Testing Concrete Masonry Units

ASTM C 140

This test is conducted in accordance with ASTM C 140 without exception.

Test results are reported on Lab Form CON513.

Standard Specification for Sodium Chloride

ASTM D 632

This test is conducted in accordance with ASTM D 632 without exception.

Test results are reported on Lab Form MSC006.

Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

ASTM D 1785

This procedure is conducted in accordance with ASTM D 1785 without exception.

Results are reported on Lab Form MSC007 or MSC110.

Styrene Butadiene Latex Modifiers for Bridge Deck Overlay Concrete Diesel Fuel Flash Point Determination by Rapid Flash Point Tester

FHWA-RD-78-35

This test is conducted in accordance with FHWA-RD-78-35 without exception.

Test results are reported on Lab Form CON508.

Diesel Fuel Flash Point Determination by Rapid Flash Point Tester

SC T 105

1. Scope

To perform a quick flash point analysis of diesel fuel to discover the possibility of contamination. If the sample flashes within 5° C of ASTM D975 specification, the State of South Carolina Department of Agriculture will perform further testing.

2. Referenced Documents

2.1 AASHTO Standards
2.2 ASTM D975

3. Apparatus

3.1 ASTM 9 C Thermometer
3.2 Heat resistant gloves
3.3 Rapid Flash Point Tester
3.4 Water

4. Test Specimens

4.1 One quart of diesel fuel

5. Procedure

5.1 Shake diesel fuel sample.
5.2 Fill outer cup of flash point tester to fill line with water.
5.3 Add diesel fuel to inner cup to just above ridge.
5.4 Light the burner and the ignition tip adjusting the size of the flame to the size of a pea.
5.5 Use the flame to remove any bubbles from the diesel fuel in the inner cup.
5.6 Place the top complete with thermometer on the sample cup. Starting temperature should be no higher than 20° C to 26° C.
5.7 Lower ignition tip into cup for 1-2 seconds. If a blue arc appears, then the sample has flashed.
5.8 If a blue arc does not appear, place the sample cup complete with top into the outer cup of the tester.
5.9 Check every 2° C to see if the sample flashes. Take care not to let the temperature rise too rapidly.

5.10 Record the temperature at which a blue arc of flame appears.

6. Calculations

None

7. Report

Report flash point in °C to the nearest degree. Test results are reported on Lab Form MSC 002.

Test Method for Determining Rideability
with the Rainhart Profilograph

SC T 121

1. Scope

This method outlines a procedure for determining the rideability (expressed as Profile Index) of a bridge deck or concrete pavement with the Rainhart Profilograph.

2. Referenced Documents

2.1 ASTM Standard
   E 1274 Standard Test Method for Measuring Pavement Roughness Using a Profilograph
2.2 Rainhart's "Profilograph Operating Manual"

3. Apparatus

3.1 Rainhart Profilograph
   3.1.1 Major and minor truss system
   3.1.2 Chart recorder
   3.1.3 Direct measuring wheel
   3.1.4 Averaging wheels
3.2 Tape measure
3.3 Traffic paint or lumber crayon
3.4 Profile Index measuring equipment
   3.4.1 Engineer's scale (metric or standard)
   3.4.2 Blanking band (clear plastic scale 2.5 inches (64 mm) wide and 10.0 inches (254 mm) long with the center 0.2 inch (5 mm) "blacked out", having 0.1 inch (2 mm) vertical graduations)

4. Test Specimens

4.1 Concrete bridge decks or concrete pavements as specified in contracts
4.2 Areas of interest

5. Procedure

5.1 Bridge deck or concrete pavements
   5.1.1 Bridge deck or concrete pavement preparation (surface must be free of debris)

- 5.1.1.1 Verify beginning of bridge or roadway or termini of roadway.
- 5.1.1.2 Verify width of concrete and establish centerline with traffic paint or lumber crayon.
- 5.1.1.3 Measure three (3) feet (915 mm) from the each side of the established centerline to establish wheelpath number two (2) with traffic paint or lumber crayon at sufficient intervals to maintain proper wheelpath alignment.
- 5.1.1.4 Measure six (6) feet (1829 mm) towards the shoulder from each wheelpath number two (2) to establish wheelpath number one (1) with traffic paint or lumber crayon at sufficient intervals to maintain proper wheelpath alignment.
- 5.1.1.5 Repeat section 5 as necessary for multilane bridges and roads.

5.1.2 Profilograph pretest check and assembly
- 5.1.2.1 Attach the two (2) removable minor trusses.
- 5.1.2.2 Attach drive chain to the chart recorder.
- 5.1.2.3 Attach chart recorder to major truss and direct measuring wheel.
- 5.1.2.4 Check all truss joints and measuring wheels.
- 5.1.2.5 Load and properly align chart recorder paper (Rainhart Cat. No. 1006).
- 5.1.2.6 Load and properly align two (2) fine line plastic point pens in the chart recorder.
- 5.1.2.7 Select proper scale gear on chart recorder (one inch equals ten feet (1"=10')).

5.1.3 Make project notes on chart recorder paper.
- 5.1.3.1 Road or bridge identification
- 5.1.3.2 Lane
- 5.1.3.3 Direction
- 5.1.3.4 Date
- 5.1.3.5 File number
- 5.1.3.6 Operators

5.1.4 Align direct measuring wheel of Profilograph with wheel path number one (1) in traffic direction at the beginning of the bridge or roadway and reset distance counter to 0.

5.1.5 Lower chart recorder pens.

5.1.6 Push Profilograph in established wheelpaths.

5.1.7 Make necessary notes (i.e. joints, etc.).

5.1.8 Record distance tested, as measured by the distance counter, on chart recorder paper.

5.1.9 Repeat steps 5.1.3 through 5.1.8 as necessary for each wheelpath.

5.2 Areas of interest
5.2.1 Conduct all tests on areas of interest as outlined by the requester.

6. Calculations

Profile Index - Sum the scallops (bumps) that exceed above and below the two tenth inch (0.2) (5 mm) blanking bank on the profilogram of scale one inch equals ten feet (1"=10'). Multiply the results by the length factor [one (1) mile (in feet) (kilometer in meters) divided by the length of the test section (feet or meters)].

$$\text{Factor} = \frac{\text{one (1) mile (feet) (km (m))}}{\text{length of test section (feet or meters)}}$$

Profile Index = Summation of scallops X factor

6.1 From the starting point, place the blanking band in such a way as to "blank out" as much of the profile as possible. When this is done properly, the scallops should be approximately balanced above and below.
6.2 Mark the beginning and the end of the blanking band.
6.3 Starting from the beginning, measure and record on the profilogram the height of all of the scallops projecting at least 0.03 inch (.75 mm) above and below the blanking band and 0.20 inch (5mm) long. Each scallop is to be measured to the nearest 0.05 inch (1 mm).
6.4 Move the scale to the end of the first blanking band section and repeat steps 6.2 and 6.3 as necessary until complete.
6.5 Record data on "Profilograph Data" worksheet.
6.5.1 Project notes (section 5.1.3)
6.5.2 Resident Construction Engineer
6.5.3 Contractor
6.5.4 Test section length
6.5.5 Factor
6.5.6 Scallop measurements
6.5.7 Summation of scallops
6.5.8 Profile Index
6.5.9 Notes (section 5.1.7)

7. Report

7.1 Test results are reported on Lab Form PE 121 with a cover memorandum. Data and calculations are recorded on worksheet PE 121 WA and PE 121 WB.
7.2 Report areas of interest as requested.

Test Method for Determining Pavement Roughness
With the Mays Ride Meter

SC T 122

1. Scope

This test method outlines a procedure for determining the relative roughness (expressed in Inches of Roughness Per Mile) of a roadway surface with the Mays Ride Meter (MRM).

2. Referenced Documents

2.1 ASTM Standards
- E 1082 Standard Test Method for Measurement of Vehicular Response to Traveled Surface Roughness
- E 1136 Standard Specification for a Radial Standard Reference Test Tire
- E 1170 Standard Practices for Simulating Vehicular Response to Longitudinal Profiles of a Vehicular Traveled Surface
- E 1215 Standard Specifications for Trailers Used for Measuring Vehicular Response to Road Roughness

2.2 Rainhart's manuals
- "Mays Ride Meter Booklet"
- "Mays Ride Meter Trailer"

3. Apparatus

3.1 Mays Ride Meter
- 3.1.1 Roughness trailer
- 3.1.2 Transmitter
- 3.1.3 Chart recorder
- 3.1.4 Tow vehicle
- 3.1.5 Distance Measuring Instrument/Distance Event Marker (DMI)

4. Test Specimens

4.1 Asphalt and concrete pavements with posted speed limits of 50 miles per hour or greater and as specified in contracts.

4.2 Areas of interest

5. Procedure

5.1 Asphalt and concrete pavements

5.1.1 Pretest Check

5.1.1.1 Check all tow vehicle to trailer connections (electrical and mechanical).

5.1.1.2 Check all lights.

5.1.1.3 Check tire pressure on tow vehicle (35 psi).

5.1.1.4 Check tire pressure on trailer (32 psi).

5.1.2 Connect the chart recorder to the transmitter.

5.1.3 Load and properly align the chart recorder paper in the chart recorder.

5.1.4 Load and properly align the three (3) fine line plastic point pens in the chart recorder.

5.1.5 Turn the Numetrics DMI on at least one (1) mile before reaching the test section to:

5.1.5.1 Verify calibration number is correct.

5.1.5.2 Verify unit of measure is correct (miles, etc.).

5.1.5.3 Set auto-event marker to one-tenth (0.1) mile.

5.1.6 Activate all safety lights.

5.1.7 Establish limits of the test section prior to testing in a manner that is easily observed by the tow vehicle driver and MRM operator.

5.1.8 Make project notes on chart recorder paper.

5.1.8.1 Trailer number

5.1.8.2 Calibration factor

5.1.8.3 Road number

5.1.8.4 Direction

5.1.8.5 Date

5.1.8.6 File number

5.1.8.7 Operator and driver

5.1.9 Activate the chart recorder at least one-tenth (0.1) mile before reaching the test section.

5.1.10 Key in beginning milepost on DMI (usually zero (0) unless interstate).

5.1.11 Adjust speed to 50 mph before beginning of test section and maintain 50 mph during the test.

5.1.12 Drive in the normal wheelpaths.

5.1.13 Simultaneously press the start button on the DMI and the manual event marker button on the chart recorder.

5.1.14 Use the manual event marker button on the chart recorder to note bridges, mileposts, etc. and note landmarks on graph.

5.1.15 Press the event marker button on the chart recorder at the nearest one-tenth (0.1) mile before the end of the test section.

5.1.16 Repeat steps 5.1.8 through 5.1.15 twice (all test sections must be measured at least three (3) times.)

5.2 Areas of interest
    5.2.1 Conduct all tests on areas of interest as outlined by the requester.

6. Calculations

Inches of Roughness Per Mile - The average length of graph per mile advanced by the MRM chart recorder divided by the length of road multiplied by the calibration factor.

$$\text{Average length of graph per mile} = \frac{\text{Average length of graph advanced per mile (inches)}}{\text{length of test section (mile)}}$$

Inches of Roughness Per Mile = average length of graph per mile X calibration factor

6.1 From the starting point, measure the length of graph for each mile section or portion thereof with an engineer's scale and record the length on the chart paper. Exclude bridges from the nearest one-tenth (0.1) mile before and after.
6.2 Record data on an "MRM Quality Acceptance" worksheet.
    6.2.1 Project notes (Section 5.1.8)
    6.2.2 Resident Construction Engineer
    6.2.3 Contractor
    6.2.4 Section termini (Section 5.1.7)
    6.2.5 Length of graph
    6.2.6 Notes (Section 5.1.14)
6.3 Average the three (3) lengths of graph advanced for each section.
6.4 Divide the average length of graph (inches) for each section by section length (mile) to obtain the average length of graph per mile.
6.5 Multiply the average length of graph per mile by the calibration factor to determine the roughness in inches per mile and record on the "MRM Quality Acceptance" worksheet.

7. Report

7.1 Test results are reported on Lab Form PE 122 and 122 A with a cover memorandum. Data and calculations are recorded on worksheet PE 122 W.
7.2 Areas of interest are reported as requested.

Appendix

Laboratory Forms

S. C. DEPARTMENT OF TRANSPORTATION
FORM AGG203

TEST REPORT
FINE AGGREGATE
(SC STANDARD 701)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

FINE AGGREGATE GRADATION (AASHTO T-27)

TOTAL PASSING 3/8" ____________ %
TOTAL PASSING No. 4 ____________ %
TOTAL PASSING No. 8 ____________ %
TOTAL PASSING No. 16 ____________ %
TOTAL PASSING No. 30 ____________ %
TOTAL PASSING No. 50 ____________ %
TOTAL PASSING No. 100 ____________ %
TOTAL PASSING No. 200 ____________ %

ORGANIC IMPURITIES IN FINE AGGREGATES (AASHTO T-21)

ORGANIC COLORIMETRIC (AASHTO T-21) ____________

EFFECT OF ORGANIC IMPURITIES IN FINE AGGREGATE ON STRENGTH OF MORTAR (AASHTO T-71)

STRENGTH TEST AT 7 DAYS ____________ %
STRENGTH TEST AT 28 DAYS ____________ %

Note: Strength test is not required if color is less than 4.

This sample of ____________

NOTES ____________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

AASHTOT21
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM AGG204

TEST REPORT
COARSE AGGREGATE
(SC STANDARD 701)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

COARSE AGGREGATE GRADATION (AASHTO T-27)

PASSING 2” ____________ %
PASSING 1 1/2” ____________ %
PASSING 1” ____________ %
PASSING 3/4” ____________ %
PASSING 1/2” ____________ %
PASSING 3/8” ____________ %
PASSING NO. 4 ____________ %
PASSING NO. 8 ____________ %
PASSING NO. 16 ____________ %
PASSING NO. 100 ____________ %

This sample of ____________

NOTES ____________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

AASHTOT27
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM AGG205

TEST REPORT
MICRO-DEVAL ABRASION

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

MICRO-DEVAL ABRASION (AASHTO T-327)

GRADE OF MICRO-DEVAL TEST ____________

MICRO-DEVAL ABRASION LOSS ____________ **%**

GRADE OF MICRO-DEVAL TEST ____________

MICRO-DEVAL ABRASION LOSS ____________ **%**

GRADE 1 SAMPLE CONSISTS OF MATERIAL PASSING THE 3/4” SIEVE
GRADE 2 SAMPLE CONSISTS OF MATERIAL PASSING THE 5/8” SIEVE
GRADE 3 SAMPLE CONSISTS OF MATERIAL PASSING THE 1/2” SIEVE

This sample of coarse aggregate ____________________________

NOTES ____________________________

COPY TO ____________________ COPY TO ____________________
COPY TO ____________________ COPY TO ____________________
COPY TO ____________________ COPY TO ____________________

AASHTOTP58

Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM AGG206

TEST REPORT
LOS ANGELES ABRASION

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

LOS ANGELES ABRASION (AASHTO T-96)

"A" LA GRADATION	"B" LA GRADATION
SAMPLE CONSIST OF MATERIAL PASSING THE 1 1/2" SIEVE LOS ANGELES ABRASION LOSS ______ %	SAMPLE CONSIST OF MATERIAL PASSING THE 3/4" SIEVE LOS ANGELES ABRASION LOSS ______ %

"C" LA GRADATION	"D" LA GRADATION
SAMPLE CONSIST OF MATERIAL PASSING THE 3/8" SIEVE LOS ANGELES ABRASION LOSS ______ %	SAMPLE CONSIST OF MATERIAL PASSING THE NO. 4 SIEVE LOS ANGELES ABRASION LOSS ______ %

This sample of coarse aggregate LA abrasion ______

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

AASHTO-T96
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM AGG207

TEST REPORT
SODIUM SULFATE SOUNDNESS

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SOUNDNESS – SODIUM SULFATE (AASHTO T-104)

COARSE AGGREGATE

FIVE ALTERNATIONS WITH A MAXIMUM LOSS OF 15%

LOSS 1 1/2" – 3/4" ______ %

LOSS 3/4" – 3/8" ______ %

LOSS 3/8" – No. 4 ______ %

FINE AGGREGATE

FIVE ALTERNATIONS WITH A MAXIMUM LOSS OF 10%

FINE AGGREGATE LOSS ______ %

This sample is for information only.

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

AASHTOT104
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM AGG208

TEST REPORT
SPECIFIC GRAVITY AND ABSOROPTION

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF DATE SAMPLED IDENTIFICATION MARKS SAMPLE TAKEN FROM SAMPLED BY QUANTITY REPRESENTED SUPPLY SOURCE ADDRESS	SUBMITTED BY ADDRESS TO BE USED IN DATE RECEIVED DATE TESTED TESTED BY

SPECIFIC GRAVITY AND ABSOROPTION
(AASHTO T-85)

PERCENT ABSORPTION ________________ %

BULK SPECIFIC GRAVITY (DRY) ________________ %

BULK SPECIFIC GRAVITY (SSD) ________________ %

APPARENT SPECIFIC GRAVITY ________________ %

This sample of coarse aggregate specific gravity and absorption is for information only.

NOTES ________________

COPY TO ________________ COPY TO ________________
COPY TO ________________ COPY TO ________________
COPY TO ________________ COPY TO ________________

AASHTO-T85

Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM AGG209

TEST REPORT
SAND EQUIVALENT
(SC STANDARD 401)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED 0 Per TON	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SAND EQUIVALENT (AASHTO T-176)

SAND EQUIVALENT ____________ %

This sample of ____________

NOTES ____________

COPY TO ____________	COPY TO ____________
COPY TO ____________	COPY TO ____________
COPY TO ____________	COPY TO ____________

AASHTOT176

Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM AGG211

TEST REPORT
BASE COURSE AGGREGATE
(SC STANDARD 305)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

BASE COURSE AGGREGATE GRADATION (AASHTO T-27)

SIEVE ANALYSIS, PERCENT BY WEIGHT

TOTAL PASSING 2" ____________ %

TOTAL PASSING 1 1/2" ____________ %

TOTAL PASSING 1" ____________ %

TOTAL PASSING 1/2" ____________ %

TOTAL PASSING No. 4 ____________ %

TOTAL PASSING No. 30 ____________ %

TOTAL PASSING No. 200 ____________ %

PLASTIC INDEX AND LIQUID LIMIT

LIQUID LIMIT (AASHTO T-89) ____________

PLASTIC INDEX (AASHTO T-90) ____________

0 = NON-PLASTIC

This sample of ____________

NOTES ____________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

AASHTOT-27
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM AGG212

TEST REPORT
FINE AGGREGATE
BLENDING OF TWO SAMPLES
(SC STANDARD 701)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

FINE AGGREGATE GRADATION (AASHTO T-21 and AASHTO T-27)

SAMPLE NO. 1		SAMPLE NO. 2		COMPOSITE OF SAMPLE 1 AND SAMPLE 2	
LABORATORY NO.		LABORATORY NO.			
PERCENT USED	%	PERCENT USED	%		
PASSING 3/8”	%	PASSING 3/8”	%	TOTAL PASSING 3/8”	%
PASSING No. 4	%	PASSING No. 4	%	TOTAL PASSING No. 4	%
PASSING No. 8	%	PASSING No. 8	%	TOTAL PASSING No. 8	%
PASSING No. 16	%	PASSING No. 16	%	TOTAL PASSING No. 16	%
PASSING No. 30	%	PASSING No. 30	%	TOTAL PASSING No. 30	%
PASSING No. 50	%	PASSING No. 50	%	TOTAL PASSING No. 50	%
PASSING No. 100	%	PASSING No. 100	%	TOTAL PASSING No. 100	%
PASSING No. 200	%	PASSING No. 200	%	TOTAL PASSING No. 200	%

ORGANIC IMPURITIES IN FINE AGGREGATES (AASHTO T-21)

	SAMPLE NO. 1	**SAMPLE NO. 2**
ORGANIC COLORIMETRIC VALUE		

Note: Strength test is required if color is not within tolerance.

EFFECT OF ORGANIC IMPURITIES IN FINE AGGREGATE ON STRENGTH OF MORTAR (AASHTO T-71)

COMBINED SAMPLES RESULTS

AVERAGE RELATIVE STRENGTH ______ %, AT 7 DAYS.
AVERAGE RELATIVE STRENGTH ______ %, AT 28 DAYS.

This sample of FA-10 blend

NOTES:

COPY TO	COPY TO
COPY TO	COPY TO
COPY TO	COPY TO

AASHTO-T21
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM AGG214

TEST REPORT
FINE AGGREGATES

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF DATE SAMPLED IDENTIFICATION MARKS SAMPLE TAKEN FROM SAMPLED BY QUANTITY REPRESENTED SUPPLY SOURCE ADDRESS	SUBMITTED BY ADDRESS TO BE USED IN DATE RECEIVED DATE TESTED TESTED BY

FINE AGGREGATE GRADATION (AASHTO T-27)	
TOTAL PASSING 3/8" ______ %	ORGANIC COLORIMETRIC (AASHTO T-21) ______
TOTAL PASSING 3/8" ______ %	EFFECT OF ORGANIC IMPURITIES (AASHTO T-71) STRENGTH TEST AT 7 DAYS ______ % STRENGTH TEST AT 28 DAYS ______ % Note: Strength test is not required if color is less than 4.
TOTAL PASSING No. 8 ______ %	FINENESS MODULUS, FM (AASHTO T-71) ______
TOTAL PASSING No. 16 ______ %	PERCENT ABSORPTION (AASHTO T-84) ______ %
TOTAL PASSING No. 30 ______ %	BULK SATURATED SURFACE DRY SPECIFIC GRAVITY (AASHTO T-84) ______
TOTAL PASSING No. 50 ______ %	SOUNDNESS (AASHTO T-104) SODIUM SULFATE LOSS, 5 CYCLES ______ %
TOTAL PASSING No. 100 ______ %	
TOTAL PASSING No. 200 ______ %	

NOTES:

REMARKS:

NOTES

1. This approval is not intended to eliminate gradation control and/or contamination control at the job site.
2. Blending of sands is approved only if the composite blend of the sands meets gradation requirements. Any combination of the approved sands is approved as long a gradation requirements are met and the concrete displays satisfactory workability, etc. Any questions regarding blending should be directed to the Office of Materials and Research.
3. Colorimetric test exceeding color plate 3 has been tested and shall not be used from this source.
4. Colorimetric test of color plate 4 has been tested and approved from this source.
5. Colorimetric test of color plate 5 has been tested and approved from this source.
6. Soundness results are made every 5 years. These results are based on the previous year's test.
7. Does not meet FA-10 Gradation but meets FA-10M gradation for manufactured sand.
8. Refer back to coarse aggregate approval sheet for use of the material from this source.

LEGEND

B - Banked	M - Manufactured	R - River
D - Dredged	N - Natural	S - Screened
L - Lightweight	P - Processed	W - Washed

COPIES:

SUPPLIER: ______ AGG. FILE: ______
DISTRICT LAB: ______
OTHER: ______

SCSS701-10
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER Date

S. C. DEPARTMENT OF
TRANSPORTATION
FORM AGG215

TEST REPORT
COARSE AGGREGATE

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

COARSE AGGREGATE GRADATION (AASHTO T-27)

GRADATION CLASSIFICATION ____________
PASSING 2” ____________ %
PASSING 1 1/2” ____________ %
PASSING 1” ____________ %
PASSING 3/4” ____________ %
PASSING 1/2” ____________ %
PASSING 3/8” ____________ %
PASSING NO. 4 ____________ %
PASSING NO. 8 ____________ %
PASSING NO. 16 ____________ %
PASSING NO. 100 ____________ %

THIS GRADATION ____________________

LOS ANGELES ABRASION LOSS (AASHTO T-96)

____________ %
____________ %
____________ %

MICRO-DEVAL ABRASION LOSS (AASHTO T-327)

____________ %
____________ %

Micro-Deval results are for information only.

SPECIFIC GRAVITY and ABSORPTION (AASHTO T-85)

PERCENT ABSORPTION ____________ %
BULK DRY SPECIFIC GRAVITY ____________ %
BULK SSD SPECIFIC GRAVITY ____________ %
APPARENT SPECIFIC GRAVITY ____________ %

MOH’S HARDNESS VALUE (SC T-7) ____________

SAND EQUIVALENCY OF UNWASHED SCREENINGS (AASHTO T-176)

AVERAGE VALUE ____________

SOUNDNESS – SODIUM SULFATE (AASHTO T-104)

FIVE	1 1/2” – 3/4”	%
CYCLES	1/2” – 3/8”	%
LOSS	3/8” – No. 4	%

NOTES: ____
REMARKS: ____
____

NOTES

1. Soundness tests are made every five years. These results are based on the previous year’s test.
2. Approved only for use in Aggregate Base.
3. Approved for use in Class B Concrete, Graded Aggregate Base Course, Asphalt Aggregate Base Course, Asphalt Concrete Intermediate Course
4. Stone from this source may be loaded from yards other than the quarry.
5. Approved on a job to job basis per Standard Specifications Subsection 401.03(d)
6. Not approved in Prestress work due to high Chloride Ion content.
7. Approved only for use in aggregate courses that will be exposed and not overlaid with additional pavement courses.
8. Approved only for use as riprap stone.

LEGEND

C -	Crushed Stone	Gr -	Granite	Q -	Quartzite
FL -	Fossiliferous Limestone	L -	Limestone	R -	Recycled Portland Cement
G -	Gravel	Lw -	Lightweight Aggregate	Sh -	Shale
Gn -	Gneiss	MFG -	Manufactured	SS -	Steel Slag
		NSS -	Non-Steel Slag		

COPIES: SUPPLIER ____________________ AGG. FILE ____________
____________________ DISTRICT LAB ____________
____________________ OTHER ____________

SSSTD70111
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

Date

S. C. DEPARTMENT OF TRANSPORTATION
FORM AGG216

TEST REPORT
COARSE AGGREGATE

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

LOS ANGELES ABRASION LOSS (AASHTO T-96)

______ %
______ %
______ %

SPECIFIC GRAVITY and ABSORPTION (AASHTO T-85)

PERCENT ABSORPTION ______ %
BULK DRY SPECIFIC GRAVITY ______
BULK SSD SPECIFIC GRAVITY ______
APPARENT SPECIFIC GRAVITY ______

MICRO-DEVAL ABRASION LOSS (AASHTO T-327)

______ %
______ %

Micro-Deval results are for information only

SAND EQUIVALENCY OF UNWASHED SCREENINGS (AASHTO T-176)

AVERAGE VALUE ______

MOH'S HARDNESS VALUE (SC T-7) ______

NOTES: ______
REMARKS: ______

NOTES

1. Soundness tests are made every five years. These results are based on the previous year's test.
2. Approved only for use in Aggregate Base.
3. Approved for use in Class B Concrete, Graded Aggregate Base Course, Asphalt Aggregate Base Course, Asphalt Concrete Intermediate Course and Asphalt Concrete Surface Type 4.
4. Stone from this source may be loaded from yards other than the quarry.
5. Approved on a job to job basis per Standard Specifications Subsection 401.03(d)
6. Not approved in Prestress work due to high Chloride Ion content.
7. Approved only for use in aggregate courses that will be exposed and not overlaid with additional pavement courses.
8. Approved only for use as riprap stone.

LEGEND

C -	Crushed Stone	Gr -	Granite	Q -	Quartzite
FL -	Fossiliferous Limestone	L -	Limestone	R -	Recycled Portland Cement
G -	Gravel	Lw -	Lightweight Aggregate	Sh -	Shale
Gn -	Gneiss	MFG -	Manufactured	SS -	Steel Slag
		NSS -	Non-Steel Slag		

COPIES: SUPPLIER ______ AGG. FILE ______
______ DISTRICT LAB ______
______ OTHER ______

SSST701-11
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

Date

S. C. DEPARTMENT OF
TRANSPORTATION
FORM ASP901

TEST REPORT
CUTBACK ASPHALT
(AASHTO M-81 AND AASHTO M-82)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SOURCE OF SUPPLY	
ADDRESS	

SAYBOLT VISCOSITY (AASHTO T-72)

VISCOSITY (Saybolt Furol) in ______________ SECONDS

DISTILLATION TEST (AASHTO T-78)

RESIDUE FROM DISTILLATION TO 680 ^{o} F, PERCENTAGE VOLUME BY DIFFERENCE ______________

This sample of cutback asphalt ______________

NOTES ______________

COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________

M82-1
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM ASP902

TEST REPORT
CUTBACK ASPHALT
(AASHTO M-81 AND AASHTO M-82)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SOURCE OF SUPPLY	
ADDRESS	

APPEARANCE ____________________

FLASH POINT (Tag. Open Cup) F (AASHTO T-79) __________ **^{o} F**

VISCOSITY (AASHTO T-72) (Saybolt Furol) at __________ ^{o} F in __________ SECONDS

DISTILLATION TEST (AASHTO T-78)

TO 374 ^{o} F ____________________

TO 437 ^{o} F ____________________

TO 500 ^{o} F ____________________

TO 600 ^{o} F ____________________

RESIDUE FROM DISTILLATION TO 680 ^{o} F, PERCENTAGE VOLUME BY DIFFERENCE __________

TEST ON RESIDUE FROM DISTILLATION:

PENETRATION (AASHTO T-49) ____________________

This sample of cutback ____________________

NOTES ____________________

COPY TO ____________________ COPY TO ____________________

COPY TO ____________________ COPY TO ____________________

COPY TO ____________________ COPY TO ____________________

AASHTOM82
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM ASP903

TEST REPORT
PG BINDER VISCOSITY
(AASHTO T-316)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

VISCOSITY USING ROTATIONAL VISCOMETER (AASHTO T-316)

VISCOSITY, ROTATIONAL ______________ Pa-s

This sample of PG Binder

NOTES ______________

COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________

T316
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM ASP904

TEST REPORT
PG BINDER
(AASHTO M-320 AND AASHTO R-29)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

PERFORMANCE GRADE BINDER

ORIGINAL BINDER

VISCOSITY, ROTATIONAL (AASHTO T-316) ____________ Pa-s

DSR (AASHTO T-315) ____________ kPa

TEST TEMPERATURE ____________ °C

This sample of PG Binder ____________

NOTES ____________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

M320-1
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM ASP905

TEST REPORT
EMULSIFIED ASPHALT
(AASHTO M-140, M-208, M-316 AND SC STANDARD 407)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SOURCE OF SUPPLY	
ADDRESS	

SAYBOLT VISCOSITY (AASHTO T-72)

VISCOSITY (Saybolt Furol) at ______________ ^{o}F in ______________ SECONDS

DISTILLATION TEST (AASHTO T-49)

RESIDUE BY DISTILLATION ______________ %

This sample of Emulsified Asphalt ______________

NOTES ______________

COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________

M140-208-1

Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM ASP906

TEST REPORT
EMULSIFIED ASPHALT
(AASHTO M-140, M-208, M-316 AND SC STANDARD 407)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SOURCE OF SUPPLY	JOB MIX NUMBER
ADDRESS	COMMENTS

SAYBOLT VISCOSITY (AASHTO T-72)

VISCOSITY (Saybolt Furol) at ________ ^{o} F in ________ SECONDS

DISTILLATION TEST (AASHTO T-59)

RESIDUE BY DISTILLATION ________ %

SIEVE TEST ________ %

PENETRATION OF BITUMINOUS MATERIALS (AASHTO T-49)

PENETRATION OF RESIDUE, AT 77^{o} F ________

This sample of Emulsified Asphalt ________

NOTES ________

COPY TO ________ COPY TO ________

COPY TO ________ COPY TO ________

COPY TO ________ COPY TO ________

M140-M208

Rev. 8/06

M. O. FLETCHER

MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM ASP907

TEST REPORT
PREFORMED EXPANSION JOINT FILLER
(AASHTO M 213)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SOURCE OF SUPPLY	
ADDRESS	

PREFORMED EXPANSION JOINT FILLERS (AASHTO M-213)

DIMENSIONS (AASHTO T-42)

THICKNESS ________ INCHES
DEPTH ________ INCHES

DETERMINING PROPERTIES (AASHTO T-42)

WATER ABSORPTION ________ PERCENT BY WEIGHT
COMPRESSION ________ POUNDS PER SQUARE INCH
RECOVERY ________ PERCENT OF ORIGINAL THICKNESS
ASPHALT CONTENT ________ PERCENT BY WEIGHT

This sample of expansion joint material

NOTES ________

COPY TO ________ COPY TO ________
COPY TO ________ COPY TO ________
COPY TO ________ COPY TO ________

AASHTOT42
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM ASP908

TEST REPORT
PG BINDER
(AASHTO M-320 AND AASHTO R-29)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

PERFORMANCE GRADE BINDER

ORIGINAL BINDER

VISCOSITY, ROTATIONAL (AASHTO T-316)		Pa-s
DYNAMIC SHEAR RHEOMETER, (DSR) (AASHTO T-315)		kPa
DSR TEST TEMPERATURE		°C
SPECIFIC GRAVITY (AASHTO T-228)		
FLASH POINT (AASHTO T-48)		°C

ROLLING THIN-FILM OVEN, AGED (AASHTO R-28)

MASS LOSS		%
DYNAMIC SHEAR RHEOMETER, (DSR) (AASHTO T-315)		kPa
DSR TEST TEMPERATURE		°C

PRESSURIZED AGING VESSEL, RESIDUE (AASHTO R-28)

DYNAMIC SHEAR RHEOMETER, (DSR) (AASHTO T-315)		kPa
PAV TEST TEMPERATURE		°C

BENDING BEAM RHEOMETER (AASHTO T-313)

BBR (AASHTO T-313) STIFFNESS		mPa
BBR SLOPE (m-VALUE)		
BBR TEMPERATURE		°C

This sample of PG Binder

NOTES

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AASHTOM320
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM CEM606

TEST REPORT
PORTLAND CEMENT
(AASHTO M-85)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SOURCE OR SHIP NAME ______
DATE OF GRIND OR ARRIVAL ______
TYPE OF CEMENT ______

PHYSICAL ANALYSIS OF HYDRAULIC CEMENT (AASHTO M-85)

FINENESS (ASTM C-204) ______ cm^2/g
NORMAL CONSISTENCY (ASTM C-187) ______ %
SOUNDNESS, AUTOCLAVE EXPANSION (ASTM C-151) ______ %
MORTAR BAR EXPANSION ______ %

VICAT TIME OF SETTING (ASTM C-191)

INITIAL ______ Minutes
FINAL ______ Minutes

COMPRESSIVE STRENGTH (ASTM C-109)

AGE AT BREAK, DAYS ______ ______ ______
AVERAGE, psi ______ ______ ______

CHEMICAL ANALYSIS OF HYDRAULIC CEMENT (AASHTO T-105)

SILICON DIOXIDE	%	SULFUR TRIOXIDE	%	RATIO OF Al_2O_3 to Fe_2O_3			
ALUMINUM OXIDE	%	LOSS ON IGNITION	%	TRICALCIUM ALUMINATE			
FERRIC OXIDE	%	INSOLUBLE RESIDUE	%	TRICALCIUM SILICATE			
MAGNESIUM OXIDE	%	EQUIVALENT ALKALIES	%	DICALCIUM SILICATE			

This sample of ______

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

M-85_T-105
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM CEM606

TEST REPORT
PORTLAND CEMENT
(AASHTO M-85)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SOURCE OR SHIP NAME ______
DATE OF GRIND OR ARRIVAL ______
TYPE OF CEMENT ______

PHYSICAL ANALYSIS OF HYDRAULIC CEMENT (AASHTO M-85)

FINENESS (ASTM C-204) ______ cm^2/g
NORMAL CONSISTENCY (ASTM C-187) ______ %
SOUNDNESS, AUTOCLAVE EXPANSION (ASTM C-151) ______ %
MORTAR BAR EXPANSION ______ %

VICAT TIME OF SETTING (ASTM C-191)

INITIAL ______ Minutes
FINAL ______ Minutes

COMPRESSIVE STRENGTH (ASTM C-109)

AGE AT BREAK, DAYS			
AVERAGE, psi			

CHEMICAL ANALYSIS OF HYDRAULIC CEMENT (AASHTO T-105)

SILICON DIOXIDE	%	SULFUR TRIOXIDE	%	RATIO OF Al2O3 to Fe2O3			
ALUMINUM OXIDE	%	LOSS ON IGNITION	%	TRICALCIUM ALUMINATE			
FERRIC OXIDE	%	INSOLUBLE RESIDUE	%	TRICALCIUM SILICATE			
MAGNESIUM OXIDE	%	EQUIVALENT ALKALIES	%	DICALCIUM SILICATE			

This sample of ______
NOTES ______

COPY TO	COPY TO
COPY TO	COPY TO
COPY TO	COPY TO

M-85_T-105
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM CEM607

TEST REPORT
PORTLAND CEMENT
(AASHTO M-85)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SOURCE OR SHIP NAME ____________________

DATE OF GRIND OR ARRIVAL ____________________

CHEMICAL ANALYSIS OF HYDRAULIC CEMENT (AASHTO T-105)

SILICON DIOXIDE	______ %	INSOLUBLE RESIDUE	______ %
ALUMINUM OXIDE	______ %	EQUIVALENT ALKALIES	______ %
FERRIC OXIDE	______ %	RATIO OF Al2O3 to Fe2O3	______
MAGNESIUM OXIDE	______ %	TRICALCIUM ALUMINATE	______
SULFUR TRIOXIDE	______ %	TRICALCIUM SILICATE	______
LOSS ON IGNITION	______ %	DICALCIUM SILICATE	______

MORTAR BAR EXPANSION ______ %

This sample of ____________________

NOTES ____________________

COPY TO ______	COPY TO ______
COPY TO ______	COPY TO ______
COPY TO ______	COPY TO ______

AASHTOT105
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM CEM608

TEST REPORT
PORTLAND CEMENT
(AASHTO M-85)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SOURCE OR SHIP NAME ______
DATE OF GRIND OR ARRIVAL ______
TYPE OF CEMENT ______

PHYSICAL ANALYSIS OF HYDRAULIC CEMENT (AASHTO M-85)

FINENESS (ASTM C-204) ______ cm^2/g
NORMAL CONSISTENCY (ASTM C-187) ______ %
SOUNDNESS, AUTOCLAVE EXPANSION (ASTM C-151) ______ %
MORTAR BAR EXPANSION ______ %

VICAT TIME OF SETTING (ASTM C-191)

INITIAL ______ Minutes
FINAL ______ Minutes

COMPRESSIVE STRENGTH (ASTM C-109)

AGE AT BREAK, DAYS	3 Day		
AVERAGE, psi			

This sample of ______

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

AASHTO-M85
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM CON505

TEST REPORT
CONCRETE CYLINDER
(SC STANDARD 701)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

COMPRESSION CYLINDERS (ASTM C-39 AND SC T-50)

AGE OF SPECIMEN AT BREAK DAYS DATE FOR BREAKING CYLINDERS

DIAMETER X HEIGHT CROSS SECTIONAL AREA

CYLINDER BREAKS

SPECIMEN NO.	MAXIMUM LOAD FORCE	COMPRESSIVE STRENGTH (PSI)	TYPE OF FRACTURE
1			
2			

AVERAGE STRENGTH ____________ psi

The average compressive strength of the concrete ____________

The expected strength of this sample is ____________

NOTES ____________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

AASHTOT-22
Rev. 8/06

M. O. FLETCHER

S. C. DEPARTMENT OF TRANSPORTATION
FORM CON506

TEST REPORT
CHLORIDE ION IN CONCRETE AND CONCRETE RAW MATERIALS
(AASHTO T-260)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

CHLORIDE ION IN CONCRETE AND CONCRETE RAW MATERIALS (AASHTO T-260)

Total Chloride Content (Cl-ion) ______________ %

Chloride Ion per cubic yard ______________

This sample of chloride ion is for information only.

NOTES ______________

COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________

AASHTO260
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
CON507

TEST REPORT
WATER
(SC STANDARD 701)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

S.C.D.O.T. STANDARD SPECIFICATION 701

COMPRESSIVE STRENGTH OF HYDRAULIC CEMENT MORTARS (ASTM C-109)

	TESTED AT 7 DAYS	
MORTAR STRENGTH WITH COLUMBIA CITY WATER		PSI
MORTAR STRENGTH WITH SAMPLE WATER		PSI
PERCENT OF SAMPLE STRENGTH TO COLUMBIA CITY WATER		%

pH VALUE OF SAMPLE (AASTHO T-26) ____

TIME OF SETTING OF HYDRAULIC CEMENT BY VICAT NEEDLE (ASTM C-191)

	STANDARD	SAMPLE	COMPARISON	
INITIAL TIME OF SET (ASTM C-187)				Minutes
FINAL TIME OF SET (ASTM C-187)				Minutes
COMPARES WITH CITY WATER				

AUTOCLAVE EXPANSION OF PORTLAND CEMENT (ASTM C-151)	STANDARD	SAMPLE
SOUNDNESS (ASTM C-151)		
THERE ARE		

This sample of water ____

NOTES ____

COPY TO ____ COPY TO ____
COPY TO ____ COPY TO ____
COPY TO ____ COPY TO ____

SCSTD70112
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM CON508

TEST REPORT
LATEX (EMULSIONS FOR CONCRETE)
(FHWA-RD-78-35)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

LATEX EMULSIONS FOR CONCRETE (FHWA-RD-78-35)

PH ____________

SOLIDS CONTENT ____________ %

This sample of latex modifier

NOTES ____________

COPY TO ____________	COPY TO ____________
COPY TO ____________	COPY TO ____________
COPY TO ____________	COPY TO ____________

FHWARD7835
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM CON509

TEST REPORT
CONCRETE PIPE CORES
(AASHTO M-170)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

CONCRETE PIPE ABSORPTION (AASHTO T-280)

PERCENT ABSORPTION ____________ **%**

This sample of concrete pipe core ____________

NOTES ____________

COPY TO ____________ COPY TO ____________

COPY TO ____________ COPY TO ____________

COPY TO ____________ COPY TO ____________

AASHTOM170
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM CON510

TEST REPORT
CONCRETE DRILLED CORES
(SC STANDARD 701)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SOURCE OF SUPPLY	DATE OF POUR
ADDRESS	

CONCRETE DRILLED CORES (AASHTO T-24 AND ASTM C-39)

CORE ID		
DATE MADE		
HEIGHT		inches
DIAMETER		inches
CORRECTION FACTOR		
CROSS SECTIONAL AREA		inches
ACTUAL LOAD		
COMPRESSIVE STRENGTH		psi
AGE	**DAYS**	

This sample of concrete cores

NOTES

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AASHTO-T24
Rev. 8/06

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S. C. DEPARTMENT OF
TRANSPORTATION
FORM CON511

TEST REPORT
FLEXURAL STRENGTH OF CONCRETE
(SC STANDARD 501)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

FLEXURAL STRENGTH OF CONCRETE (AASHTO T-97)

SPAN 18 INCHES - TYPE LOADING IS THIRD POINT

BEAM 152.4 mm X 152.4 mm (6" x 6" x 20")

	Load lbf	Average Dimension (at Break) Width (in.)	Depth (in.)	Factor	Modulus of Rupture psi
First Beam					
Second Beam					

AGE AT BREAK **Days** AVERAGE STRENGTH

This sample of concrete beams

NOTES

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COPY TO	COPY TO
COPY TO	COPY TO

AASHTOT97
Rev. 8/06

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S. C. DEPARTMENT OF
TRANSPORTATION
FORM CON512

TEST REPORT
LATEX CYLINDERS COMPRESSION TEST
(SC STANDARD 726)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

COMPRESSION CYLINDERS (ASTM C-39 AND SC T-50)

AGE OF SPECIMEN AT BREAK DAYS DATE FOR BREAKING CYLINDERS **1/0/1900**

DIAMETER X HEIGHT CROSS SECTIONAL AREA

CYLINDER BREAKS

SPECIMEN NO.	MAXIMUM LOAD	COMPRESSIVE STRENGTH (PSI)	TYPE OF FRACTURE
1			
2			

AVERAGE STRENGTH ____________ PSI

The average compressive strength of the latex

The expected strength of this sample at Days is

NOTES

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SCSTD726
Rev. 8/06

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TRANSPORTATION
FORM CON513

TEST REPORT
CONCRETE BRICK / BLOCK
(ASTM C-55 AND ASTM C-90)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

COMPRESSIVE STRENGTH (ASTM C-140)

BRICK NUMBER	LENGTH	WIDTH	DEPTH	psi
1				
2				
3				

AVERAGE PSI OF BRICK ____________

ABSORPTION

AVERAGE ABSORPTION ____________ POUND/FOOT ^{3}

This sample of concrete brick / block

NOTES ____________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

ASTM55
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM CON514

TEST REPORT
CLAY BRICK
(AASHTO M-91AND AASHTO M-114)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF DATE SAMPLED IDENTIFICATION MARKS SAMPLE TAKEN FROM SAMPLED BY QUANTITY REPRESENTED SUPPLY SOURCE ADDRESS	SUBMITTED BY ADDRESS TO BE USED IN DATE RECEIVED DATE TESTED TESTED BY

CLAY BRICK COMPRESSIVE STRENGTH (AASHTO T-32)

BRICK NUMBER	LENGTH	WIDTH	DEPTH	psi
1				
2				
3				
4				
5				

AVERAGE PSI ____________

ABSORPTION (AASHTO T-32)

AVERAGE ABSORPTION ____________ %

This sample of clay brick

NOTES ____________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

AASHTM91
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MD418

TEST REPORT
ASPHALT MIXTURE

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	JOB MIX NUMBER
ADDRESS	

SIEVE ANALYSIS, PERCENT BY WEIGHT (SC-T-76)

	LABORATORY RESULTS	OUT OF TOLERANCE	FIELD RESULTS	OUT OF TOLERANCE
PASSING 1"				
PASSING 3/4"				
PASSING 1/2"				
PASSING 3/8"				
PASSING NO. 4				
PASSING NO. 8				
PASSING NO. 30				
PASSING NO. 100				
PASSING NO. 200				
BINDER CONTENT(SC-T-75)				
D/A RATIO				
MSG (SC-T-83)				

This sample of hot mix asphalt

NOTE 1
NOTE 2
NOTE 3
NOTE 4

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COPY TO

SCT-75
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MD419

TEST REPORT
ASPHALT MIXTURE
(SC STANDARD 401)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	JOB MIX NUMBER
ADDRESS	COMMENTS

BINDER CONTENT (SC-T-75) ____________________

VISCOSITY (AASHTO T-201) ____________________, POISES

This sample is for information only.

NOTES ____________________

COPY TO ____________________	COPY TO ____________________
COPY TO ____________________	COPY TO ____________________
COPY TO ____________________	COPY TO ____________________

SCT-75-4
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MD420

TEST REPORT
ASPHALT MIXTURE

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	JOB MIX NUMBER
ADDRESS	

SIEVE ANALYSIS, PERCENT BY WEIGHT (AASHTO T-27)

	LABORATORY RESULTS	**OUT OF TOLERANCE**	**FIELD RESULTS**	**OUT OF TOLERANCE**
PASSING 1 1/2"				
PASSING 1"				
PASSING 1/2"				
PASSING NO. 4				
PASSING NO. 8				
BINDER CONTENT(SC-T-75)				

This sample of asphalt base course

NOTE 1
NOTE 2
NOTE 3

COPY TO
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COPY TO
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COPY TO

SCT-75B
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET703

TEST REPORT
REINFORCING STEEL
(ASTM A-706)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

REINFORCING STEEL

BAR NO. (AS SUBMITTED)		
BAR MARKS…SOURCE – BAR NO		
BAR MARKS…TYPE - GRADE		
WEIGHT, LBS PER LIN. FT.		
PERCENTAGE OF THEORETICAL WEIGHT (ASTM A 706)		
YIELD STRENGTH (ASTM A 370)		
TENSILE STRENGTH (ASTM A 370)		
ELONGATION PERCENT (ASTM A 370)		
DEFORMATION HEIGHT IN. (ASTM A 706)		

This sample of reinforcing steel ________

NOTES ________

COPY TO ________ COPY TO ________
COPY TO ________ COPY TO ________
COPY TO ________ COPY TO ________

AASHTOT244
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET704

TEST REPORT
REINFORCING STEEL
DOWEL BAR
(AASHTO M-31)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF DATE SAMPLED IDENTIFICATION MARKS SAMPLE TAKEN FROM SAMPLED BY QUANTITY REPRESENTED SUPPLY SOURCE ADDRESS	SUBMITTED BY ADDRESS TO BE USED IN DATE RECEIVED DATE TESTED TESTED BY

REINFORCING STEEL DOWEL (AASHTO T-244)

SUBMITTED AS	____________	
NOMINAL AREA	____________	$IN.^2$
WEIGHT	____________	LBS PER LIN. FT.
PERCENTAGE OF THEORETICAL WEIGHT	____________	%
YIELD STRENGTH	____________	PSI
TENSILE STRENGTH	____________	PSI
ELONGATION	____________	%

This sample of reinforcing steel dowel bar ____________

NOTES ____________

COPY TO ____________	COPY TO ____________
COPY TO ____________	COPY TO ____________
COPY TO ____________	COPY TO ____________

AASHTO-M31

Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM MET705

TEST REPORT
STRESS-RELIEVED STRAND
(AASHTO M-203)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

STRESS-RELIEVED STRAND
(AASHTO T-244)

DIMENSIONS OF STRAND (AASHTO M-203)

DIAMETER OF STRAND, CROWN TO CROWN ________ IN.

DIAMETER OF CENTER STRAND IS GREATER THAN LARGEST OUTER STRAND BY ________ IN.

BREAKING STRENGTH OF STRAND

ULTIMATE STRENGTH OF CABLE STRAND ________ LBS.

This sample of **cable**

NOTES

COPY TO	COPY TO
COPY TO	COPY TO
COPY TO	COPY TO

AASHTOM203

Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET706

TEST REPORT
COLD DRAWN STEEL WIRE
(AASHTO M-32)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

STEEL WIRE FOR CONCRETE REINFORCEMENT (AASHTO T-244)

1ST DIAMETER ______________________ IN.

GAGE ______________________

REDUCTION IN AREA ______________________ %

MECHANICAL TESTING OF STEEL PRODUCTS

ULTIMATE STRESS ______________________ psi

This sample of

NOTES

COPY TO	COPY TO
COPY TO	COPY TO
COPY TO	COPY TO

AASHTOM32
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET707

TEST REPORT
DEFORMED REINFORCING WIRE
(AASHTO M-221)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

DEFORMED REINFORCING WIRE

BAR NO. (AS SUBMITTED) ____________

WEIGHT, LBS PER LIN. FT. ____________

PERCENTAGE OF THEORETICAL WEIGHT ____________

TENSILE STRENGTH, psi (AASTHO T-244) ____________

DEFORMATION HEIGHT, INCH ____________

NUMBER OF DEFORMATIONS PER INCH ____________

LINES OF DEFORMATIONS PER BAR ____________

This sample of deformed wire ____________

NOTES ____________

COPY TO ____________ COPY TO ____________

COPY TO ____________ COPY TO ____________

COPY TO ____________ COPY TO ____________

AASHTOM225
Rev. 8/06

M. O. FLETCHER

MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET708

TEST REPORT
GUARDRAIL AND GUARDRAIL POST
(SC STANDARD 806)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF DATE SAMPLED IDENTIFICATION MARKS SAMPLED BY QUANTITY REPRESENTED SUPPLY SOURCE ADDRESS	SUBMITTED BY ADDRESS TO BE USED IN DATE FIELD TESTED TESTED BY

GUARDRAIL BEAMS

MEASUREMENT OF COATING THICKNESS BY THE MAGNETIC METHOD

VISUAL INSPECTION

MANUFACTURER ______

HEAT NUMBER ______

STAMPED WITH M-180-A-2 ______

ZINC COATING MEASUREMENTS

AVERAGE READING FROM 1ST SECTION OF BEAM ______ **oz./sq.ft.**

AVERAGE READING FROM 2ND SECTION OF BEAM ______ **oz./sq.ft.**

AVERAGE READING FROM 3RD SECTION OF BEAM ______ **oz./sq.ft.**

GUARDRAIL POST

STANDARD SPECIFICATION FOR ZINC (HOT-DIP GALVANIZED) COATINGS

ZINC COATING MEASUREMENTS	FIRST SPOT READINGS	SECOND SPOT READINGS
READING NO. 1	**oz./sq.ft.**	**oz./sq.ft.**
READING NO. 2	**oz./sq.ft.**	**oz./sq.ft.**
READING NO. 3	**oz./sq.ft.**	**oz./sq.ft.**
READING NO. 4	**oz./sq.ft.**	**oz./sq.ft.**
READING NO. 5	**oz./sq.ft.**	**oz./sq.ft.**
AVERAGE READING	**oz./sq.ft.**	**oz./sq.ft.**

WOOD POST STAMPED WITH AWW ______

This sample of guardrail and post ______

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

AASHTOM180
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM MET709

TEST REPORT
FENCING POST, RODS, AND BARS
(SC STANDARD 806)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF DATE SAMPLED IDENTIFICATION MARKS SAMPLE TAKEN FROM SAMPLED BY QUANTITY REPRESENTED SUPPLY SOURCE ADDRESS	SUBMITTED BY ADDRESS TO BE USED IN DATE RECEIVED DATE TESTED TESTED BY

FENCING POSTS, RODS, AND BARS (STANDARD DRAWING NO. 806-2)

NAME OF SAMPLE SUBMITTED	GRADE	COATING* TYPE	COATING* AMOUNT	DIMENSIONS OR DIAMETER		WEIGHT (LBS/FT)	MEETS SPECIFICATIONS
CORNER POST OR PULL POST				OUTSIDE in.	INSIDE in.		
				OUTSIDE in.	INSIDE in.		
				DIMENSIONS			
				DIMENSIONS W/ GAP			
BRACE BAR				OUTSIDE in.	INSIDE in.		
TENSION BAR				DIAMETER in.			
STRETCHER BAR				DIMENSIONS			
	GRADE OR CLASSIFICATION		COATING AMOUNT	DIMENSIONS	GAGE		
	TYPE OF COATING			OUTSIDE in.	INSIDE in.		

* AASHTO M-111 OR AASHTO M-232 AS APPLICABLE.

This sample of fencing material

NOTES

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AASHTM-181
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM MET710

TEST REPORT
FENCING HARDWARE
(SC STANDARD 806)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

TYPE OF SAMPLE SUBMITTED	ITEM MEASUREMENT	TYPE OF COATING	WEIGHT OF COATING *	MEETS SPECS.
Tension Wire	(AASHTO T-244) Tensile Strength lbf Gage	AASHTO M-111 OR AASHTO M-232 AS APPLICABLE.		
Tie Wire Or Brace Wire	Gage	AASHTO T-65 OR AASHTO T-213 AS APPLICABLE.		
Turnbuckle				
Extension Arm for Barbed Wire				
Tubular Line Post Cap				
"H" column Post Cap				
"C" Column Post Cap				
Loop Cap				
Bottom Gate Hinge				
Rail Attachment				
Fabric Band				
Band for Barbed Wire				

This sample of fence hardware

NOTES

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AASHT-M181
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET711

TEST REPORT
SQUARE TUBING SIGN POST
(SC T-138)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SQUARE TUBING SIGN POST (SC T-138)

OUTSIDE DIMENSION ____________ IN.

INSIDE DIMENSION ____________ IN.

WALL THICKNESS ____________ IN.

ZINC COATING (AASHTO M-111) ____________ OZ/SQFT

AVERAGE HOLE DIAMETER ____________ IN.

AVERAGE DISTENCE BETWEEN HOLES ____________ IN.

VISUAL INSPECTION OF COATING ______________________________

This sample of type ______________________________

NOTES ______________________________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

SC-T-138
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET712

TEST REPORT
U-SECTION SIGN POST
(SC T-138)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

U-SECTION SIGN POST (SC T-138)

TYPE		P
"A" DIMENSION		in.
"B" DIMENSION		in.
"C" DIMENSION		in.
LENGTH		in.
WEIGHT		g
WEIGHT		LBS/FT
AVERAGE HOLE DIAMETER		in.
AVERAGE DISTENCE BETWEEN HOLES		in.
ZINC COATING (AASHTO M-111)		OZ/SQFT
VISUAL INSPECTION OF COATING		

This sample of P U-section sign post

NOTES

COPY TO	COPY TO
COPY TO	COPY TO
COPY TO	COPY TO

SCT-138
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET713

TEST REPORT
STRUCTURAL STEEL FASTENERS
(SC STANDARD 709)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF DATE SAMPLED IDENTIFICATION MARKS SAMPLE TAKEN FROM SAMPLED BY QUANTITY REPRESENTED SUPPLY SOURCE ADDRESS	SUBMITTED BY ADDRESS TO BE USED IN DATE RECEIVED DATE TESTED TESTED BY

BOLT (AASHTO M-164 & M-253)

MANUFACTURER ____
HEAT NUMBER ____ PHYSICAL MEASUREMENTS ____
LOT NUMBER ____ HARDNESS (ROCKWELL "C") ____

NUT (AASHTO M-291 & M-292)

MANUFACTURER ____
HEAT NUMBER ____ PHYSICAL MEASUREMENTS ____
LOT NUMBER ____ HARDNESS (ROCKWELL "C") ____

FLAT WASHERS (AASHTO M-293)

MANUFACTURER ____
HEAT NUMBER ____ PHYSICAL MEASUREMENTS ____
LOT NUMBER ____ HARDNESS (ROCKWELL "C") ____

DIRECT TENSION INDICATOR (ASTM F-959)

MANUFACTURER ____
HEAT NUMBER ____ PHYSICAL MEASUREMENTS ____
LOT NUMBER ____ STRENGTH TEST ____ kips ____

Bolt, Nut, and Washer Assembly Rotational Capacity Test

TENSION AT REQUIRED TURN ____ kips PHYSICAL APPEARANCE ____
TORQUE AT REQUIRED TURN ____ ft/lb LUBRICATION ____

This sample of structural steel bolt assemblies

NOTES ____

COPY TO ____ COPY TO ____
COPY TO ____ COPY TO ____
COPY TO ____ COPY TO ____

SCSTD70906
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET714

TEST REPORT
WIRE FABRIC
(AASHTO M-55)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

STEEL WIRE FOR CONCRETE REINFORCEMENT (AASHTO T-244)

	HORIZONTAL WIRE	VERTICAL WIRE	
1^{ST} DIAMETER			IN.
GAGE			
REDUCTION IN AREA			%

MECHANICAL TESTING OF STEEL PRODUCTS

ULTIMATE STRESS			psi

This sample of wire fabric ______

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

AASHTOM55
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET715

TEST REPORT
WOVEN WIRE FENCING
(SC STANDARD 806)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

FENCING WOVEN WIRE

NUMBER OF HORIZONTAL WIRES		
HEIGHT		INCHES
SPACING OF STAY WIRES		INCHES
GAGE OF TOP AND BOTTOM WIRES		GAGE
GAGE OF HORIZONTAL AND STAY WIRES		GAGE
* COATING		OZ./SQ. FT.
DESIGN NUMBER		
CLASSIFICATION		
TENSION OF TOP OR BOTTOM WIRE		LBF
TENSION OF LINE WIRE (AVERAGE OF 3)		LBF

* AASHTO T-65 OR AASHTO T-213 AS APPLICABLE.

This sample of woven wire fencing ____________________

NOTES ____________________

COPY TO ____________________ COPY TO ____________________
COPY TO ____________________ COPY TO ____________________
COPY TO ____________________ COPY TO ____________________

AASHTOM279
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET716

TEST REPORT
BARBED WIRE FENCE
(SC STANDARD 806)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

BARBED WIRE (AASHTO M-280)

GAGE OF WIRE	______	GAGE
GAGE OF BARBS	______	GAGE
SPACING OF BARBS	______	INCHES
NUMBER OF BARBS	______	
* COATING	______	OZ./SQ. FT.

* AASHTO T-65 OR AASHTO T-213 AS APPLICABLE.

This sample of barbed wire fencing

NOTES ______

COPY TO ______	COPY TO ______
COPY TO ______	COPY TO ______
COPY TO ______	COPY TO ______

AASHTOM280
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET717

TEST REPORT
CHAIN-LINK FENCING
(SC STANDARD 806)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

CHAIN-LINK FENCING

CHAIN-LINK FABRIC GAGE ______

SIZE OF MESH ______

HEIGHT ______

TYPE OF COATING ______

* COATING ______ oz/sqft

* AASHTO T-65 OR AASHTO T-213 AS APPLICABLE FOR ZINC OR ALUMINUM COATING.

This sample of chain link fencing ______

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

AASHTOM181
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM MET718

TEST REPORT
MECHANICAL COUPLER
(ASTM A-706 AND SC STANDARD 703)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF DATE SAMPLED IDENTIFICATION MARKS SAMPLE TAKEN FROM SAMPLED BY QUANTITY REPRESENTED SUPPLY SOURCE ADDRESS	SUBMITTED BY ADDRESS TO BE USED IN DATE RECEIVED DATE TESTED TESTED BY

MECHANICAL COUPLER (ASTM A-370)

BAR NO. (AS SUBMITTED) ____________

BAR MARKS…SOURCE – BAR NO ______ | ______

BAR MARKS…TYPE - GRADE ______ | ______

TENSILE STRENGTH (ASTM A 370) ____________

This sample of mechanical coupler ____________

NOTES ____________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

SCSS703-05
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MET719

TEST REPORT
GUARDRAIL HARDWARE
(AASHTO M-232)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

GUARDRAIL HARDWARE (SC-T-137)

	MATERIAL TESTED	DIMENSIONS	WEIGHT OF COATING	MEETS SPECIFICATIONS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

This sample of guardrail hardware

NOTES

COPY TO
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COPY TO

SCSTDDR805
Rev. 8/06

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MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM MSC002

TEST REPORT
DIESEL FUEL
(ASTM D-975 AND SC-T-105)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

DIESEL FUEL (ASTM D-975)

Flash Point ____________ **ºF**

This sample of diesel fuel ____________

NOTES ____________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

ASTMD975
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM MSC003

TEST REPORT
HYDRATED LIME
(AASHTO M-303)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

CHEMICAL LIMITS

TOTAL ACTIVE LIME CONTENT, BY MASS ____________ %

UNHYDRATED LIME CONTENT, PERCENT BY MASS CaO ____________ %

"FREE WATER" CONTENT, PERCENT BY MASS H2O ____________ %

PHYSICAL REQUIREMENTS

RESIDUE RETAINED ON A NO. 30 SIEVE, BY MASS ____________ %

RESIDUE RETAINED ON A NO. 200 SIEVE, BY MASS ____________ %

This sample of hydrated lime ____________

NOTES ____________

COPY TO ____________ COPY TO ____________

COPY TO ____________ COPY TO ____________

COPY TO ____________ COPY TO ____________

AASHTOT219
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM MSC006

TEST REPORT
ROAD SALT
(ASTM D-632)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

ROAD SALT (ASTM D-632)

PASSING 1/2"		%
PASSING 3/8"		%
PASSING NO. 4		%
PASSING NO. 8		%
PASSING NO. 30		%
TOTAL CHLORIDES		%

This sample of road salt

NOTES

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COPY TO	COPY TO
COPY TO	COPY TO

ASTMD632
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MSC007

TEST REPORT
PVC SOLID WALLED PIPE
(AASHTO M-278 AND ASTM D-1785)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

PVC SOLID WALLED PIPE (AASHTO M-278 AND ASTM D-1785)

INSIDE DIAMETER ______________ mm

AVERAGE OUTSIDE DIAMETER ______________ mm

AVERAGE MINIMAL WALL THICKNESS ______________ mm

PIPE FLATTENING ______________________

This sample of solid walled pvc pipe

NOTES ______________________

COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________

AASHT-M278
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MSC008

TEST REPORT
PERFORATED CORRUGATED
POLYETHYLENE PIPE
(AASHTO M-252)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

PERFORATED CORRUGATED POLYETHYLENE DRAINAGE PIPE (AASHTO M-252)

DIMENSIONS

INSIDE DIAMETER ______ mm
SHELL THICKNESS ______ mm
SLOT LENGTH ______ mm
SLOT WIDTH ______ mm
SLOT AREA ______ mm

STIFFNESS AT 5% DEFLECTION

PSI ______ N/M/MM ______

This sample of perforated corrugated pipe

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

AASHTOM252
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MSC009

TEST REPORT
CORRUGATED POLYETHYLENE PIPE
(AASHTO M-252)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SOLID WALLED CORRUGATED POLYETHYLENE DRAINAGE PIPE (AASHTO M-252)

INSIDE DIAMETER ______________ mm
SHELL THICKNESS ______________ mm

STIFFNESS AT 5% DEFLECTION

PSI ______________ N/M/MM ______________

This sample of corrugated pipe

NOTES ______________

COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________

AASHT-M252
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM MSC110

TEST REPORT
PERFORATED PVC PIPE
(AASHTO M-278 AND ASTM D-1785)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

PVC PERFORATED PIPE (AASHTO M-278 AND ASTM D-1785)

INSIDE DIAMETER	____________	mm
AVERAGE OUTSIDE DIAMETER	____________	mm
AVERAGE WALL THICKNESS	____________	mm
DIAMETER OF PERFORATION	____________	mm
ROWS OF PERFORATION	____________	
HEIGHT OF CENTERLINE OF PERFORATIONS	____________	mm
LENGTH OF CENTERLINE OF PERFORATIONS	____________	mm
PIPE FLATTENING	________________________	

This sample of perforated pvc pipe ____________________

NOTES ____________________

COPY TO ____________	COPY TO ____________
COPY TO ____________	COPY TO ____________
COPY TO ____________	COPY TO ____________

AASHTO278
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM SO112

TEST REPORT
4" X 4" SOIL CEMENT PILLS

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

4" X 4" SOIL CEMENT PILLS

SPECIMEN NUMBER	**1**	**2**
LOAD		
COMPRESSIVE STRENGTH, psi		

AGE AT BREAK ______ DAYS

This sample of Soil Cement Pills is for information only.

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

Pills4X4
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM SO113

TEST REPORT
UNCONFINED COMPRESSIVE STRENGTH OF
ROCK CORES

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

ROCK CORES (SC-T-39)

SPECIMEN NUMBER	
LOAD (lbs)	
LOAD (kN)	
COMPRESSIVE STRENGTH (psi)	
COMPRESSIVE STRENGTH (kN/m^2)	
UNIT WEIGHT (lb/ft^3)	
DENSITY (kg/m^3)	

This sample of rock cores is for information only.

COPY TO	COPY TO
COPY TO	COPY TO
COPY TO	COPY TO

SCT39
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM SO115

TEST REPORT
MSE BACKFILL-REINFORCED SOIL SLOPE

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

MECHANICALLY STABILIZED EARTH RETAINING WALL BACKFILL

SIEVE ANALYSIS OF FINE AGGREGATES (AASHTO T-27)

MATERIAL PASSING 1 1/2" ________ %

MATERIAL PASSING 3/4" ________ %

MATERIAL PASSING NO. 40 ________ %

MATERIAL PASSING NO. 100 ________ %

MATERIAL PASSING NO. 200 ________ %

DETERMINATION OF pH OF SOIL (AASHTO T-289) ________

DETERMINATION OF SOIL COLOR ________

This sample of MSE Backfill ________

NOTES ________

COPY TO ________ COPY TO ________

COPY TO ________ COPY TO ________

COPY TO ________ COPY TO ________

SCSTD713-2
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM SO116

TEST REPORT
SOIL
DETERMINING pH OF SOIL

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

DETERMINING pH OF SOIL FOR USE IN CORROSION TESTING (AASHTO T-289)

pH ____________________

DETERMINATION OF SOIL COLOR ____

This sample ____

NOTES ____

COPY TO ____________________ COPY TO ____________________
COPY TO ____________________ COPY TO ____________________
COPY TO ____________________ COPY TO ____________________

AASHTOT289
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM SO117

TEST REPORT
SAND CLAY BASE
(SC STANDARD 303)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

MECHANICAL ANALYSIS OF SOILS BY ELUTRIATION (SC T-34)

PASSING 1 1/2" ______ %

SAND ABOVE NO. 60 ______ %

SILT ______ %

CLAY (BY ELUTRIATION) ______ %

DETERMINATION OF SOIL COLOR

______

LIQUID LIMIT AND PLASTIC INDEX

LIQUID LIMIT (AASHTO T-89) ______

PLASTIC INDEX (AASHTO T-90) ______

This sample of Sand Clay ______

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

SCSTD303
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM SO118

TEST REPORT
ASPHALT SAND ELUTRIATION
(SC T-34)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

ELUTRIATION (SC T-34)

TOTAL SAND ______ %

SILT ______ %

CLAY (BY ELUTRIATION) ______ %

DETERMINATION OF SOIL COLOR ______

This sample of asphalt sand ______

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

SC-T-34
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM SO119

TEST REPORT
SOIL
CLASSIFICATION

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SAMPLE AS A WHOLE: (SC T-34)		**MATERIAL UNDER NO. 10: (SC T-34)**	
		RETAINED NO. 20	%
PASSING 2 1/2"	%	PASSING NO. 20 RET. NO. 40	%
PASSING 1 1/2"	%	PASSING NO. 40 RET. NO. 60	%
PASSING 3/4"	%	SAND ABOVE NO. 60	%
PASSING 3/8"	%	PASSING NO. 60 RET. NO. 100	%
PASSING NO. 4	%	PASSING NO. 100 RET. NO. 200	%
PASSING NO. 10	%	TOTAL SAND	%
SILT	%	SILT	%
CLAY	%	CLAY (BY ELUTRIATION)	%

DETERMINATION OF SOIL COLOR

LIQUID LIMIT (AASHTO T-89)
PLASTIC INDEX (AASHTO T-90)

AASHTO CLASSIFICATION (M-145)

This sample

NOTES

COPY TO	COPY TO
COPY TO	COPY TO
COPY TO	COPY TO

AASHTOM145
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM SO120

TEST REPORT
SOIL CLASSIFICATION - MOISTURE DENSITY

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	COMMENTS
ADDRESS	

SAMPLE AS A WHOLE: (SC T-34)		MATERIAL UNDER NO. 10: (SC T-34)	
		RETAINED NO. 20	____ %
PASSING 2 1/2"	____ %	PASSING NO. 20 RET. NO. 40	____ %
PASSING 1 1/2"	____ %	PASSING NO. 40 RET. NO. 60	____ %
PASSING 3/4"	____ %	SAND ABOVE NO. 60	____ %
PASSING 3/8"	____ %	PASSING NO. 60 RET. NO. 100	____ %
PASSING NO. 4	____ %	PASSING NO. 100 RET. NO. 200	____ %
PASSING NO. 10	____ %	TOTAL SAND	____ %
SILT	____ %	SILT	____ %
CLAY	____ %	CLAY (BY ELUTRIATION)	____ %

LIQUID LIMIT AND PLASTIC INDEX

LIQUID LIMIT (AASHTO T-89) ____
PLASTIC INDEX (AASHTO T-90) ____

CLASSIFICATION

AASHTO CLASSIFICATION (M-145) ____

DETERMINATION OF SOIL COLOR ____

MOISTURE-DENSITY RELATIONSHIP (AASHTO T-99)

OPTIMUM MOISTURE CONTENT ____ % MAXIMUM DRY DENSITY, PCF ____ %

This sample is for information only.

NOTES ____

COPY TO ____ COPY TO ____
COPY TO ____ COPY TO ____
COPY TO ____ COPY TO ____

M145-T99
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM SO121

TEST REPORT
SOIL
LIQUID LIMIT AND PLASTIC INDEX

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

DETERMINING THE LIQUID LIMIT OF SOILS (AASHTO T-89)

LIQUID LIMIT ____________

DETERMINING THE PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (AASHTO T-90)

PLASTIC INDEX ____________

DETERMINATION OF SOIL COLOR

____

This sample ____________

NOTES ____________

COPY TO ____________	COPY TO ____________
COPY TO ____________	COPY TO ____________
COPY TO ____________	COPY TO ____________

AASHTOT89
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM SO122

TEST REPORT
SOIL DENSITY
(AASHTO T-99)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

MOISTURE-DENSITY RELATIONSHIP (AASHTO T-99)

OPTIMUM MOISTURE CONTENT ______ % MAXIMUM DRY DENSITY ______ pcf

This sample of is for information only.

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

AASHTOT99
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM SO123

TEST REPORT
SOIL CLASSIFICATION WITH DENSITY AND INORGANIC IGNITION LOSS

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	COMMENTS
ADDRESS	

SAMPLE AS A WHOLE: (SC T-34)

PASSING 2 1/2"	______	%
PASSING 1 1/2"	______	%
PASSING 3/4"	______	%
PASSING 3/8"	______	%
PASSING NO. 4	______	%
PASSING NO. 10	______	%
SILT	______	%
CLAY	______	%

MATERIAL UNDER NO. 10: (SC T-34)

RETAINED NO. 20	______	%
PASSING NO. 20 RET. NO. 40	______	%
PASSING NO. 40 RET. NO. 60	______	%
SAND ABOVE NO. 60	______	%
PASSING NO. 60 RET. NO. 100	______	%
PASSING NO. 100 RET. NO. 200	______	%
TOTAL SAND	______	%
SILT	______	%
CLAY (BY ELUTRIATION)	______	%

LIQUID LIMIT AND PLASTIC INDEX

LIQUID LIMIT (AASHTO T-89) ______
PLASTIC INDEX (AASHTO T-90) ______

CLASSIFICATION OF SOILS (AASHTO M-145)

CLASSIFICATION ______

DETERMINATION OF SOIL COLOR ______

MOISTURE-DENSITY RELATIONSHIP (AASHTO T-99)

OPTIMUM MOISTURE CONTENT ______ %
MAXIMUM DRY DENSITY ______ PCF

IGNITION LOSS OF INORGANIC SOILS (SC T-36)

LOSS OF IGNITION ______ %

This sample is for information only.

NOTES ______

COPY TO ______	COPY TO ______
COPY TO ______	COPY TO ______
COPY TO ______	COPY TO ______

T99M145T36
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM SO124

TEST REPORT
SOIL CLASSIFICATION WITH
DENSITY AND ORGANIC IGNITION LOSS

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	COMMENTS
ADDRESS	

SAMPLE AS A WHOLE: (SC T-34)		**MATERIAL UNDER NO. 10: (SC T-34)**	
		RETAINED NO. 20	____ %
PASSING 2 1/2"	____ %	PASSING NO. 20 RET. NO. 40	____ %
PASSING 1 1/2"	____ %	PASSING NO. 40 RET. NO. 60	____ %
PASSING 3/4"	____ %	SAND ABOVE NO. 60	____ %
PASSING 3/8"	____ %	PASSING NO. 60 RET. NO. 100	____ %
PASSING NO. 4	____ %	PASSING NO. 100 RET. NO. 200	____ %
PASSING NO. 10	____ %	TOTAL SAND	____ %
SILT	____ %	SILT	____ %
CLAY	____ %	CLAY (BY ELUTRIATION)	____ %

LIQUID LIMIT AND PLASTIC INDEX

LIQUID LIMIT (AASHTO T-89) ____

PLASTIC INDEX (AASHTO T-90) ____

CLASSIFICATION OF SOILS (AASHTO M-145)

CLASSIFICATION ____

DETERMINATION OF SOIL COLOR ____

MOISTURE-DENSITY RELATIONSHIP (AASHTO T-99)

OPTIMUM MOISTURE CONTENT ____ %

MAXIMUM DRY DENSITY ____ PCF

IGNITION LOSS OF ORGANIC SOILS (AASHTO T-267)

LOSS OF IGNITION ____ %

This sample

NOTES ____

COPY TO ____ COPY TO ____
COPY TO ____ COPY TO ____
COPY TO ____ COPY TO ____

M145T99267
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF TRANSPORTATION
FORM SO125

TEST REPORT
SOIL CLASSIFICATION WITH INORGANIC IGNITION LOSS

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	COMMENTS
ADDRESS	

SAMPLE AS A WHOLE: (SC T-34)

PASSING 2 1/2" ______ %
PASSING 1 1/2" ______ %
PASSING 3/4" ______ %
PASSING 3/8" ______ %
PASSING NO. 4 ______ %
PASSING NO. 10 ______ %
SILT ______ %
CLAY ______ %

MATERIAL UNDER NO. 10: (SC T-34)

RETAINED NO. 20 ______ %
PASSING NO. 20 RET. NO. 40 ______ %
PASSING NO. 40 RET. NO. 60 ______ %
SAND ABOVE NO. 60 ______ %
PASSING NO. 60 RET. NO. 100 ______ %
PASSING NO. 100 RET. NO. 200 ______ %
TOTAL SAND ______ %
SILT ______ %
CLAY (BY ELUTRIATION) ______ %

LIQUID LIMIT AND PLASTIC INDEX

LIQUID LIMIT (AASHTO T-89) ______
PLASTIC INDEX (AASHTO T-90) ______

CLASSIFICATION OF SOILS (AASHTO M-145)

CLASSIFICATION ______

DETERMINATION OF SOIL COLOR

______

IGNITION LOSS OF INORGANIC SOILS (SC T-36)

LOSS OF IGNITION ______ %

This sample ______
NOTES ______

COPY TO ______
COPY TO ______
COPY TO ______
COPY TO ______
COPY TO ______
COPY TO ______

M145-SCT36
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM SO126

TEST REPORT
SOIL CLASSIFICATION WITH
ORGANIC IGNITION LOSS

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	COMMENTS
ADDRESS	

SAMPLE AS A WHOLE: (SC T-34)

PASSING 2 1/2"		%
PASSING 1 1/2"		%
PASSING 3/4"		%
PASSING 3/8"		%
PASSING NO. 4		%
PASSING NO. 10		%
SILT		%
CLAY		%

MATERIAL UNDER NO. 10: (SC T-34)

RETAINED NO. 20		%
PASSING NO. 20 RET. NO. 40		%
PASSING NO. 40 RET. NO. 60		%
SAND ABOVE NO. 60		%
PASSING NO. 60 RET. NO. 100		%
PASSING NO. 100 RET. NO. 200		%
TOTAL SAND		%
SILT		%
CLAY (BY ELUTRIATION)		%

LIQUID LIMIT AND PLASTIC INDEX

LIQUID LIMIT (AASHTO T-89) ____________

PLASTIC INDEX (AASHTO T-90) ____________

CLASSIFICATION OF SOILS (AASHTO M-145)

CLASSIFICATION ____________

DETERMINATION OF SOIL COLOR

____

IGNITION LOSS OF ORGANIC SOILS (AASHTO T-267)

LOSS OF IGNITION ____________ %

This sample

NOTES ____________________________

COPY TO	COPY TO
COPY TO	COPY TO
COPY TO	COPY TO

M145-T267
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM SO127

TEST REPORT
SOIL CLASSIFICATION - SOIL CEMENT
(AASHTO M-145 - SC T-38)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	COMMENTS
ADDRESS	

SAMPLE AS A WHOLE: (SC T-34)		MATERIAL UNDER NO. 10: (SC T-34)	
		RETAINED NO. 20	%
PASSING 2 1/2"	%	PASSING NO. 20 RET. NO. 40	%
PASSING 1 1/2"	%	PASSING NO. 40 RET. NO. 60	%
PASSING 3/4"	%	SAND ABOVE NO. 60	%
PASSING 3/8"	%	PASSING NO. 60 RET. NO. 100	%
PASSING NO. 4	%	PASSING NO. 100 RET. NO. 200	%
PASSING NO. 10	%	TOTAL SAND	%
SILT	%	SILT	%
CLAY	%	CLAY (BY ELUTRIATION)	%

LIQUID LIMIT AND PLASTIC INDEX

LIQUID LIMIT (AASHTO T-89) ________

PLASTIC INDEX (AASHTO T-90) ________

CLASSIFICATION OF SOILS (AASHTO M-145)

CLASSIFICATION ________

DETERMINATION OF SOIL COLOR ________

MOISTURE-DENSITY RELATIONSHIP (AASHTO T-99)

OPTIMUM MOISTURE CONTENT ________ % MAXIMUM DRY DENSITY ________ PCF

SOIL CEMENT (SC T-38)

SOIL CEMENT APPLICATION RATE ________ %, AT ________ LBS./SQ.YD., AT ________ INCHES.

This sample is for information only.

NOTES ________

COPY TO ________ COPY TO ________
COPY TO ________ COPY TO ________
COPY TO ________ COPY TO ________

M145-SCT38
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM SO128

TEST REPORT
COQUINA SHELL BASE

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (AASHTO T-27)

PASSING 3 1/2" SIEVE ______ %

MATERIALS FINER THAN 75-µM (NO. 200) SIEVE IN MINERAL AGGREGATES BY WASHING (AASHTO T-11)

MATERIAL FINER THAN NO. 200 SIEVE BY WASHING ______ %

DETERMINING THE LIQUID LIMIT OF SOILS (AASHTO T-89) AND
DETERMINING THE PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (AASHTO T-90)

LIQUID LIMIT ______
PLASTICITY INDEX ______

DETERMINATION OF CALCIUM CARBONATE EQUIVALENCE OF COQUINA AND OTHER SOIL SAMPLES (SC-T-6)

CALCIUM CARBONATE EQUIVALENT ______ %

MOISTURE-DENSITY RELATIONS OF SOILS, USING A 10 LB. RAMMER AND 18 IN. DROP (SC-T-140)

OPTIMUM MOISTURE CONTENT ______ %
MAXIMUM DRY DENSITY ______ PCF

THE CALIFORNIA BEARING RATIO (AASHTO T-193)

CALIFORNIA BEARING RATIO AT 100% ______ %

This coquina shell base sample is for information only.

NOTES ______

COPY TO ______	COPY TO ______
COPY TO ______	COPY TO ______
COPY TO ______	COPY TO ______

SCSTD304
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM SO129

TEST REPORT
COARSE AGGREGATE PROCTOR

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SOURCE OF SUPPLY	
ADDRESS	

MOISTURE-DENSITY RELATIONS OF SOILS OR SOIL-AGGREGATE MIXTURE
USING A 10 LB. RAMMER AND 18 IN. DROP
(SC-T-140)

OPTIMUM MOISTURE CONTENT ______________ %

MAXIMUM DRY DENSITY ______________ pcf

For information only.

COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________
COPY TO ______________ COPY TO ______________

SCT140
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM TM804

TEST REPORT
LARGE GLASS BEADS
(FHWA FP-96)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	COMMENTS
ADDRESS	

LARGE GLASS BEADS (ASTM D-1214)

GRADATION PERCENT PASSING	(SC STANDARD 604)
No. 8 ______ %	
No. 10 ______ %	
No. 12 ______ %	
No. 14 ______ %	RETAINED ON ______ %
No. 16 ______ %	RETAINED ON ______ %
No. 18 ______ %	REMAINING SIEVES ______ %
No. 20 ______ %	
No. 25 ______ %	

This sample of glass beads ______

NOTES ______

COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______
COPY TO ______ COPY TO ______

ASTM1214L
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM TM805

TEST REPORT
SMALL GLASS BEADS USED IN EPOXY PAINT

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

SMALL GLASS BEADS USED IN EPOXY PAINT (AASHTO M-247-81)

GRADATION PERCENT RETAINED (ASTM D-1214)	PERCENT ROUND (ASTM D-1155)
No. 20 ________ %	________ %
No. 30 ________ %	
No. 50 ________ %	
No. 80 ________ %	MOISTURE RESISTANCE-FLOW CHARACTERISTICS (SC STANDARD 604)
No. 100 ________ %	MOISTURE RESISTANCE ________
PAN ________ %	

This sample of glass beads ________

NOTES ________

COPY TO ________	COPY TO ________
COPY TO ________	COPY TO ________
COPY TO ________	COPY TO ________

ASTMD1214E
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM TM806

TEST REPORT
SMALL GLASS BEADS - TYPE I
(AASHTO M-247)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	COMMENTS
ADDRESS	

SMALL GLASS BEADS TYPE I (AASHTO M-247)

GRADATION, PERCENT PASSING
(ASTM D-1214)

No. 16 ____________ %

No. 20 ____________ %

No. 30 ____________ %

No. 50 ____________ %

No. 100 ____________ %

PERCENT ROUND
(ASTM D-1155)

____________ %

MOISTURE RESISTANCE-FLOW CHARACTERISTICS
(AASHTO M-247)

MOISTURE RESISTANCE ____________

This sample of glass beads ____________

NOTES ____________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

AASHTOM247
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM TM807

TEST REPORT
LARGE GLASS BEADS USED IN EPOXY PAINT
(AASHTO M-247)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	BATCH NUMBER
ADDRESS	

LARGE GLASS BEADS USED IN EPOXY PAINT (AASHTO M-247)

GRADATION PERCENT RETAINED (ASTM D-1214)		(SC STANDARD 604) PERCENT ANGULARITY	
No. 10	%	RETAINED ON	%
No. 12	%	RETAINED ON	%
No. 14	%	REMAINING SIEVES	%
No. 16	%		
No. 18	%	MOISTURE RESISTANCE-FLOW CHARACTERISTICS	
No. 20	%		
PAN	%	MOISTURE RESISTANCE	

This sample of glass beads

NOTES

COPY TO	COPY TO
COPY TO	COPY TO
COPY TO	COPY TO

ASTM1214-E
Rev. 8/06

M. O. FLETCHER

S. C. DEPARTMENT OF TRANSPORTATION
FORM TM808

TEST REPORT
PAVEMENT MARKERS
(SC STANDARD 605 OR SC STANDARD 602)

LABORATORY NO.

COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	LOT NUMBER
ADDRESS	

PAVEMENT MARKERS (SC-T-111)

COLOR ____________

COMPRESSION ____________

DIMENSION ____________

REFLECTIVE SIDES ____________

AVERAGE SPECIFIC INTENSITY AT 0^o INCIDENCE ANGLE ____________

AVERAGE SPECIFIC INTENSITY AT 20^o INCIDENCE ANGLE ____________

________ OF ________ MARKERS MEET SPECIFIC INTENSITY REQUIREMENTS.

________ OF ________ MARKERS MEET IMPACT TEST REQUIREMENTS.

________ MARKERS MEET THE ABRASION TEST REQUIREMENT.

This sample of pavement markers ____________

NOTES ____________

COPY TO ____________ COPY TO ____________

COPY TO ____________ COPY TO ____________

COPY TO ____________ COPY TO ____________

AASHTOT257
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM TM809

TEST REPORT
WATERBORNE TRAFFIC PAINT
(SC STANDARD 604)

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

WATERBORNE TRAFFIC PAINT (SC STANDARD 604)

MANUFACTURER ____________________
BATCH NUMBER ____________________

PHYSICAL TEST

DENSITY OF PAINT (ASTM D-1475) ____________ LBS/GAL
VISCOSITY OF PAINT (ASTM D-562) ____________ KREB UNITS
NO-PICK-UP TIME (ASTM D-711) ____________ MINUTES
FLEXIBILITY (SCDOT STANDARD 604.024C) ____________
5 DAY SETTLEMENT (ASTM D-898) ____________ DEGREE OF SETTLING
COLOR (SCDOT STANDARD 604.02.4L) ____________________

CHEMICAL TEST

AVERAGE NON-VOLATILE MATTER (ASTM D-2369) ____________ % SOLIDS
AVERAGE PIGMENT CONTENT (ASTM D-3723) ____________ %
VEHICLE, BY WEIGHT (ASTM D-3723) ____________ %
AVERAGE OF NON-VOLATILE IN VEHICLE (ASTM D-3723) ____________ %

This sample of ____________________
NOTES ____________________

COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________
COPY TO ____________ COPY TO ____________

SCSTD604
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

S. C. DEPARTMENT OF
TRANSPORTATION
FORM TM810

TEST REPORT
TRAFFIC PAINT
SOLVENTBORNE PAINT

LABORATORY NO.
COLUMBIA, SC

FILE NO. PROJECT NO. PIN

SAMPLE OF	SUBMITTED BY
DATE SAMPLED	ADDRESS
IDENTIFICATION MARKS	TO BE USED IN
SAMPLE TAKEN FROM	DATE RECEIVED
SAMPLED BY	DATE TESTED
QUANTITY REPRESENTED	TESTED BY
SUPPLY SOURCE	
ADDRESS	

TRAFFIC PAINT (SUPPLEMENTAL SPECIFICATION)

MANUFACTURER ____________________

BATCH NUMBER ____________________

PHYSICAL TEST

DENSITY OF PAINT (ASTM D-1475) ____________ LBS/GAL

VISCOSITY OF PAINT (ASTM D-562) ____________ KREB UNITS

NO-PICK-UP TIME (ASTM D-711) ____________ MINUTES

FLEXIBILITY (SCDOT STANDARD) ____________

5 DAY SETTLEMENT (ASTM D-898) ____________ DEGREE OF SETTLING

COLOR (SCDOT STANDARD) ____________

CHEMICAL TEST

AVERAGE PIGMENT CONTENT (ASTM D-2698) ____________ %

VEHICLE, BY WEIGHT (ASTM D-2369) ____________ %

AVERAGE NON-VOLATILE MATTER (ASTM D-2369) ____________ %

AVERAGE OF NON-VOLATILE IN VEHICLE (ASTM D-2698) ____________ %

This sample of ____________________

NOTES ____________________

COPY TO ____________ COPY TO ____________

COPY TO ____________ COPY TO ____________

COPY TO ____________ COPY TO ____________

SCSTD-604
Rev. 8/06

M. O. FLETCHER
MATERIALS AND RESEARCH ENGINEER

This test form is currently under development. If you have questions, please contact the Office of Materials and Research at (803)737-6681.