



Designation: C 92 – 95 (Reapproved 1999)

## Standard Test Methods for Sieve Analysis and Water Content of Refractory Materials<sup>1</sup>

This standard is issued under the fixed designation C 92; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

### 1. Scope

1.1 These test methods cover a wet and a dry method for sieve analysis of refractory materials.

1.1.1 *Wet Sieve Analysis*—Water promotes the slaking of clays and helps to separate fine particles, washing them from the larger grains. This method is recommended for use with materials that require water addition, and that slake in normal industrial use.

1.1.2 *Dry Sieve Analysis*—The dry method is not as effective as the wet method in determining the amount of material present in the smaller particle sizes. It is recommended (1) for clays, when the slaking action of water is undesirable, (2) when the material is in the form of coarsely ground grog and calcine, and (3) when the clay is to be used in such a way that the ultimate particle size is of secondary importance.

1.2 These test methods also cover determination of the water content of refractory materials in the wet condition and of air-dried samples as received, so that the sieve analysis can be calculated on the dry basis. Included is a method for obtaining the water content of other refractory materials, such as plastic refractories and wet mixes.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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:

C 429 Test Method for Sieve Analysis of Raw Materials for Glass Manufacture<sup>2</sup>

E 11 Specification for Wire-Cloth Sieves for Testing Purposes<sup>3</sup>

E 105 Practice for Probability Sampling of Materials<sup>3</sup>

E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process<sup>3</sup>

#### 2.2 Other Document:

ASTM STP 447 *Manual on Test Sieving Methods*<sup>4</sup>

### 3. Significance and Use

3.1 Particle size distribution has a major affect upon most of the refractory properties. These test methods provide a means of measuring the distribution for the purpose of comparison to the desired distribution.

3.2 These test methods also cover determination of the water content of refractory materials in the wet condition and of air-dried samples received, so that the sieve analysis can be calculated on the dry basis.

3.3 These methods can produce data for specification acceptance, design purposes, manufacturing control, and research and development.

3.4 A reference set of standard matched or calibrated sieves<sup>5</sup> shall be provided for use in checking the set of sieves used in the actual sieve analysis of samples. The sieves for use in sieve analysis may also be standard matched sieves or may be unmatched sieves conforming to the Specification Table in Specification E 11, provided that such sieves will give results that differ by no more than 5 % from those obtained with the reference set when the two sets are compared in accordance with the section of Test Method C 429 on testing of sieves and samples splitters.

### 4. Apparatus

4.1 ASTM sieves, or the equivalent Tyler Series listed in Table 1, shall be used. The wire cloth for the sieves, described in Specification E 11, shall be woven (not twilled) and

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 15.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>4</sup> Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

<sup>5</sup> Matched sieves such as those supplied by W. S. Tyler, Inc., Mentor, OH 44060, have been found satisfactory.

**TABLE 1 ASTM Sieves and the Equivalent Tyler Standard Series**

ASTM Sieves (U.S. Standard Series) No.	Tyler Standard Series (Mesh Designation)	Sieve Opening
0.265 in.	3	6.7 mm
4	4	4.75 mm
6	6	3.35 mm
8	8	2.36 mm
12	10	1.70 mm
16	14	1.18 mm
20	20	850 $\mu$ m
30	28	600 $\mu$ m
40	35	425 $\mu$ m
50	48	300 $\mu$ m
70	65	212 $\mu$ m
100	100	150 $\mu$ m
140	150	106 $\mu$ m
200	200	75 $\mu$ m

mounted without distortion or looseness in 8-in. (200-mm) diameter circular frames. Pans and covers shall be provided for the sieves.

### 5. Sampling, Test Specimens, and Test Units

5.1 A representative sample of the material to be tested shall weigh at least four to five times the required weight of the actual test specimen. Material on which the water content is to be determined shall be packed in a watertight container.

#### 5.2 Water Content:

5.2.1 *Wet-Type Air-Setting Refractory Mortars*—Remove approximately 50 g of the material immediately after opening the original container and after carefully mixing the contents. To facilitate handling the specimen, place it on a tared piece of waxed paper or aluminum weighing dish. Weigh the test specimen to the nearest 0.1 g both before and after drying for 24 h at 220 to 230°F (105 to 110°C). Calculate the percentage of water to the nearest 0.1 % on the as-received basis.

5.2.2 *Materials Other Than Wet-Type Air-Setting Refractory Mortars* (ground fire clays, fireclay mortars, dry-type air-setting mortars, plastic refractories, and similar materials)—If the material is shipped in the wet condition, prevent loss of water before obtaining a test specimen of approximately 250 g. Weigh the test specimen to the nearest 0.1 g both before and after drying for 3 h at 220 to 230°F (105 to 110°C). Calculate the percentage of water to the nearest 0.1 % on the as-received basis. The dried specimen may be required for further tests (see Sections 6 and 7).

### WET SIEVE ANALYSIS

#### 6. Dry Materials

6.1 If the material is received in the dry condition, the test specimen (Note 1) shall consist of the dried and weighed test specimen prepared in accordance with 5.2.2.

NOTE 1—The size of the test specimen may be changed by reason of the nature of the material. For example, some clays tend to pack or cake on the sieves when ground to exceedingly fine particle size, in which case a 100-g sample may be used. For plastic refractories or coarsely ground mixes, the weight of the specimen could be increased to 500 g.

#### 7. Wet Materials

7.1 Materials prepared with water (plastic refractories, wet-type high-temperature bonding mortars, etc.) shall be tested as

received. Take two test specimens immediately after opening the original container and, in the case of mortars, after carefully mixing the contents. Use one specimen for determining the water content in accordance with either 5.2.1 or 5.2.2. Obtain approximately 250 g of the other specimen (Note 1) for sieve analysis. Weigh the test specimen to the nearest 0.1 g and transfer to the 1-dm<sup>3</sup> container (see Section 8). Wash the utensils used during weighing (to which a small part of the sample may adhere) with a small jet of water from a ¼-in. (6-mm) hose to ensure a quantitative transfer of the weighed specimen to the container.

### 8. Procedure

8.1 Place the test specimen into a container of about 1-dm<sup>3</sup> capacity. Add sufficient water to form a slurry. Allow slaking to proceed for 1 h, after which a further addition of water may be necessary. Then transfer the test specimen (without loss) to the finest sieve to be used in the analysis. Wash with a small jet of water from a ¼-in. (6-mm) rubber hose until the water passing through the sieve contains only traces of the specimen. Exercise care during washing to prevent loss by splashing. It may be necessary to break up lumps by gently rubbing between the fingers, but never by rubbing or pressing against the sieve. Then dry the washed residue in the sieve to constant weight at 220 to 230°F (105 to 110°C). This usually requires about 2 h. If desired, a preliminary drying period at a lower temperature may be used. Then transfer the dried residue to the top or coarsest sieve of the series to be used. Complete the sieving and weighing operations in accordance with Section 10 or 11.

### 9. Calculation and Report

9.1 Calculate the wet sieve analysis for the test specimen on the dry weight, and report the results to the nearest 0.1 % of the material retained on each sieve (Note 2). Report the percentage passing the finest sieve as the difference between 100 % and the sum of the percentages retained on the other sieves.

NOTE 2—As an alternative, the results of sieve analysis may be reported on the cumulative basis, either as the total percentage retained on or passing each sieve.

### DRY SIEVE ANALYSIS

#### 10. Mechanical Sieving

10.1 When the sieving is to be done mechanically, arrange the sieves in the order of size with the coarsest sieve at the top of the series. The specimen for sieving (Note 1) shall consist of a dried and weighed material prepared in accordance with 5.2.2. Transfer the specimen to the top sieve of the series, and mechanically sieve until less than 0.1 g passes through each sieve after hand sieving for 1 min, as described in Section 11. The machine-sieving operation usually requires about 15 min. Then carefully separate the sieves and determine the amount of material retained on each by weighing to the nearest 0.1 g.

#### 11. Hand Sieving

11.1 The specimen for sieving (Note 1) shall consist of a dried and weighed material prepared in accordance with 5.2.2. Use one sieve at a time beginning with the coarsest and then successively to finer sizes. Alternately tap and rotate the sieve,