

ALDOT 432-2009  
Ground Tire Rubber (GTR) Testing

## 1. SCOPE

- 1.1 This method is used to determine the physical requirements of ground tire rubber for use in asphalt rubber using a Sieve Analysis, Specific Gravity Test, Moisture Content Test, and Metal Contaminants Test.

## 2. REFERENCED DOCUMENTS

- 2.1 AASHTO T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
- 2.2 AASHTO T 255 Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying
- 2.3 AASHTO M 92 Standard Specification for Wire-Cloth Sieves for Testing Purposes
- 2.4 AASHTO M 231 Standard Specification for Weighing Devices Used in the Testing of Materials.
- 2.5 ASTM D 297 Standard Test Methods for Rubber Products - Chemical Analysis
- 2.6 ASTM D 1511 Standard Test Method for Carbon Black-Pellet Size Distribution
- 2.7 ASTM D 2240 Standard Test Method for Rubber Property-Durometer Hardness
- 2.8 Alabama Department of Transportation Standard Specifications for Highway Construction

## 3. APPARATUS

- 3.1 Balance - The balance shall conform to the requirements of AASHTO M 231 for the class of general purpose balance required for the principal sample mass of the sample being tested.
- 3.2 Mechanical sieve shaker - a mechanically operated sieve shaker which imparts a uniform rotary and vertical tapping motion to a stack of 200 mm (8 in.) sieves as described in ASTM D1511.
- 3.3 Sieves - U.S. Standard sieves or equivalents, conforming to AASHTO M 92. Sieves included shall be No. 16 (1.18 mm), No. 30 (0.60 mm), No. 50 (0.30 mm), No. 100 (0.15 mm) and No. 200 (0.075 mm).
- 3.4 Oven - Convection type oven capable of maintaining the temperature surrounding the sample at  $60 \pm 2^{\circ}\text{C}$  ( $140 \pm 5^{\circ}\text{F}$ ).
- 3.5 Sample Pan - a pan not affected by heat and of sufficient volume to contain the sample without danger of spilling.
- 3.6 A scoop and heat resistant gloves.

- 3.7 Pycnometer - A flask or other suitable container which can be accurately calibrated and to which the ground tire rubber sample can be readily introduced. The volume of the container filled to the calibration mark shall be at least 50% greater than the space required to accommodate the test sample.
- 3.8 Water bath - Capable of maintaining a constant temperature  $25 \pm 0.5^{\circ}\text{C}$  ( $77 \pm 1^{\circ}\text{F}$ ).
- 3.9 Magnet - The magnet with sufficient strength to attract small metallic particles from within the rubber sample.
- 3.10 Rubber balls - Each ball shall have a mass of  $8.5 \pm 0.5$  grams, a diameter of  $24.5 \pm 0.5$  mm, and a Shore Durometer "A" hardness of  $50 \pm 5$  in conformance with the requirements in ASTM Designation: D 2240.
- 3.11 Talc - Hydrous Magnesium Silicate shall have a specific gravity of 2.76 and a maximum of 2% retained on the No. 200 sieve in a washed sieve analysis.

#### **4. TESTING PROCEDURES FOR GROUND TIRE RUBBER**

##### **4.1 SIEVE ANALYSIS OF GROUND TIRE RUBBER SAMPLE**

- 4.1.1 This procedure covers sieve analysis in accordance with AASHTO T 27.
- 4.1.2 A weighed sample of ground tire rubber is separated through a nest of sieves for determination of particle size distribution.
- 4.1.3 Nest the sieves in order of decreasing size of opening from top to bottom and place the sample, or portion of the sample if it is to be sieved in more than one increment, on the top sieve.
- 4.1.4 Place one rubber ball on each sieve and stack sieves in order of sieve size.
- 4.1.5 Weigh  $100 \pm 2.0$  grams of ground tire rubber and record weight to nearest 0.1 gram.
- 4.1.6 Weigh  $25 \pm 0.5$  grams of talc and record weight to the nearest 0.1 gram. Mix the talc thoroughly with ground tire rubber until particle agglomerates are broken and talc is uniformly mixed.
- 4.1.7 Introduce the rubber-talc sample mixture into the top sieve of the nested stack.
- 4.1.8 Place the sieve stack into the sieve shaker and agitate the sample for  $10 \pm 1$  minute.
- 4.1.9. Tare weighing pan on scale.
- 4.1.10. Starting with the top sieve, remove the screened fraction and pour contents into the weighing pan, and record the weight to the nearest 0.1 gram. Repeat for each sieve.

## **4.2 Calculations**

- 4.2.1 To calculate the weight of the contents of the bottom pan, empty its contents on the scale and record. Sum the total weight of the contents of each sieve including the bottom pan and subtract the original weight of the rubber obtained in 4.1.5. The remainder is considered to be talc and shall be subtracted from the bottom pan contents.
- 4.2.2 The sum of the weights of each fraction shall not be less than the original weight of the rubber sample plus 70% of the talc added, or greater than the original weight of the rubber sample plus 100% of the talc added. Repeat the test if either of these conditions occur
- 4.2.3 Calculate percentages passing each sieve to the nearest 0.1% on the basis of the total weight of the initial dry sample.

## **5.0 MOISTURE CONTENT TEST FOR GROUND TIRE RUBBER**

### **5.1 Moisture Content Procedure**

- 5.1.1 This procedure covers the testing of moisture in a sample in according to AASHTO T 255, except for the drying temperature.
- 5.1.2 Weigh out  $50 \pm 5$  grams of a sample of ground tire rubber in the clean drying pan. Record the weight to the nearest 0.01 gram. Any moisture condensing on the cover shall be included in the moisture determination. This mass must be taken as soon as possible, but no longer than 10 minutes after the test sample is obtained. The drying pan should be covered during handling and determining the mass of the sample (A), but uncovered during drying.
- 5.1.3 Dry the sample thoroughly at  $140^{\circ} \pm 5^{\circ}\text{F}$  ( $60^{\circ} \pm 2^{\circ}\text{C}$ ) in the sample container by means of the convection oven, exercising care to avoid loss of any materials. Very rapid heating could cause some particles to explode and pop, resulting in loss of material.
- 5.1.4 After 30 minutes of drying, remove the sample and container from oven and determine the mass of the pan, sample and cover to the nearest 0.01 gram. Return the sample to the oven.
- 5.1.5 Reweigh the sample, pan and cover after 15 minutes in the oven and in 15 minute increments hereafter until the sample is considered dry. The sample is considered thoroughly dry when two consecutive weights result in less than 0.1 grams of additional loss in weight. Record the dried sample weight to the nearest 0.1 gram after it has cooled to room temperature and label as constant dry mass (B).

## 5.2 Calculations

Determine the percent moisture as follows, and report to the nearest 0.1 percent.

$$\text{Percent Moisture} = \left( \frac{A - B}{B} \right) \times 100$$

Where:           A = Original Wet mass of test sample.  
                  B = Constant Dry mass of test sample

## 6.0 SPECIFIC GRAVITY TEST FOR GROUND TIRE RUBBER

### 6.1 Specific Gravity Procedure

- 6.1.1 This procedure covers the specific gravity of ground tire rubber in accordance with ASTM D-297.
- 6.1.2 The specific gravity of a sample of ground tire rubber is determined by weighing the rubber sample in air and immersing the sample in an alcohol filled pycnometer.
- 6.1.3 Weigh out  $50 \pm 1$  grams of a ground tire rubber sample and record the weight to the nearest 0.1 grams. Label this weight as the dry weight (A) of sample.
- 6.1.4 Fill a pycnometer up to the calibration marks with alcohol, at a temperature of  $25 \pm 0.5^\circ \text{C}$  ( $77 \pm 1^\circ \text{F}$ ), and record the weight(C) to the nearest 0.1 gram. Record the density (D) of the alcohol as given by manufacturer. Dry pycnometer prior to continuing with procedure.
- 6.1.5 Place the weighed rubber sample into an empty pycnometer, then fill the pycnometer with alcohol to the calibration mark.
- 6.1.6 Remove any entrapped air by gently agitating the sample and pycnometer. Do not invert sample.
- 6.1.7 Ensure the level of alcohol in pycnometer is level with calibration mark. Add more alcohol as needed.
- 6.1.8 Place the pycnometer with rubber sample and alcohol into a constant temperature water bath and allow the temperature of sample and alcohol to stabilize to  $25 \pm 0.5^\circ \text{C}$  ( $77 \pm 1^\circ \text{F}$ ).
- 6.1.9 Once temperature has stabilized, remove the pycnometer from water bath and dry off outside surface of pycnometer.
- 6.1.10 Weigh pycnometer, sample and alcohol and record weight (B) to the nearest 0.1 gram.

## 6.2 CALCULATIONS

6.2 Calculate the specific Gravity of the sample as follows:

$$\text{Specific Gravity (SG)} = \{(0.9970 * A) * D\} / \{A - (B - C)\}$$

Where

SG = Specific gravity of sample

A = Mass of original sample, g

B = Mass of pycnometer filled with rubber and alcohol, g

C = Mass of pycnometer filled with alcohol, g

D = Density of alcohol, g / cc

## 7.0 METAL CONTAMINANTS TESTS FOR GROUND TIRE RUBBER

### 7.1 METALS TESTING PROCEDURE

- 7.1.1 This test determines the amount of any metals contained in a sample of the ground tire rubber by passing a magnet over the sample.
- 7.1.2 Weigh out a sample of 99 to 101 grams of ground tire rubber and record the weight of the sample (A) to the nearest 0.1 grams.
- 7.1.3 Spread the sample evenly, approximately 12 mm (0.5 inches) thick, across a flat surface.
- 7.1.4 Pass a magnet across the sample in a circular motion approximately 25mm (1 inch) above the sample. Any metal particles removed from sample and stuck to magnet should be cleaned off and set aside.
- 7.1.5 Stir rubber sample and spread out evenly and repeat magnet testing until all metal particles have been removed.
- 7.1.6 Weigh rubber sample, minus the metals removed and record this weight (B) to the nearest 0.1 grams.

### 7.2 CALCULATIONS

Calculate the total metal content in the sample as follows:

$$M = ((A-B) / B) * 100$$

Where

M = Metal content of sample, %

A = Mass of original sample, g

B = Mass of remaining sample, g

## **8.0 REPORTING**

Results from the Sieve Analysis, Moisture Content, Specific Gravity, and Metal Contaminants shall be reported as required by the Standard Specifications for Highway Construction Section 410.