



Designation: D5644 – 23

Standard Test Method for Rubber Compounding Materials—Determination of Particle Size Distribution of Recycled Vulcanizate Particulate Rubber¹

This standard is issued under the fixed designation D5644; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method describes the procedures for determining average particle size distribution of recycled vulcanizate particulate rubber by the mechanical vibratory sieve shaker test method for 90 μm (170 mesh) or larger particles.

1.2 The values stated in SI units are to be regarded as the standard.

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[D1566 Terminology Relating to Rubber](#)

[D5603 Classification for Rubber Compounding Materials—Recycled Vulcanizate Rubber](#)

[E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves](#)

[E105 Guide for Probability Sampling of Materials](#)

3. Terminology

3.1 Definitions:

¹ This test method is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.27 on Rubber Sustainability.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.1 *parent compound, n*—original compound used in the product.

3.1.2 *recycled vulcanizate rubber, n*—vulcanized rubber that has been processed to give particulates or other forms of different shapes, sizes, and size distributions.

3.1.3 *Discussion*—The words “vulcanizate” and “vulcanized rubber” are interchangeable. Additional terminology associated with this classification can be found in Terminology [D1566](#).

4. Significance and Use

4.1 The particulate size distribution of vulcanizate particulate rubber is used for the purpose of assigning a product mesh or average particle size designation.

4.2 The product designation for mesh size for the Ro-tap method is based on the size designation screen which allows a range for the upper limit retained of maximum 5 % for up to 850 μm (20 mesh) particles, maximum 10 % for 850 to 150 μm (20 to 100 mesh), and maximum 15 % for 125 to 20 μm (120 to 635 mesh). No rubber particles shall be retained on the zero screen (see Table 2, Classification [D5603](#)).

4.3 The weight percent retained on a specific screen is noted.

5. Summary of Test Method

5.1 *Mechanical Vibratory Sieve Shaker Method*—A 100 ± 1 g specimen of the recycled rubber is combined with a fixed amount of flowing agent (for example, hydrous magnesium silicate (talc), fumed, aluminum oxide, fumed silica, or calcium carbonate) and placed on top of a series of mesh sieves, with the coarsest sieve being on top and the finest on the bottom. The specimen is placed in a mechanical vibratory sieve shaker for 10 to 20 min, depending on the classification by particle size identified in Classification [D5603](#) 5.4.1 of the recycled rubber. The weight of the rubber retained on the individual sieves is then recorded and the mesh designation of the product determined.

6. Apparatus

6.1 *Mechanical Vibratory Sieve Shaker*³—This is a mechanically operated sieve shaker that imparts a uniform rotary and tapping motion to a stack of 200 mm (7.9 in.) sieves in accordance with 6.2. The sieve shaker should be adjusted to accommodate a stack of sieves, receiver pan, and cover plate. The bottom stops should be adjusted to give a clearance of 1.5 mm (0.06 in.) between the bottom plate and the screens so that the screens will be free to rotate. The sieve shaker machine shall be powered with an electric motor operating 28.75 to 29.17 Hz (1725 to 1750 rpm). This will produce 2.33 to 2.60 Hz and 280 to 320 rotary motions/min. The cover plate shall be fitted with a cork stopper that shall extend from 3.00 to 9.00 mm (0.118 to 0.354 in.) above the metal recess. At no time, shall rubber, wood, or other material other than cork be permitted.

6.2 *Standard Sieves*, stainless steel or brass, 200 mm (7.9 in.) in diameter in accordance with Specification E11. The sieve set should include a lid and a bottom pan.

6.3 *Digital Scale with Tare Function*, with a sensitivity of weighing at a minimum 0.1 g.

6.4 *Brushes*:

6.4.1 A soft brass wire brush for cleaning sieves 425 μm (40) mesh and coarser.

6.4.2 A nylon bristle brush for cleaning sieves finer than 425 μm (40) mesh.

6.5 *Glass or Metal Measuring Cup*, with a capacity of 500 cm^3 (1 pint).

6.6 *Glass Wide-Mouth Jar with Lid*, with capacity of 500 cm^3 (1 pint).

6.7 *Rubber Balls*,⁴ with a diameter from 25 to 50 mm (1 to 2 in.) or plastic rings with a height of 20 ± 3 mm, an outside diameter of 60 ± 3 mm, and an inside diameter of 58 ± 3 mm. The height of the balls or rings must be less than the depth of the screens being used. Use two balls or two plastic rings per test screen as per 7.1.5. Balls and rings are not to be used simultaneously.

6.8 *Flow Agent (same as 5.1)*, usually some mixture of magnesium silicate, silica, magnesium oxide, magnesium-aluminum silicate with at least 90 % of the particles being less than 40 μm (approximately 400 mesh) in size.

7. Procedure

7.1 *Selection and Preparation of Test Screens*:

7.1.1 Select test screens appropriate to the particle size distribution of the product being tested. A set of two to six sieves and a receiver pan are normally used. The actual number of sieves is to be agreed upon by vendor and customer.

7.1.2 Verify each screen has been cleaned of all particles on both sides of screen with brush (see 6.4).

7.1.3 Stack test screens in order of increasing mesh size with smallest number on top (coarsest) and highest number on bottom (finest).

7.1.4 Add bottom receiver pan to stack.

7.1.5 Verify rubber balls or plastic rings are in place in test screens; For products of 425 μm (40 mesh) or finer, add two rubber balls or two plastic rings per sieve. For products coarser than 425 μm (40 mesh), the use of rubber balls or plastic rings as an agitation aid is optional. Rubber balls and plastic rings are not to be mixed on any test screen.

7.2 *Preparation of Specimen*:

7.2.1 Obtain approximately 150 to 200 g of vulcanizate particulate rubber from the lot (refer to Practice E105).

7.2.2 Place an empty glass or metal measuring cup on digital scale. Press tare feature to determine tare weight of measuring cup.

7.2.3 Using the glass or metal measuring cup weigh 100 g of specimen to the nearest gram.

7.2.4 Transfer 100 g of specimen into glass jar as defined in 6.6.

7.3 *Preparation of Flow Agent*:

7.3.1 Place empty glass or metal measuring cup on digital scale; press tare feature to determine tare weight of measuring cup.

7.3.2 Using the empty glass or metal measuring cup weigh flow agent per product gradation designation. For products designated coarser than 300 μm (50 mesh), weigh 5.0 ± 0.1 g of flow agent. For products designated 300 μm (50 mesh) or finer, weigh 15.0 ± 0.1 g of flow agent.

7.3.3 Add flow agent to specimen in glass jar as defined in 6.6 and seal glass jar with lid.

7.3.4 Thoroughly shake the glass jar for a minimum of 1 min until agglomerates are broken and flow agent is uniformly mixed or dispersed.

7.4 Remove specimen and flow agent from glass jar and place on top screen. Place cover on top of stack.

7.5 Place the stack in the shaker.

7.6 Activate the shaker for 10 min for products designated coarser than 300 μm (50 mesh). For products designated 300 μm (50 mesh) or finer, activate the shaker for 20 min.

7.7 After the shaker completes the appropriate cycle, remove the stack.

7.8 *Determine and Record Results*:

7.8.1 Place empty glass or metal measuring cup on digital scale; press tare feature to determine tare weight of measuring cup;

7.8.2 Starting with the top sieve, remove the screened fraction by gently tapping its contents to one side and pouring the contents into the metal or glass measuring cup and recording its mass to the nearest 0.1 g. Record any mass less than 0.1 g as trace.

7.8.3 Brush any material adhering to the bottom of the screen onto the next finer screen.

7.8.4 Empty the glass or metal measuring cup and set the specimen aside.

³ The Ro-Tap Sieve Shaker meets the specified conditions and has been found satisfactory for this purpose and is available from many scientific laboratory suppliers.

⁴ Available from various sieve manufacturing suppliers.