Designation: E161 – 12

Standard Specification for Precision Electroformed Sieves[1]

This standard is issued under the fixed designation E161; 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.

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

1. Scope

1.1 This specification covers the requirements for design and construction of electroformed sieves. These sieves are used to perform particle-size distribution analysis and in preparing narrowly designated particle-size fractions. They may also be used as reference standards when suitably calibrated. A method of calibrating these sieves is included in Annex A1.

NOTE 1—Complete instructions and procedures on the use and calibration of testing sieves are contained in ASTM Manual 32.[2] This publication also contains a list of all published ASTM Standards on sieve analysis procedures for specific materials or industries.

1.2 The sieve analysis results from two testing sieves of the same sieve designation may not be the same because of the variances in sieve opening permitted by this specification. To minimize the differences in sieve analysis results, the use of testing sieves matched on a performance basis is suggested.

NOTE 2—For other types of sieves, see Specifications E11 and E323.

1.3 The values stated in SI units shall be considered standard for the dimensions of the electroformed mesh openings and the size of the wires in the electroformed mesh. The values stated in inch-pound units shall be considered standard with regard to the sieve frames.

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:*[3]

C430 Test Method for Fineness of Hydraulic Cement by the 45-μm (No. 325) Sieve

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

E323 Specification for Perforated-Plate Sieves for Testing Purposes

E1638 Terminology Relating to Sieves, Sieving Methods, and Screening Media

2.2 *ISO Standard:*[4]

ISO 565 Test sieves—Metal Wire Cloth, Perforated Plate and Electroformed Sheet-Nominal Aperture Sizes

3. Terminology

3.1 *Definitions*—For definitions of related terms, refer to Terminology E1638.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *electroformed material, n*—electrodeposited grid material consisting of precision openings used as the base material for electroformed sieves.

3.2.2 *electroformed sieves, n*—see *test sieve (electroformed).*

3.2.3 *non-standard frames (electroformed), n*—sieve frames other than as specified in accordance with Table 2 of Specification E161 that may be circular, square, rectangular, or non-metal.

3.2.3.1 *Discussion*—The frame may have the electroformed sheet permanently attached, or it may be designed so the electroformed sheet is replaceable.

3.2.4 *support grid, n*—conductive metal grid mounted to the sieve sheet.

[1] This specification is under the jurisdiction of ASTM Committee E29 on Particle and Spray Characterization and is the direct responsibility of Subcommittee E29.01 on Sieves, Sieving Methods, and Screening Media on Sieves, Sieving Methods, and Screening Media.

Current edition approved April 1, 2012. Published May 2012. Originally approved in 1960. Last previous edition approved in 2010 as E161 – 00 (2010). DOI: 10.1520/E0161-12.

[2] ASTM Manual 32, Manual on Test Sieving Methods, available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

[3] 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.

[4] Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, http://www.iso.ch.

TABLE 1 Nominal Dimensions, Permissible Variations and Limits for Precision Electroformed Sieves

Nominal Opening Size, μm[A]	Tolerance on Sieve Openings, ±μm	Limits, Openings per Linear cm[B]		Limits, Openings per Linear in.	
		Min	Max	Min	Max
500	2.0	15.35	16.14	39	41
425	2.0	17.32	18.11	44	46
355	2.0	19.29	20.87	49	53
300	2.0	22.83	24.41	58	62
250	2.0	25.20	26.77	64	68
212	2.0	31.89	33.46	81	85
180	2.0	35.04	36.61	89	93
150	2.0	41.34	46.06	105	117
125	2.0	46.06	51.18	117	130
106	2.0	47.24	59.06	120	150
90	2.0	55.12	78.74	140	200
75	2.0	59.06	78.74	150	200
63	2.0	66.93	98.43	170	250
53	2.0	78.74	110.24	200	280
45	2.0	90.55	118.11	230	300
38	2.0	98.43	137.80	250	350
32	2.0	110.24	157.48	280	400
25	2.0	118.11[C]	196.85[C]	300[C]	500[C]
20	2.0	157.48[C]	295.28[C]	400[C]	750[C]
15	2.0	157.48[C]	295.28[C]	400[C]	750[C]
10	2.0	196.85[C]	393.70[C]	500[C]	1000[C]
5	2.0	196.85[C]	590.55[C]	500[C]	1500[C]

[A] These nominal size openings are from the preferred number series R40/3 and R10. (Openings on apertures 32 μm and less are series R10.) These standard designations correspond to the values for test sieve apertures recommended by the International Standards Organization, Geneva, Switzerland, in ISO 565. Other opening sizes are not precluded.

[B] These limits permit at least two adjacent sieves to be formed with the same number of openings per cm. The percent open area must in no case be so great that the width of metal between openings is less than 13 μm.

[C] 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.

3.2.5 *test sieve (electroformed), n*—a sieve manufactured by mounting electroformed material consisting of high precision openings in a frame, designed for use in particle size analysis by sieving.

4. Ordering Information

4.1 Orders for items under this specification include the following information as necessary:

4.1.1 Name of material (Electroformed Sieve),

4.1.2 ASTM designation and year of issue (Specification E161 – XX),

4.1.3 Quantity of each item, and

4.1.4 Standard sieve designation (Table 1, Column 1).

4.1.5 For testing sieves in standard circular frames:

4.1.5.1 Nominal sieve frame diameter, and

4.1.5.2 Nominal sieve frame height.

4.1.6 For sieve cloth not in frames or in non-standard frames:

4.1.6.1 Lateral dimension of sieve mesh, and

4.1.6.2 Description of non-standard frame.

4.1.7 For sieves requiring supporting grid:

4.1.7.1 Support grid desired,

4.1.7.2 Support grid mounted up or down, and

4.1.8 Compatible sieve pans and covers.

5. Sieve Sheet Requirements

5.1 The material used in the manufacture of the sieve sheet shall be nickel or a metal suitable for electrodeposition in a firm crystalline structure. The sheet shall have square or round openings with straight uniform sides and smooth, flat surfaces except for a slight bevel along the edges of the openings. The thickness of the sheet (exclusive of the supporting grid, see 5.2), is governed by the method of manufacture, the size of the openings and the width of material between openings, but in no case shall the thickness of material between the openings be less than 10 μm (0.0004 in.).

5.2 If a supporting grid is required for durability, the sieve sheet shall be mounted to the supporting metal grid in such a manner that the sheet is firmly bonded to the grid. The supporting grid shall be of suitable thickness and strand width to provide adequate support to the sheet. The sheet shall be mounted on the supporting grid with the openings running in the same direction as those of the supporting grid.

5.3 The finished and mounted sieve sheet from which the sieves are constructed, shall conform to the requirements for opening size and spacing as outlined in Table 1. Extraneous metal formed in or near the corners which does not restrict the passage of a spheroidal particle shall be disregarded. The mean dimension of these openings as defined in Table 1 establishes the designated size of the sieve.

NOTE 3—In instances where a support grid is required for durability, opening sizes smaller than the allowable tolerances will be observed. This occurs where the support grid overlaps the sieve openings in such a way as to either block a portion of the opening or to create several smaller openings. This is an unavoidable situation and has been determined to have little measurable effect on the sieving open area or sieve performance.

5.3.1 There shall be no punctures, missing or deformed areas, or other obvious defects in the sieve sheet.

6. Test Sieve Frames

6.1 *General Requirements*—Frames for precision electroformed sieves shall be made from non-corrosive material such as brass or stainless steel, and constructed in such a manner as to be rigid.

6.1.1 The sieve sheet shall be mounted on the frame without distortion, looseness, or waviness.

6.1.2 To prevent the material being sieved from catching in the joint between the sieve sheet and the frame, the joint shall be filled smoothly or constructed so that the material will not be trapped.

6.2 *Standard Circular Frames*—Sieve frames shall be circular, of seamless construction, with nominal diameters of 3, 3.94, 7.87, 8, and 12 in. (76.2, 100, 200, 203.2, and 304.8 mm) as may be specified. The dimensions shall conform to the requirements in Table 2.

6.2.1 The bottom of the frames shall be constructed so as to provide an easy sliding fit with any sieve frames of the same nominal diameter conforming to the specified dimensions.

6.2.2 The joint or fillet at the connection of the sieve sheet to the frames will provide a minimum clear sieving surface with a diameter equal to the nominal diameter less 0.5 in. (13 mm).

TABLE 2 Dimensions of Standard Circular Frames

Current Nominal Diameter, in.	Proposed Revision Mean Diameter		Comments Typical Frame[A] Nominal Height[B]
	Inside at Top[C]	Outside on Skirt	
3	3.000 in. + 0.030/–0.000 (76.20 mm + 0.76/–0.00)	3.000 in. + 0.000/–0.030 (76.20 mm + 0.00/–0.76)	1 in. (25.4 mm)
8	8.000 in. + 0.030/–0.000 (203.20 mm + 0.76/–0.00)	8.000 in. + 0.000/–0.030 (203.20 mm + 0.00/–0.76)	2 in. (50.8 mm) FH[D] 1 in. (25.4 mm) HH[E]
12	12.00 in. + 0.030/–0.000 (304.80 mm + 0.76/–0.00)	12.00 in. + 0.000/–0.030 (304.80 mm + 0.00/–0.76)	2 in. (50.8 mm) FH

[A] Other frame heights are not precluded.
[B] Distance from the top of the frame to the sieve cloth surface.
[C] Measured 0.2 in. (5 mm) below the top of the frame.
[D] FH = Full height.
[E] HH = Half height.

6.3 *Non-Standard Frames*—Other sieve frames may be either square, rectangular, or circular.

6.3.1 The frame may have the sieve sheet permanently installed or may be designed to permit replacement.

NOTE 4—Refer to Test Method C430, which contains requirements for 3-in. (76.2-mm) diameter by 3-in. (76.2-mm) high sieves used in the mineral industries, especially the cement group.

6.3.2 The provisions of 6.1 apply, except that the frames may also be made of other materials.

NOTE 5—Exercise care to prevent loss of material when using non-standard sieve frames.

6.4 *Pans and Covers*—Pans and covers for use with sieves shall be made so as to nest with the sieves. Pans with extended rims (stacking skirts) shall be furnished when specified. The pans and covers shall conform to the dimensions in Table 2.

7. Product Marking

7.1 Each sieve shall bear a label marked with the following information:

7.1.1 This ASTM designation,

7.1.2 The nominal size of the openings in micrometres,

7.1.3 The mean size in μm, and

7.1.4 The name of the manufacturer or the responsible distributor.

8. Keywords

8.1 opening; particle size; sieve; sieve analysis; sieve designation; sieve sheet; test sieve

ANNEXES

(Mandatory Information)

A1. METHOD OF CALIBRATING PRECISION ELECTROFORMED SIEVES

A1.1 The unique manner of forming the sieve sheet makes it easier and more precise to measure the openings rather than the nominal width of metal between adjacent openings as is frequently done in the case of wire-cloth sieves. In some cases, electrodeposition produces small spurs or bulges of metal which project several μm into the open area in the plane of the sheet, thereby restricting the passage of spheroidal particles which would go through a normally perfect opening.

A1.2 Scan the entire area with a wide-angle binocular microscope having a magnifying power of approximately 50× to determine if the sheet conforms to the specifications given in 5.3, and if the edges between the sheet and frame are sealed completely.

A1.2.1 Most microscopes will accommodate the 76.2-mm (3-in.) sieve on the existing stage without modifications. A microscope fitted with a 20× or 40× objective and a filar micrometer eyepiece of 10 or 12.5 power is sufficient for most of the sieves.

A1.2.2 Measurements must be sensitive to 0.5 μm. Bottom illumination of preferably monochromatic light with essentially parallel rays is necessary. It is also a distinct advantage to have vertical illumination through the objective. The magnification of the apparatus, and filar micrometer if used, is determined by means of a calibrated-stage micrometre certified to ±0.5 μm for the 0.01 mm scale divisions and not greater than ±0.5 μm accumulated error for the complete scale.

A1.2.3 Calibration is accomplished by focusing the microscope at the narrowest point of the open area, aligning the cross hair of the micrometer with the edges of the opening, and measuring across the opening to the opposite edge. By turning the micrometer in only one direction any instrument backlash is avoided. Only openings with straight sides (no spurs or bulges projecting more than 1 μm into the opening from the center portion of the side) are measured. The number of openings actually measured and the number of openings that would have been measured except for the presence of spurs or bulges are noted. It is recommended that these measurements

be made in at least 20 fields chosen at random over the area of the sieve. At least five actual measurements shall be made in each field. Half of the openings shall be measured in one direction and half in the other.

A1.2.4 Sieves with openings less than 25 μm in size shall be measured with the microscope fitted with the 40× objective.

A1.2.5 It is necessary to attain considerable experience in the use of the equipment and in making measurements before the desired accuracy is attained. Therefore, it is recommended that several operators measure a sieve several times in order to detect personal variations.

A1.3 If suitable standard materials having spheroidal particles in a known size distribution are available, they may be used as a standard for calibrating sieves. Values from such calibrations are not as accurate as those obtained from microscopic measurements but will serve as an approximation of the conformance to specifications. Periodic tests on such material will serve to detect the presence of broken meshes that might not be observed by microscopical scanning. Calibrated glass sphere reference materials may be obtained from the U.S. Department of Commerce National Institute of Standards and Technology (NIST). Currently, five glass sphere SRMs are available from the NIST SRM Program;[5] they are: SRM 1003b which consists of glass spheres with diameters ranging from 10 to 60 μm; SRM 1004a glass spheres with diameters ranging from 40 to 170 μm; SRM 1017b glass spheres with diameters ranging from 100 to 400 μm; SRM 1019a glass spheres with diameters ranging from 760 to 2160 μm. Detailed instructions for use are provided in the certificate which accompanies each SRM unit.

[5] Available from National Institute of Standards and Technology (NIST), Standard Reference Materials, 100 Bureau Drive, Stop 2300, Gaithersburg, MD 20899-2300, http://www.nist.gov.

A2. CLEANING AND REPAIR

A2.1 Particles can be removed from metal framed precision electroformed sieves with the aid of an ultrasonic bath of mild detergent and distilled water or any other chemical recommended by sieve manufacturer. The sieve shall be placed in the vertical position. 150 watts maximum ultrasonic energy shall 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. Do not use a brush or pressurized air to clean the sieve sheet.

A2.2 If the sieve sheet is broken, it can be repaired by applying epoxy cement with the point of a fine needle or applying small spheres of metal solder with a pencil-point iron. In both procedures a low power (10 to 50×) binocular microscope is a necessary aid.