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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Flow Rate and Tap Density of Electrical Grade Magnesium Oxide For Use in Sheathed Heating Elements¹

This standard is issued under the fixed designation D 3347; 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 covers the determination of the flow rate and the tap density which predicts the fill rate and flow rate of granular electrical grade magnesium oxide used in the manufacturing of sheathed heating elements.

1.2 *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:

D 2755 Test Method of Sampling and Reduction to Test Weight of Electrical Grade Magnesium Oxide²

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *fill density, n*—the weight per unit volume in grams per cubic centimetre of electrical grade magnesium oxide in a sheathed heating element after the filling operation.

3.1.2 *fill rate, n*—the rate in inches per minute required to fill a sheathed heating element with electrical grade magnesium oxide.

3.1.3 *flow rate, n*—the time in seconds required for a 100 g specimen of electrical grade magnesium oxide to flow through the orifice of the flow rate and tap density testing machine hopper.

3.1.4 *tap density, n*—the weight per unit volume in grams per cubic centimetre of electrical grade magnesium oxide in the receiver tube of the flow rate and tap density testing machine after completion of the test.

4. Summary of Test Method

4.1 The flow rate is the time, in seconds, required for a weighed specimen to flow freely through an orifice into a receiver tube that is simultaneously tapped.

4.2 Following the determination of the flow rate, a cali-

brated plug is placed in the receiver tube and the tap density is read from the scale on the plug at the completion of the test.

5. Significance and Use

5.1 The flow rate is a measure that indicates how the magnesium oxide will perform during the heating element filling operation. A user can correlate the flow rate to his filling equipment.

5.2 The tap density is a relative measure of the fill density of magnesium oxide powder in a heating element before compaction. The fill density influences such factors as elongation of the tube during compaction, final density after compaction, and thermal conductivity of the compacted magnesium oxide.

6. Apparatus

6.1 *Balance*, capable of weighing 100.00 ± 0.02 g.

6.2 *Flow Rate and Tap Density Testing Machine*³ (Fig. 1 and Fig. 2).

6.3 *Stopwatch*.

7. Sampling

7.1 Obtain the sample of magnesium oxide in accordance with Test Method D 2755.

8. Machine Setup

8.1 Place the flow rate and tap density testing machine on a rigid table and level the machine base to ensure the receiver tube is held exactly vertical. A bubble level mounted on the machine base has been found to be satisfactory.

8.2 Remove hopper and clean the interior surfaces to ensure free flow of the magnesium oxide. Remove receiver tube and ensure that no residual magnesium oxide has been retained. Replace receiver tube on machine with the identification number facing the operator. Replace the hopper on the machine and lower into the operating position.

9. Procedure

9.1 Weigh out a specimen of 100.00 ± 0.02 g of magnesium oxide powder as obtained in accordance with 7.

9.2 With the receiver tube and hopper on the operating position, start the machine tapping.

¹ This test method is under the jurisdiction of ASTM Committee D-9 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.14 on Electric Heating Unit Insulation.

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² *Annual Book of ASTM Standards*, Vol 10.02.

³ Flow rate and tap density testing machine, available from Boeh Tool and Die Co., 520 McNally Rd., Pittsburg, PA 15226, has been found satisfactory for this method.

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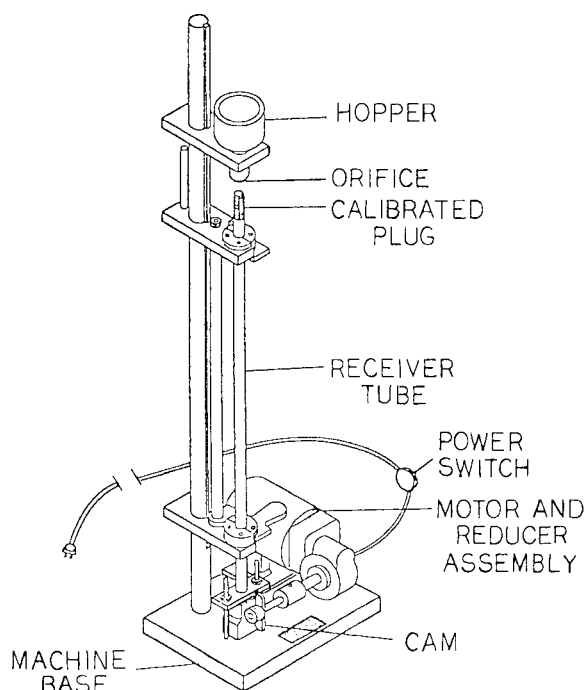


FIG. 1 Flow Rate and Tap Density Testing Machine

9.3 Pour the specimen into the hopper. At the instant the specimen begins to flow from the orifice, start the stopwatch.

9.4 Carefully observe the flow of the specimen through the orifice and stop the stopwatch when the flow ceases. Turn the machine off. Record the flow time in seconds to the nearest second.

9.5 Tap the hopper to dislodge any powder adhering to the sides of the hopper.

9.6 Insert the calibrated plug into the tube, restart the machine, and allow the tube to tap five times. Read the tap density from the scale on the plug at the top of the receiver tube to the nearest 0.01 g/cm^3 .

9.7 Repeat 9.1-9.6 with two additional specimens and average the results.

10. Report

10.1 Report the following information:

10.1.1 Complete identification of the sample of magnesium oxide,

10.1.2 Average flow rate, in seconds, and

10.1.3 Average tap density, in g/cm^3 .

11. Precision and Bias

11.1 The precision of this test method has not been determined. In a well equipped laboratory with trained personnel, it is expected that triplicate determinations on a single sample of material with a single piece of equipment should agree to within $\pm 2 \%$ on flow rate and $\pm 0.01 \text{ g/cm}^3$ on tap density. Two laboratories, each reporting the average of three replicate measurements, should agree to within $\pm 4 \%$ on flow rate and $\pm 0.02 \text{ g/cm}^3$ on tap density.

11.2 This test method has no bias because the values for tap density and flow rate of magnesium oxide are defined in terms of this test method.

12. Keywords

12.1 fill density; fill rate; flow rate; magnesium oxide; sheathed heating elements; tap density