# APPENDIX

TABLE 1—*U.S. standard sieve series (ASTM Designation E11[a]).*

| Sieve Designation | | Nominal Sieve Opening, in.[c] | Nominal Wire Diameter, mm[a] |
|---|---|---|---|
| Standard[b] | Alternative | | |
| (1) | (2) | (3) | (4) |
| 125 mm | 5 in. | 5 | 8.0 |
| 106 mm | 4.24 in. | 4.24 | 6.40 |
| 100 mm[d] | 4 in.[d] | 4 | 6.30 |
| 90 mm | 3 1/2 in. | 3.5 | 6.08 |
| 75 mm | 3 in. | 3 | 5.80 |
| 63 mm | 2 1/2 in. | 2.5 | 5.50 |
| 53 mm | 2.12 in. | 2.12 | 5.15 |
| 50 mm[d] | 2 in.[d] | 2 | 5.05 |
| 45 mm | 1 3/4 in. | 1.75 | 4.85 |
| 37.5 mm | 1 1/2 in. | 1.5 | 4.59 |
| 31.5 mm | 1 1/4 in. | 1.25 | 4.23 |
| 26.5 mm | 1.06 in. | 1.06 | 3.90 |
| 25.0 mm[d] | 1 in.[d] | 1 | 3.80 |
| 22.4 mm | 7/8 in. | 0.875 | 3.50 |
| 19.0 mm | 3/4 in. | 0.750 | 3.30 |
| 16.0 mm | 5/8 in. | 0.625 | 3.00 |
| 13.2 mm | 0.530 in. | 0.530 | 2.75 |
| 12.5 mm[d] | 1/2 in.[d] | 0.500 | 2.67 |
| 11.2 mm | 7/16 in. | 0.438 | 2.45 |
| 9.5 mm | 3/8 in. | 0.375 | 2.27 |
| 8.0 mm | 5/16 in. | 0.312 | 2.07 |
| 6.7 mm | 0.265 in. | 0.265 | 1.87 |
| 6.3 mm[d] | 1/4 in.[d] | 0.250 | 1.82 |
| 5.6 mm | No. 3 1/2[e] | 0.223 | 1.68 |
| 4.75 mm | No. 4 | 0.187 | 1.54 |
| 4.00 mm | No. 5 | 0.157 | 1.37 |
| 3.35 mm | No. 6 | 0.132 | 1.23 |
| 2.80 mm | No. 7 | 0.111 | 1.10 |
| 2.36 mm | No. 8 | 0.0937 | 1.00 |
| 2.00 mm | No. 10 | 0.0787 | 0.900 |
| 1.70 mm | No. 12 | 0.0661 | 0.810 |
| 1.40 mm | No. 14 | 0.0555 | 0.725 |
| 1.18 mm | No. 16 | 0.0469 | 0.650 |
| 1.00 mm | No. 18 | 0.0394 | 0.580 |
| 850 μm[f] | No. 20 | 0.0331 | 0.510 |
| 710 μm | No. 25 | 0.0278 | 0.450 |
| 600 μm | No. 30 | 0.0234 | 0.390 |
| 500 μm | No. 35 | 0.0197 | 0.340 |
| 425 μm | No. 40 | 0.0165 | 0.290 |
| 355 μm | No. 45 | 0.0139 | 0.247 |
| 300 μm | No. 50 | 0.0117 | 0.215 |
| 250 μm | No. 60 | 0.0098 | 0.180 |
| 212 μm | No. 70 | 0.0083 | 0.152 |
| 180 μm | No. 80 | 0.0070 | 0.131 |
| 150 μm | No. 100 | 0.0059 | 0.110 |
| 125 μm | No. 120 | 0.0049 | 0.091 |

TABLE 1—(Continued)—*U. S. standard sieve series (ASTM Designation E 11* [a]).

| | | | |
|---|---|---|---|
| 106 μm | No. 140 | 0.0041 | 0.076 |
| 90 μm | No. 170 | 0.0035 | 0.064 |
| 75 μm | No. 200 | 0.0029 | 0.053 |
| 63 μm | No. 230 | 0.0025 | 0.044 |
| 53 μm | No. 270 | 0.0021 | 0.037 |
| 45 μm | No. 325 | 0.0017 | 0.030 |
| 38 μm | No. 400 | 0.0015 | 0.025 |

[a] For complete specifications including permissible variations from nominal apertures and wire diameters and method of checking and calibrating, see the most recent ASTM Designation E 11 (Vol. 14.02), issued by American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa 19103.

[b] These standard designations correspond to the values for test sieve apertures recommended by the International Standards Organization, Geneva, Switzerland.

[c] Only approximately equivalent to the metric values in column 1.

[d] These sieves are not in the standard series but they have been included because they are in common usage.

[e] These numbers (3½ to 400) are the approximate number of openings per linear inch but it is preferred that the sieve be identified by the standard designation in millimeters or μm.

[f] 1000 μm = 1 mm.

TABLE 2—*U.S. standard perforated plates sieves (ASTM Designation E 323[a]).*

| Sieve Designation and Aperture Size[b] | | Centers | | Plate Thickness | | |
|---|---|---|---|---|---|---|
| Standard[b] mm | Alternative in.[d] | Standard mm | Alternative in.[d] | Standard mm | Alternative in.[d] | gage[e] |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 125 | 5 | 160 | 6 1/4 | 3.4 | 0.1345 | 10 |
| 106 | 4 1/4 | 135 | 5 1/4 | 3.4 | 0.1345 | 10 |
| 100[f] | 4 | 128 | 5 | 3.4 | 0.1345 | 10 |
| 90 | 3 1/2 | 111 | 4 3/8 | 2.7 | 0.1046 | 12 |
| 75 | 3 | 95 | 3 3/4 | 2.7 | 0.1046 | 12 |
| 63 | 2 1/2 | 80 | 3 1/8 | 2.7 | 0.1046 | 12 |
| 53 | 2 1/8 | 68 | 2 5/8 | 2.7 | 0.1046 | 12 |
| 50[f] | 2 | 64 | 2 1/2 | 2.7 | 0.1046 | 12 |
| 45 | 1 3/4 | 57 | 2 1/4 | 1.9 | 0.0747 | 14 |
| 37.5 | 1 1/2 | 48 | 1 7/8 | 1.9 | 0.0747 | 14 |
| 31.5 | 1 1/4 | 41 | 1 5/8 | 1.9 | 0.0747 | 14 |
| 26.5 | 1 1/16 | 35 | 1 5/16 | 1.9 | 0.0747 | 14 |
| 25.0[f] | 1 | 32 | 1 1/4 | 1.9 | 0.0747 | 14 |
| 22.4 | 7/8 | 29 | 1 1/8 | 1.9 | 0.0747 | 14 |
| 19.0 | 3/4 | 25 | 1 | 1.9 | 0.0747 | 14 |
| 16.0 | 5/8 | 21 | 13/16 | 1.9 | 0.0747 | 14 |
| 13.2 | 17/32 | 18 | 3/4 | 1.9 | 0.0747 | 14 |
| 12.5[f] | 1/2 | 17 | 11/16 | 1.9 | 0.0747 | 14 |
| 11.2 | 7/16 | 15 | 5/8 | 1.9 | 0.0747 | 14 |
| 9.5 | 3/8 | 13.0 | 1/2 | 1.9 | 0.0747 | 14 |
| 8.0 | 5/16 | 11.0 | 7/16 | 1.9 | 0.0747 | 14 |
| 6.7 | 17/64 | 9.9 | 25/64 | 1.5 | 0.0598 | 16 |
| 6.3[f] | 1/4 | 9.5 | 3/8 | 1.5 | 0.0598 | 16 |
| 5.6 | 7/32 | 8.7 | 11/32 | 1.5 | 0.0598 | 16 |
| 4.75 | 3/16 | 6.8 | 1/4 | 1.5 | 0.0598 | 16 |
| 4.00 | 5/32 | 5.9 | 7/32 | 1.5 | 0.0598 | 16 |
| 3.35 | 0.127 (1/8) | 4.9 | 3/16 | 1.5 | 0.0598 | 16 |
| 2.80 | 7/64 | 4.4 | 11/64 | 1.5 | 0.0598 | 16 |
| 2.36 | 3/32 | 3.8 | 5/32 | 1.5 | 0.0598 | 16 |
| 2.00 | 0.078 | 3.3 | 1/8 | 1.5 | 0.0598 | 16 |
| 1.70 | 0.066 | 2.9 | 7/64 | 0.8 | 0.0299 | 22 |
| 1.40 | 0.055 | 2.6 | 0.100 | 0.8 | 0.0299 | 22 |
| 1.18 | 0.045 | 2.2 | 0.090 | 0.8 | 0.0299 | 22 |
| 1.00 | 0.039 | 2.0 | 0.077 | 0.8 | 0.0299 | 22 |

[a] For complete specifications, including permissible variations from normal apertures, plate thicknesses and other characteristics, and for method of checking, see the most recent ASTM Designation E 323 (Vol. 14.02) issued by American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa. 19103.

[b] The values shown in this table refer to both round and square apertures. In general, square-aperture perforated-sieve plates are available only in 3.35 mm and larger.

[c] These standard designations, progressing from a base of 1 mm in the ratio of approximately $\sqrt[4]{2}$ to 1, correspond to the values for test sieve apertures recommended by the International Standards Organization, Geneva, Switzerland.

[d] Only approximately equivalent to the standard values.

[e] The gage values are for carbon steel. For other materials, the gage used should be the nearest decimal equivalent of the U.S. standard gage for steel.

[f] These sieves are not in the standard series but they have been included because they are in common usage.

TABLE 3—*International Standard (ISO)—Test Sieves—Woven Metal Wire Cloth and Perforated Plate Nominal Size of Apertures*

| MILLIMETER SIZES | | | |
|---|---|---|---|
| Table 1 | | Table 2 | |
| Principal sizes (R 20/3) | Supplementary sizes (R 20) | Principal sizes (R 20/3) | Supplementary sizes (R 40/3) |
| mm | mm | mm | mm |
| 125 | 125 | 125 | 125 |
| | 112 | | 106 |
| | 100 | | |
| 90.0 | 90.0 | 90.0 | 90.0 |
| | 80.0 | | 75.0 |
| | 71.0 | | |
| 63.0 | 63.0 | 63.0 | 63.0 |
| | 56.0 | | 53.0 |
| | 50.0 | | |
| 45.0 | 45.0 | 45.0 | 45.0 |
| | 40.0 | | 37.5 |
| | 35.5 | | |
| 31.5 | 31.5 | 31.5 | 31.5 |
| | 28.0 | | 26.5 |
| | 25.0 | | |
| 22.4 | 22.4 | 22.4 | 22.4 |
| | 20.0 | | 19.0 |
| | 18.0 | | |
| 16.0 | 16.0 | 16.0 | 16.0 |
| | 14.0 | | 13.2 |
| | 12.5 | | |
| 11.2 | 11.2 | 11.2 | 11.2 |
| | 10.0 | | 9.50 |
| | 9.00 | | |
| 8.00 | 8.00 | 8.00 | 8.00 |
| | 7.10 | | 6.70 |
| | 6.30 | | |
| 5.60 | 5.60 | 5.60 | 5.60 |
| | 5.00 | | 4.75 |
| | 4.50 | | |
| 4.00 | 4.00 | 4.00 | 4.00 |
| | 3.55 | | 3.35 |
| | 3.15 | | |
| 2.80 | 2.80 | 2.80 | 2.80 |
| | 2.50 | | 2.36 |
| | 2.24 | | |
| 2.00 | 2.00 | 2.00 | 2.00 |
| | 1.80 | | 1.70 |
| | 1.60 | | |
| 1.40 | 1.40 | 1.40 | 1.40 |
| | 1.25 | | 1.18 |
| | 1.12 | | |
| 1.00 | 1.00 | 1.00 | 1.00 |

NOTE—The proposed nominal sizes of apertures are taken from the series R 20 and R 40/3 of preferred numbers given in ISO/R 3. Sizes below 40 $\mu$m are based on series R'20 (Table 1) and R'40/3 (Table 2) given in ISO/R 497.

All sizes below 45 $\mu$m are regarded as supplementary sizes, regardless of series.

TABLE 3—(Continued)—*International Standard (ISO)—Test Sieves—Woven Metal Wire Cloth and Perforated Plate Nominal Size of Apertures*

| MICROMETER SIZES | | | |
|---|---|---|---|
| Table 1 | | Table 2 | |
| Principal sizes (R 20/3) | Supplementary sizes (R 20) | Principal sizes (R 20/3) | Supplementary sizes (R 40/3) |
| μm | μm | μm | μm |
| | 900 | | 850 |
| | 800 | | |
| 710 | 710 | 710 | 710 |
| | 630 | | 600 |
| | 560 | | |
| 500 | 500 | 500 | 500 |
| | 450 | | 425 |
| | 400 | | |
| 355 | 355 | 355 | 355 |
| | 315 | | 300 |
| | 280 | | |
| 250 | 250 | 250 | 250 |
| | 224 | | 212 |
| | 200 | | |
| 180 | 180 | 180 | 180 |
| | 160 | | 150 |
| | 140 | | |
| 125 | 125 | 125 | 125 |
| | 112 | | 106 |
| | 100 | | |
| 90 | 90 | 90 | 90 |
| | 80 | | 75 |
| | 71 | | |
| 63 | 63 | 63 | 63 |
| | 56 | | 53 |
| | 50 | | |
| 45 | 45 | 45 | 45 |
| | 40 | | 38 |
| | 36 | | |
| | 32 | | 32 |
| | 28 | | 26 |
| | 25 | | |
| | 22 | | 22 |
| | 20 | | |

All sizes listed in R20/3 and R40/3 are included in ASTM E-11 and E-323.

Some foreign countries may use sizes listed in R/20. These are not all compatible with E-11 or E-323.

## Suggestions on Procedures for Making Sieve Analysis with Precision Electroformed Sieves

Precision electroformed sieves must be considered as delicate precision instruments and handled with the utmost care to obtain satisfactory results and reasonable sieve life.

Sieves should conform to ASTM Specification E 161-67 and should be calibrated or given correction factors to conform to one of the methods given in the Appendix to Specification E 161.

When using the vibration type electromagnetic shaker, (Fig. 8), it is recommended that the sieve or sieve stack with pan and cover be secured to the shaker pad with two rubber bands, in such a manner that the stack bounces and rocks slightly when the control knob is turned to the medium or high position. Avoid the use of metal spring holders as they hold the stack too firmly to permit the desired rocking motion. A good practice is to hold adjacent sieves together with 3½ by ¾-in. rubber bands to reduce wear of one sieve on another, as well as to prevent escape of any air-borne material.

When using a sifter of the "oscillating air column" type (see Paragraph 8.5 and Fig. 9) with electroformed sieves, follow the manufacturer's instructions as the suggestions in the two preceding paragraphs would not apply.

*Weighing*—Samples are not removed from electroformed sieves for weighing as there is too much danger of loss in the transfer of the small retained fractions. This loss causes serious errors in the recorded results. Sieves and the pan are weighed on an analytical balance before and after the test to obtain the weights of the retained fractions.

When removing sample fractions from the sieve after the test, gently brush and tap the contents loose from the sieve while it is held in an inverted position. Do not attempt to dislodge particles by slapping the sieve on the bench, because this action will spring and tear the fine mesh from its supporting grid. Avoid using a sieve that has become blinded for a subsequent test until the sieve has been cleaned and the blinding eliminated, or reduced to less than 15 percent.

Sample sizes for tests with electroformed sieves cannot be precisely stated because of factors such as particle shape, density, propensity to agglomerate, size range and distribution, number of sieves used in the test, and the percentage of open area of the sieve. Sample sizes should be as small as practicable, and weights should be recorded to the nearest milligram. Samples should be large enough to obtain weighable retained fractions on the sieve without overloading any sieve as overloading increases the blinding problem.

*Wet Sieving*—If a sample has a preponderance of particles smaller than 40 $\mu$m or cannot be dry sieved conveniently, it may be wet sieved through electroformed sieves with a suitable polar liquid or hydrocarbon containing a trace of dispersant. A set of sieves may be mounted in an airtight manner on a suction flask, which can be vibrated as mild alternate suction, and pressure applied to the flask. The sample is washed through each sieve in turn with a fine stream of the liquid and at the same time stroked across the sieve sheet with a ⅜-in. wide flat lettering brush.

*Cleaning and Repair*—Precision electroformed sieves may be cleaned with the aid of ultrasonic vibrations while immersed in an equivolume mixture of denatured or isopropyl alcohol and distilled water. The sieve should be placed in the ultrasonic cleaning tank with the sieve sheet in the vertical position. Low-power ultrasonic energy should be used for not more than 15 s at a time to prevent cavitation damage to the sieve sheet. Remove the sieve, flush with distilled water, and dry in an oven at 100 C.

If the sieve sheet is broken it can be repaired by: (1) applying epoxy resin type cement with the point of a fine needle, or (2) applying small spheres of metal solder with a pencil point iron. In both procedures a low-power ($\times$10 to $\times$50) binocular microscope is a necessary aid.

TABLE 4—*Precision electroformed sieves (ASTM Designation E 161[a]).*

| Sieve Designation, Nominal Size of Opening,[b] μm | Permissible Variation of Sieve Openings, μm | Limits, Openings per Linear Inch,[c] min and max |
|---|---|---|
| 1 | 2 | 3 |
| 150 | 147 to 153 | 90 to 120 |
| 125 | 122 to 128 | 110 to 145 |
| 106 | 104 to 108 | 135 to 175 |
| 90 | 88 to 92 | 160 to 210 |
| 75 | 73 to 77 | 190 to 245 |
| 63 | 61 to 65 | 225 to 290 |
| 53 | 51 to 55 | 240 to 320 |
| 45 | 43 to 47 | 260 to 350 |
| 38 | 36 to 40 | 285 to 400 |
| 32 | 30 to 34 | 380 to 500 |
| 27 | 25 to 29 | 450 to 550 |
| 22 | 20 to 24 | 450 to 550[d] |
| 15 | 13 to 17 | 450 to 700[d] |
| 10 | 9 to 11 | 450 to 800[d] |
| 5 | 4 to 6 | 450 to 1000[d] |

[a] For complete specifications, including method of calibrating electroformed sieves, see the most recent ASTM Designation E 161 issue by American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa. 19103.

[b] These nominal size openings are approximately in a ratio of $\sqrt[4]{2}$ to 1 for the openings 22 μm and larger. These standard designations correspond to the values for test sieve apertures recommended by the International Standards Organization, Geneva, Switzerland.

[c] These limits permit at least two adjacent sieves to be formed with the same number of openings per inch. The percent open area must in no case be so great that the width of metal between openings is less than 18 μm.

[d] Because of their greater durability in routine testing, sieves made close to the minimum limit are normally supplied. Sieves made close to the maximum limit may be obtained only on special order but are preferable from the standpoint of logical progression and better test completion time.

TABLE 5—*Suggested bulk volume of test sample for sieve analysis with 8-in. and 200-mm round sieves.*[a]

| Standard Sieve Designation | | Bulk Volume of Material | |
|---|---|---|---|
| Standard | Alternate | Recommended Volume of Material for Test Sample | Maximum Permitted Volume on Sieve on Completion of Sieving |
| 1 | 2 | 3 | 4 |
| 25.0 mm | 1 in. | 1800 $cm^3$ | 900 $cm^3$ |
| 22.4 | 7/8 | 1600 | 800 |
| 19.0 | 3/4 | 1400 | 700 |
| 16.0 | 5/8 | 1000 | 500 |
| 12.5 | 1/2 | 800 | 400 |
| 11.2 | 7/16 | 800 | 400 |
| 9.5 | 3/8 | 600 | 300 |
| 8.0 | 5/16 | 500 | 250 |
| 6.3 | 1/4 | 400 | 200 |
| 5.6 | No. 3 1/2 | 400 | 200 |
| 4.0 | No. 5 | 350 | 150 |
| 2.80 | No. 7 | 240 | 120 |
| 2.0 | No. 10 | 200 | 100 |
| 1.40 | No. 14 | 160 | 80 |
| 1.0 | No. 18 | 140 | 70 |
| 710 μm | No. 25 | 120 | 60 |
| 500 | No. 35 | 100 | 50 |
| 355 | No. 45 | 80 | 40 |
| 250 | No. 60 | 70 | 35 |
| 180 | No. 80 | 60 | 30 |
| 125 | No. 120 | 50 | 25 |
| 90 | No. 170 | 40 | 20 |
| 63 | No. 230 | 35 | 17 |
| 45 | No. 325 | 30 | 15 |
| 38 | No. 400 | 25 | 12 |

[a] The recommended weight of material for a sieve test sample is calculated by multiplying the bulk volume figure in Column 3 by the particular bulk density in grams per cubic centimeter of the material, rounded out within a tolerance of ±25 percent. If the density figure for the material being tested is not readily available, use the factor of the nearest similar material shown in Table 6.

TABLE 6—*Typical bulk densities of various particulate materials.* (Weights, per unit of volume, are of divided, crushed, or pulverized materials in freely poured condition.[a])

| Material | Average Weight | |
|---|---|---|
| | Lbs/Ft³ | G/Cm³ |
| Alumina | 44 | 1.23 |
| Aluminum, calcined | 128 | 2.05 |
| Aluminum oxide | 122 | 1.96 |
| Aluminum shot | 96 | 1.54 |
| Ammonium nitrate | 48 | 0.77 |
| Ammonium sulphate | 61 | 0.98 |
| Asbestos ore | 54 | 0.87 |
| Bagasse | 6 | 0.09 |
| Bauxite ore | 75 to 85 | 1.20 to 1.36 |
| Bentonite | 50 to 65 | 0.80 to 1.04 |
| Bicarbonate of soda | 57 | 0.91 |
| Borax | 50 to 61 | 0.80 to 0.98 |
| Boric acid | 58 | 0.93 |
| Calcite | 90 to 105 | 1.44 to 1.68 |
| Calcium carbide | 75 | 1.20 |
| Calcium carbonate | 49 | 0.79 |
| Calcium chloride | 64 | 1.03 |
| Calcium phosphate | 57 | 0.91 |
| Carbon black | 24 | 0.33 |
| Cellulose powder | 16 | 0.26 |
| Cement, portland | 90 to 100 | 1.44 to 1.60 |
| Cement clinker | 75 to 80 | 1.20 to 1.28 |
| Chrome ore | 140 | 2.25 |
| Clay | 30 to 75 | 0.48 to 1.20 |
| Coal, anthracite | 55 | 0.88 |
| Coal, bituminous | 50 | 0.88 |
| Coke breeze | 25 to 35 | 0.40 to 0.56 |
| Coke, petroleum | 25 to 40 | 0.40 to 0.64 |
| Copper ore | 100 to 150 | 1.60 to 2.40 |
| Coquina shell | 80 | 1.28 |
| Corn starch | 40 | 0.64 |
| Diatomaceous earth | 31 | 0.5 |
| Dicalcium phosphate | 64 | 1.03 |
| Dolomite, crushed | 90 to 100 | 1.44 to 1.60 |
| Feldspar, crushed | 65 to 84 | 1.04 to 1.35 |
| Ferrophosphorous | 196 | 3.1 |
| Fire clay | 80 | 1.28 |
| Flour, wheat | 24 | 0.38 |
| Flour, maize | 37 | 0.59 |
| Fluorspar | 90 to 120 | 1.44 to 1.92 |
| Fly ash | 49 | 0.79 |
| Fullers earth | 30 to 40 | 0.48 to 0.6 |
| Garnet | 168 | 2.69 |
| Glass beads | 76 | 1.22 |
| Glass, crushed | 66 | 1.06 |
| Glass cullet | 93 | 1.49 |
| Granite, crushed | 95 to100 | 1.52 to 1.60 |
| Gravel | 90 to 100 | 1.44 to 1.60 |
| Gypsum, calcined | 58 | 0.93 |
| Gypsum, crushed | 90 to 100 | 1.44 to 1.60 |
| Irone ore | 120 to 150 | 1.92 to 2.40 |
| Kaolin | 160 | 2.56 |
| Kyanite | 68 | 1.09 |
| Lime, ground | 60 | 0.96 |
| Lime, hydrated | 25 | 0.40 |
| Limestone, crushed | 85 to 100 | 1.36 to 1.60 |
| Limestone, agricultural | 70 | 1.12 |
| Magnesite | 106 | 1.70 |
| Magnetite | 155 | 2.49 |
| Manganese ore | 120 to 136 | 1.92 to 2.18 |
| Marble, crushed | 90 to 95 | 1.44 to 1.52 |
| Metals, powdered | | |
| Aluminum | 80 | 1.28 |
| Copper | 169 | 2.71 |
| Copper-lead | 364 | 5.84 |
| Iron | 243 | 3.90 |
| Nickel | 263 | 4.22 |
| Stainless steel | 240 | 3.85 |
| Tantalum | 300 | 4.80 |
| Mica | 42 | 0.67 |
| Ore, sintered | 114 | 1.83 |
| Oyster shells, ground | 29 | 0.47 |
| Perlite ore | 65 to 75 | 1.04 to 1.20 |
| Plaster, calcined | 64 | 1.03 |
| Polyethylene pellets | 36 | 0.58 |
| Polyethylene powder | 18 | 0.29 |
| Poly (vinyl chloride) | 30 | 0.48 |
| Potash | 77 | 1.23 |
| Potassium carbonate | 79 | 1.27 |
| Pumice | 40 | 0.64 |
| Rubber, chopped | 36 | 0.58 |
| Rubber, ground | 20 | 0.32 |
| Phosphate rock | 75 to 85 | 1.20 to 1.36 |
| Salt, flake | 61 | 0.98 |
| Salt, rock | 66 | 1.06 |
| Salt, table | 75 | 1.20 |
| Sand | 90 to 100 | 1.44 to 1.60 |

TABLE 6—(Continued)—*Typical bulk densities of various particulate materials.*

| Material | Average Weight Lbs/Ft³ | Average Weight G/Cm³ | Material | Average Weight Lbs/Ft³ | Average Weight G/Cm³ |
|---|---|---|---|---|---|
| Sand, silica | 90 to 100 | 1.44 to 1.60 | Sugar, granulated | 50 | 0.80 |
| Sawdust | 18 | 0.29 | Sugar, powdered | 37 | 0.59 |
| Seacoal | 42 | 0.67 | Sulphur, crushed | 50 to 65 | 0.80 to 1.04 |
| Shale | 100 | 1.60 | Talc, powder | 34 | 0.55 |
| Shot, metal | 230 | 3.69 | Talc, granular | 44 | 0.71 |
| Silica flour | 27 | 0.43 | Traprock, | | |
| Silica gel | 45 | 0.72 | crushed | 105 to 110 | 1.68 to 1.76 |
| Soapstone, | | | Triple superphos- | | |
| pulverized | 40 | 0.64 | phate, granular | 64 | 1.03 |
| Soda ash, light | 25 to 35 | 0.40 to 0.56 | Tungsten carbide | 550 | 8.82 |
| Soda ash, heavy | 55 to 65 | 0.88 to 1.04 | Urea prills | 43 | 0.69 |
| Soda, bicarbonate | 57 | 0.91 | Vermiculite ore | 80 | 1.28 |
| Sodium nitrate | 78 | 1.25 | Wood chips | 13 | 0.21 |
| Sodium phosphate | 43 | 0.69 | Zinc dust | 144 | 2.31 |
| Sodium sulfate | 96 | 1.54 | Zirconium oxide | 200 | 3.22 |
| Steel grit | 228 | 3.66 | Zirconium sand | 162 | 2.60 |
| Stone, crushed | 85 to 95 | 1.36 to 1.52 | | | |

[a] Where a single figure is given, it represents an actual weight of a typical average sample of the material recorded by a research laboratory; therefore, the figure can be expected to vary from sample to sample of the same material.

TABLE 7—*List of ASTM published standards on sieve analysis procedures for specific materials or industries.*

| Material | ASTM Designation | Title of Standard | Sieve No. or Size Range | Dry | Wet |
|---|---|---|---|---|---|
| Activated Carbon | D 2862 | Particle Size Distribution of Granular Activated Carbon (Vol. 15.01) | 200 | | X |
| Aggregates | C117 | Test for Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing[a] (Vols. 4.02, 4.03) | 200 | | X |
| | C 125 | Definitions of Terms Relating to Concrete and Concrete Aggregates (Vols. 4.02, 4.03) | | | |
| | C 136 | Test for Sieve Analysis of Fine and Coarse Aggregates[a] (Vols. 4.02, 4.03) | 3½ in.-200 | X | |
| | C 142 | Test for Clay Lumps and Friable Particles in Aggregates (Vols. 4.02, 4.03) | 1¼ in.-20 | X | |
| | C 144 | Specification for Aggregate for Masonry Mortar (Vols. 4.02, 4.05) | 4-200 | X | |
| | C 330 | Specifications for Lightweight Aggregates for Structural Concrete (Vol. 4.02) | 1 in.-100 | X | X |
| | C 331 | Specifications for Lightweight Aggregates for Concrete Masonry Units (Vols. 4.02, 4.05) | ¾ in.-100 | X | X |

TABLE 7—(Continued)—*List of ASTM published standards on sieve analysis procedures for specific materials or industries.*

| Material | ASTM Designation | Title of Standard | Sieve No. or Size Range | Dry | Wet |
|---|---|---|---|---|---|
| Asbestos | D 2589 | Test for Bauer-McNett Wet Classification of Asbestos Fiber (Vols. 4.05, 7.02, 8.02) | 4-325 | | X |
| | D 2947 | Method for Screen Analysis of Asbestos Fibers (Vols. 4.05, 7.02, 8.02) | 4-70 | X | |
| Asphalt | D 244 | Testing Emulsified Asphalts (Vol. 4.03) | 20 | | X |
| Carbon black | D 1508 | Test Method for Carbon Black, Pelleted Fines Content (Vol. 9.01) | 100 | X | |
| | D 1511 | Test Method for Carbon Black, Pellet Size Distribution (Vol. 9.01) | 10-120 | X | |
| | D 1514 | Test Method for Sieve Residue from Carbon Black (Vol. 9.01) | 30-325 | | X |
| Cement | C 184 | Test Method for Fineness of Hydraulic Cement by the No. 100 and 200 Sieves (Vol. 4.01) | 100<br>200 | X | |
| | C 430 | Test Method for Fineness of Hydraulic Cement by the No. 325 Sieve (Vol. 4.01) | 325 | X | |
| | C 786 | Fineness of Hydraulic Cement (Vol. 4.01) | 100-325 | X | |
| Ceramic[b] | C 325 | Method for Wet Sieve Analysis of Ceramic Whiteware Clays (Vol. 15.02) | 100-325 | | X |
| | C 371 | Test for Wire-Cloth Sieve Analysis of Nonplastic Ceramic Materials[a] | 70-325 | | X |
| | C 925 | Precision Electroformed Wet Sieve Analysis of Nonplastic Ceramic Powders (Vol. 15.02) | 100-400 | | X |
| Clays | C 775 | Particle Size Analysis of Whiteware Clays (Vol. 15.02) | 10-325 | X | |
| Coal | D 197 | Sampling and Fineness Test of Pulverized Coal[a] (Vol. 5.05) | 8-325 | X | |
| | D 310 | Test Method for Size of Anthracite[a] (Vol. 5.05) | 4⅜ in.-$^3/_{16}$ in. | X | |
| | D 311 | Test Method for Sieve Analysis of Crushed Bituminous Coal[a] (Vol. 5.05) | 1 in.-6 | X | |
| | D 409 | Grindability of Coal by Hardgrove Machine Method (Vol. 5.05) | ⅜-200 | X | |
| | D 410 | Test Method for Sieve Analysis of Coal[a] (Vol. 5.05) | 8 in.-200 | X | |
| | D 431 | Method for Designating the Size of Coal from its Sieve Analysis (Vol. 5.05) | 8 in.-200 | X | |
| Coke | D 293 | Test Method for Sieve Analysis of Coke[a] (Vol. 5.05) | 4 in.-0 | X | |
| Enamel | C 285 | Methods for Sieve Analysis of Wet Milled and Dry Milled Porcelain Enamel (Vol. 15.02) | 40-325 | X | X |

TABLE 7—(Continued)—*List of ASTM published standards on sieve analysis procedures for specific materials or industries.*

| Material | ASTM Designation | Title of Standard | Sieve No. or Size Range | Dry | Wet |
|---|---|---|---|---|---|
| Glass | C 429 | Method for Sieve Analysis of Raw Materials for Glass Manufacture[a] (Vol. 15.02) | 8-200 | X | X |
| | D 1214 | Test Method for Sieve Analysis of Glass Spheres (Vol. 4.02, 4.08) | | | |
| Lime | C 110 | Physical Testing of Quicklime, Hydrated Lime, and Limestone (Vol. 4.01) | 20-325 | X | |
| | C 141 | Specification for Hydraulic Hydrated Lime for Structural Purposes (Vol. 4.01) | 20-200 | X | |
| Magnesium Oxide | D 2772 | Method for Sieve Analysis of Electrical Grade Magnesium Oxide (Vol. 10.02) | 20-200 | X | |
| Metal bearing ores | E 276 | Test for Particle Size or Screen Analysis at No. 4 Sieve and Finer for Metal Bearing Ores and Related Materials[a] (Vol. 3.05) | 4-200 | X | X |
| | E 389 | Test Method for Particle Size or Screen Analysis at No. 4 Sieve and Coarser for Metal Bearing Ores and Related Materials (Vol. 3.05) | 4 | X | |
| Metal powders | B 214 | Test for Sieve Analysis of Granular Metal Powders (Vol. 2.05) | 80-325 | X | |
| Mineral | D 451 | Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products[a] (Vols. 4.02, 4.04, 4.08) | 6-100 | X | |
| | D 452 | Test Method for Sieve Analysis of Nongranular Mineral Surfacing for Asphalt Roofing and Shingles[a] (Vols. 4.02, 4.04, 4.08) | 12-200 | X | |
| | D 546 | Test Method for Sieve Analysis of Mineral Filler for Road and Paving Materials (Vols. 4.03, 4.08) | | X | |
| Perlite | C 549 | Specification for Perlite Loose Fill Insulation[a] (Vol. 4.06) | 16-100 | X | |
| Pigments and paint | D 185 | Test Method for Coarse Particles in Pigments, Pastes, and Paints (Vols. 6.01, 6.02) | 325 | X | X |
| | D 480 | Methods of Sampling and Testing Aluminum Powder and Paste[a] (Vol. 6.02) | 100-325 | | X |
| | D 718 | Methods of Analysis of Aluminum Silicate Pigment (Vol. 6.02) | 325 | | X |
| Plastic | D 1921 | Test Method for Particle Size (Sieve Analysis) of Plastic Materials (Vol. 8.02) | | X | |

TABLE 7—(Continued)—*List of ASTM published standards on sieve analysis procedures for specific materials or industries.*

| Material | ASTM Designation | Title of Standard | Sieve No. or Size Range | Dry | Wet |
|---|---|---|---|---|---|
| Refractories | C 92 | Tests for Sieve Analysis and Water Content of Refractory Materials (Vol. 15.01) | 3-200 | X | X |
| Refuse Derived Fuel | E 828 | Designating the Size of REF-3 from its Sieve Analysis (Vol. 11.04) | 4-325 | X | |
| Resins | D 1457 | Specification for PTFE Molding and Extrusion Materials (Vol. 8.01) | 18-325 | | X |
| | D 1705 | Method for Particle Size Analysis of Powdered Polymers and Copolymers of Vinyl Chloride (Vol. 8.02) | 325 | | X |
| | D 2187 | Test Methods for Physical and Chemical Properties of Ion-Exchange Resins[a] (Vol. 11.02) | 8-100 | | X |
| Sand | C 778 | Specification for Standard Sand (Vol. 4.01) | 16-100 | X | |
| Soap | D 502 | Test Method for Particle Size of Soaps and Other Detergents (Vol. 15.04) | 12-100 | X | |
| Soil | D 421 | Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants (Vol. 4.08) | 4-40 | X | |
| | D 422 | Method for Particle-Size Analysis of Soils (Vol. 4.08) | 3 in.-200 | | X |
| | D 1140 | Test for Amount of Material in Soils Finer Than the No. 200 Sieve (Vol. 4.08) | 40-200 | | X |
| | D 2217 | Method for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants (Vol. 4.08) | 10-40 | | X |
| | D 2419 | Test for Sand Equivalent Value of Soils and Fine Aggregate (Vols. 4.02, 4.03, 4.08) | 4-200 | | X |
| | D 2487 | Test for Classification of Soils for Engineering Purposes (Vol. 4.08) | 4-200 | X | X |
| Vermiculite | C 516 | Specification for Vermiculite Loose Fill Thermal Insulation[a] (Vol. 4.06) | ¾-100 | X | |

[a] Contains suggestions on sampling.

TABLE 8—*List of ASTM published standards on sampling of particulate materials.*

| Material | ASTM Designation | Title of Standard |
|---|---|---|
| Aggregates | D 75 | Practice for Sampling Aggregates (Vols. 4.02, 4.03, 4.08) |
| Asbestos fiber | D 2590 | Method of Sampling Asbestos Fiber for Testing (Vols. 4.05, 7.02, 8.02) |
| Bituminous materials | D 140 | Methods of Sampling Bituminous Materials (Vols. 4.03, 4.08) |
| | D 979 | Methods of Sampling Bituminous Paving Mixtures (Vols. 4.03, 4.08) |
| Calcium chloride | D 345 | Methods of Sampling and Testing Calcium Chloride for Roads and Structural Applications (Vols. 4.02, 4.03, 4.08) |
| Carbon black | D 1799 | Method for Sampling Bulk Shipments of Carbon Black (Vol. 5.02) |
| | D 1900 | Method for Sampling Bulk Shipments of Carbon Black (Vol. 9.01) |
| Cement | C 183 | Methods of Sampling and Acceptance of Hydraulic Cement (Vols. 4.01, 4.03) |
| Ceramic clays | C 322 | Method of Sampling Ceramic Whiteware Clays (Vol. 15.02) |
| Coal | D 197 | Method of Sampling and Fineness Test of Pulverized Coal (Vol. 5.05) |
| | D 2013 | Method of Preparing Coal Samples for Analysis (Vol. 5.05) |
| | D 2234 | Methods for Sampling of Coal (Vol. 5.05) |
| Coke | D 346 | Method of Sampling Coke for Analysis (Vol. 5.05) |
| Electrical insulating materials | D 2755 | Method of Sampling and Reduction to Test Weight of Electrical Grade Magnesium Oxide (Vol. 10.02) |
| Lime and limestone | C 50 | Methods of Sampling, Inspection, Packing, and Marking of Lime and Limestone Products (Vols. 4.01, 4.03) |
| Metal powders | B 215 | Methods of Sampling Finished Lots of metal Powders (Vol. 2.05) |
| Plastics | D 1898 | Recommended Practice for Sampling of Plastics (Vol. 8.02) |
| Soap powders | D 460 | Methods for Sampling and Chemical Analysis of Soap and Soap Products (Vol. 15.04) |
| Statistical probabilities | E 105 | Recommended Practice for Probability Sampling of Materials (Vols. 4.03, 7.01, 14.02) |
| | E 122 | Recommended Practice for Choice of Sample Size to Estimate the Average Quality of a Lot or Process (Vol. 14.02) |
| | E 141 | Recommended Practice for Acceptance of Evidence Based on the Results of Probability Sampling (Vol. 14.02) |

## Nomenclature

*General Terms*

| | |
|---|---|
| Agglomerate | Two or more particles held together loosely by weak mechanical or physical forces. |
| Aperture | Dimensions defining an opening in a screening surface. |
| Balling | Agglomeration of particles into a very loose or feathery mass usually in a liquid. |
| Bulk density | Ratio of the mass of a material to its volume, in a freely poured condition. |
| Disperse | To separate an agglomerate or floc into measurable entities or workable particles. |
| Effective opening | The size of the largest particle that will pass a screen aperture. |
| Flocculate | An assembly of particles bonded together by strong molecular or chemical forces. |
| Near-mesh or near-size | Particles of a size approximately equal to that of the sieve aperture. |
| Open area | Ratio of the total area of the apertures to the total area of the screen, expressed as a percentage. |
| Particle size | The dimension of a particle, usually expressed in terms of the smallest sieve aperture through which it will pass. |
| Particulate | Pertaining to a material composed of distinct separate particles. |
| Representative sample | A sample taken from a larger quantity of material which retains, within close limits, the particle size distribution characteristics of the original material from which it was taken. |
| Screen | (a) A surface provided with apertures of uniform size and shape; (b) a machine provided with one or more screening surfaces. |
| Screening | The process of separating a mixture of different sizes by means of one or more screening surfaces. |
| Sieve | A screen mounted on a frame, usually for laboratory test purposes. |

*Test Sieves*

| | |
|---|---|
| Certified sieve | A test sieve that has been examined and certified by an authority, accredited for the purpose, as complying with the specifications and tolerances of the applicable standard. |
| Cover (lid) | A cover which fits snugly over a sieve to prevent the escape of material being sieved. |
| Matched sieve | A test sieve that duplicates the results of a master sieve within specified limits. |

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|---|---|
| Nesting pan | A pan with nesting skirt for use in a stack of sieves to permit two or more separate sieve tests to be made simultaneously, usually with a mechanical sieve shaker. |
| Pan (receiver) | A pan which fits snugly beneath a sieve to receive the passing fraction. |
| Sieve cloth series | Sieve cloth woven to a mathematically defined set of aperture widths, wire diameters, and tolerances. |
| Sieve frame | A rigid framework which supports the sieving medium and limits the spread of the material being sieved. |
| Sieve scale | A series of sieve apertures having a systematic mathematical progression. |
| Skirt | The portion of the sieve frame which extends below the sieving surface and nests into the next finer sieve of receiving pan. |
| Standard sieve | A sieve which conforms to a standard specification for test sieves. |

*Test Sieving*

| | |
|---|---|
| Cumulative oversize distribution graph | A graph obtained by plotting the total percentages by weight retained on each of a set of sieves of descending aperture size against the corresponding aperture sizes. |
| Cumulative undersize distribution graph | A graph obtained by plotting the total percentages by weight passing each of a set of sieves of descending aperture size against the corresponding aperture sizes. |
| Dry sieving | Sieving without the aid of a liquid. |
| End point | The stopping point in a sieve test at which further sieving fails to pass an amount sufficient to change the result. |
| Gross sample | A representative sample taken from a large volume of material that is too large to use in a test sieve. |
| Laboratory sample | See test sample. |
| Sieve analysis | The results of a sieve test showing the percentages of sample retained on (or passing) each sieve used in the test. |
| Size analysis | The results of dividing a sample into fractions of defined limits. (See also sieve analysis.) |
| Size distribution graph | A graphical representation of the results of a sieve analysis test. |
| Size range | The limits between the smallest and the largest particle in a sample. |
| Test sample | A representative sample that is small enough to use directly in a test sieve or series of sieves. |

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|---|---|
| Test sieving | Sieving with one or more test sieves to determine the particle size distribution of a particulate material. |
| Wet sieving | Sieving with the aid of a suitable liquid. |

*Production Screening*

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|---|---|
| Feed | Material supplied to a screen for screening. |
| Oversize | That portion of the feed material which has failed to pass through the apertures of a screen. |
| Oversize in undersize | Particles in a screen undersize which are larger than the nominal point of separation. |
| Point of separation | In a screening operation, the size of aperture which will allow undersize particles to pass and will reject oversize particles. |
| Screen efficiency | The percentage of recovery of the desired portion (usually the undersize) from the amount available in the feed. |
| Undersize (fines) | That portion of the feed material which has passed through the apertures of a screen. |
| Undersize in oversize | Particles in a screen oversize which are smaller than the nominal point of separation. |

*Woven Wire Cloth*

| | |
|---|---|
| Double crimp | Wire cloth woven with approximately equal corrugations in both warp and shoot to lock the wires in position. |
| Mesh | (a) The number of apertures per unit of length; (b) in countries using English measure, the number of openings, and fraction thereof, per linear inch counting from the center of a wire. |
| Plain weave | Wire cloth in which each warp wire and each shoot wire passes over one and under the next adjacent wire in both directions. |
| Rectangular mesh | Mesh with unequal aperture widths in warp and shoot direction. |
| Shoot wires | The wires running crosswise of the cloth as woven (also called "shute wires"). |
| Space cloth | Wire cloth which is designated by the clear opening between the wires instead of by the mesh. |
| Square mesh | Mesh with equal aperture widths in warp and shoot direction. |
| Twilled weave | Wire cloth in which each shoot wire passes successively over two and under two warp wires and each warp wire passes successively over two and under two shoot wires. |

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|---|---|
| Warp wires | The wires running the long way of the cloth as woven. |
| Weft wires | See shoot wires. |

*Perforated Plate*

| | |
|---|---|
| Bridge width | Distance between the nearest edges of two adjacent holes in a perforated plate. |
| Hole size | In perforated plate, the diameter of the round hole; width of the square hole at its mid-section; smallest width of the oblong hole. |
| Margin | Distance between the outside edges of the outside rows of holes and the edges of a perforated plate. |
| Perforated plate | A plate with uniform holes, in symmetrical arrangement. |
| Pitch | Distance between the centers of two adjacent holes in a perforated plate. |

*Electroformed Sieves*

| | |
|---|---|
| Electroformed mesh | A sieve sheet formed by electrodeposition on photosensitized, machine-ruled lines. |
| Micromesh | Synonym for electroformed mesh. |
| Nominal size | The specified dimension of the opening of a sieve about which the actual size is permitted to vary. |
| Sieve sheet | The sieving plate composed of the fine electroformed mesh bonded to the supporting grid. |
| Supporting grid | A relatively thick sheet of metal having large, uniform, square openings to which the fine mesh is bonded for support. |

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