Designation: E2427 – 13

Standard Test Method for Acceptance by Performance Testing for Sieves[1]

This standard is issued under the fixed designation E2427; 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 is a performance test for acceptance of sieves.

1.2 This test method compares the performance of a sieve against an inspection or calibration sieve using a known quantity of reference material such that the long-term stability of sieves can be measured.

1.3 This is a test method for checking the accuracy and long-term reliability of test sieves. Since it is not possible to adjust the measuring capability of a test sieve, the test method is designed to offer a verification procedure based on sieving performance by comparison to a standard reference. This test method is not proposed as an alternative to the inspection methods in accordance with Specification E11 or the procedures in MNL 32.

1.4 *Units*—The values stated in SI units are to be regarded as standard. All other values given are for information only.

1.5 *This test method 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:*[2]

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

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

MNL 32 Manual on Test Sieving Methods Guidelines for Establishing Sieve Analysis Procedures

3. Terminology

3.1 Definitions of terms relating to sieve analysis can be found in Terminology E1638.

3.2 *calibration test sieve, n*—a test sieve manufactured using sieve cloth which has been inspected after being mounted in the sieve frame, and that meets the requirements of Table 1 of Specification E11 in part based on the standard deviation of the required number of sample openings in the test sieve (Column 11) not exceeding the maximum allowable for a confidence level of 99.73 % (Column 12). **E11**

3.3 *endpoint, n*—point at which no material falls through the sieve concluding the sieving, taking into account sample degradation.

3.4 *inspection test sieve, n*—atest sieve manufactured using sieve cloth which has been inspected after being mounted in the sieve frame, and that meets the requirements of Table 1 of Specification E11 in part based on the standard deviation of the required number of sample openings in the test sieve (Column 9) not exceeding the maximum allowable for a confidence level of 99 % (Column 10). **E11**

3.5 *percent retained, n*—mass fraction percentage of material that is left upon or retained by the sieve after the test has been performed.

3.6 *sieve, n*—an apparatus consisting of a medium with regularly spaced apertures of uniform size, mounted in a suitable frame or holder, for use in separating material according to size.

3.7 *sieve shaker, n*—the mechanical device or method used to shake the sieves, excluding hand sieving.

4. Significance and Use

4.1 This test method may be used by producers, users, and general interest parties for research and development or production quality control work, and is useful for the comparison of sieves.

4.2 Because the reference material's particle size distribution will affect the acceptance tolerance, the user should determine an acceptance tolerance based on their specific reference material.

[1] This test method 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.

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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.

5. Interferences

5.1 The long-term use of sieves can compromise the reliability of test results. Depending on the type of materials being measured, wear can occur on the diameter of the wires causing opening sizes to change and measuring capability to drift.

5.2 The specific particle size distribution of the reference material will affect the acceptance tolerance. Therefore each reference material shall be developed based on a desired particle size distribution.

5.3 Care should be taken with the use of the reference materials. Since the same batch of material may be used more than one time, it shall not be contaminated as variation in the material will affect the test results.

5.4 The exact same sieve shaker shall be used for any performance comparison.

6. Apparatus

6.1 *Sieve*—in accordance with Specification E11 tolerances.

6.2 *Sieve Shaker*—certified as such by the manufacturer in accordance with Specification E11 tolerances.

6.3 *Calibration Sieve*—certified as such by the manufacturer in accordance with Specification E11 tolerances.

6.4 *Sieve Shaker*—mechanical device capable of holding a stack of at least one sieve and a collection device. Hand sieving (manual sieving) is not acceptable.

6.5 *Balance*—having the capacity to weigh the appropriate sample sizes in accordance with Annex A1 in grams, with accuracy to 0.01 g or better.

7. Hazards

7.1 Manufacturers' procedures should be followed when operating machinery such as sieve-shaking devices. The testing of some materials may produce dust. Proper procedures for minimizing dust inhalation and working with hazardous materials should be followed at all times. Materials likely to produce high levels of dust may not be appropriate for use without special precautions.

8. Preparation of Apparatus

8.1 Select an inspection or calibration sieve of the same nominal aperture size as the sieve to be tested for acceptance.

8.2 The selected sieve to be tested shall be physically sound. The sieve cloth shall be taut and free of broken or distorted wires. Joints shall be intact. Sieve frames shall be cylindrical and nest easily with other sieves.

8.3 Select the reference material to be used to conduct the test. Reference materials shall be either certified standard test materials that are purchased or prepared by the user. If prepared by the user, it is recommended that the reference material be of the same composition as the production material. If less than the entire batch is used, acquire a test sample in accordance with MNL 32.

9. Preparation of Reference Material

9.1 *User-Prepared Reference Material*—The reference material may be prepared from the production material being tested, provided that the material will not blind or adhere to the sieve apertures nor break down during the test procedure. Prepared reference material is not traceable and shall only be used internally for this comparative test. If certified reference material is used, no preparation of reference material is required.

9.2 In accordance with the size of the reference material produced, a sieve of the same size and a sieve that is one size coarser and a collection pan are required. For example, if 125-µm reference material is to be produced, a 125-µm (No. 120) sieve, a 150-µm (No. 100) sieve, and a collection pan are used.

9.3 Nest the sieves in the shaker with the coarser sieve in the top position, the finer sieve in the second position, and the collection pan in the bottom position. Any additional shaker positions are not used.

9.4 Add all the reference material to the coarser sieve. Continue sieving until approximately half the total amount of reference material required is retained on the finer sieve and the balance is in the collection pan. All the material retained on the finer 125-µm (No. 120) sieve will become reference material, as well as an equal amount by weight of the material in the collection pan. The material retained on the larger 150-µm (No. 100) sieve is discarded. Combine all the materials from the finer sieve and the collection pan in equal proportions to produce the amount of reference material required in accordance with Annex A1 for the performance testing.

10. Performance Test Records

10.1 A sieve may be evaluated for acceptance based on this standard comparative test method. The resulting performance test records shall be retained for the life of the sieve with its traceable number in accordance with Specification E11 marking requirements.

11. Procedure

11.1 Weigh the reference material that will be used to perform the test on a calibrated scale or balance; the recommended quantity may be referenced in accordance with Annex A1.

11.2 Nest the sieve to be tested in the collection pan in the shaker.

11.3 Place the reference material on the sieve and run the sieve shaker until endpoint.

11.4 Weigh the reference material retained on the sieve. The remainder of the reference material shall pass into the collection pan in the bottom position. The proportion of the retained material to the total starting material will be used for comparing the performance of the sieve to the inspection or calibration sieve. It is not necessary to repeat this procedure on the inspection or calibration sieve each time a sieve performance test is performed unless the material degraded during the sieving process. The inspection or calibration sieve proportion

will remain the constant for comparison provided the same batch of reference material is used.

11.5 After the weight is obtained, mix the retained material with the passed material in the collection pan, which will then become the reference material used to check the performance of subsequent sieves. Before each sieve is tested, the recombined reference material shall be weighed to obtain the starting weight for the next test. If the starting weight is less than 97 % of the original quantity, a new batch of reference material is required.

11.6 Repeat procedures 11.1 – 11.5 for all subsequent sieves. Record the results for each sieve.

11.7 The complete procedure shall be repeated for each different size sieve to be tested using the corresponding size reference material.

12. Calculation or Interpretation of Results

12.1 Normally, not all of the reference material is salvaged, as some is lost because of retention in the sieve and other losses that occur during testing. Therefore, the proportion of retained material, not the actual weight, shall be compared between sieves tested, in accordance with the following:

$$\text{Percent Retained} = (\text{Weight Retained/Starting Weight}) * 100 \quad (1)$$

12.2 Compare the results of the sieve to the inspection or calibration sieve by subtracting the percent retained on the inspection or calibration sieve from the percent retained on the sieve. For example, if the inspection or calibration sieve retained 50 % of the reference material and the sieve retained 49 % of the reference material, there is a –1 % deviation between the two sieves.

12.3 A sieve is considered acceptable for use if the percent deviation test result is within the user's tolerance for the specific reference material, not to exceed 5 %.

13. Report

13.1 The report shall include the following:

13.1.1 The percent of reference material retained on the inspection or calibration sieve,

13.1.2 The percent of the reference material retained on the sieve,

13.1.3 The percent deviation with attention to the sign (plus or minus), and

13.1.4 The acceptance status (that is, accepted or rejected).

14. Precision and Bias

14.1 The precision of this test method is based on an interlaboratory study of E2427 – 11, Test Method for Acceptance by Performance Testing for Sieves, conducted in 2012. Seven laboratories tested one material in triplicate, on both calibration and working sieves. Every "test result" represents an individual determination. Practice E691 was followed for the design and analysis of the data.[3]

14.1.1 *Repeatability (r)*—The difference between repetitive results obtained by the same operator in a given laboratory applying the same test method with the same apparatus under constant operating conditions on identical test material within short intervals of time would in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in 20.

14.1.1.1 Repeatability can be interpreted as maximum difference between two results, obtained under repeatability conditions that are accepted as plausible due to random causes under normal and correct operation of the test method.

14.1.1.2 Repeatability limits are listed in Table 1.

14.1.2 *Reproducibility (R)*—The difference between two single and independent results obtained by different operators applying the same test method in different laboratories using different apparatus on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in 20.

14.1.2.1 Reproducibility can be interpreted as maximum difference between two results, obtained under reproducibility conditions that are accepted as plausible due to random causes under normal and correct operation of the test method.

14.1.2.2 Reproducibility limits are listed in Table 1.

14.1.3 The above terms (repeatability limit and reproducibility limit) are used as specified in Practice E177.

14.1.4 Any judgment in accordance with statements 14.1.1 and 14.1.2 would have an approximate 95 % probability of being correct.

14.2 *Bias*—At the time of the study, there was no accepted reference material suitable for determining the bias for this test method, therefore no statement on bias is being made.

14.3 The precision statement was determined through statistical examination of 100 results, from seven laboratories, on one material.

14.4 To judge the precision of two test results, it is recommended to compare a material closest in characteristics to a test material.

15. Keywords

15.1 sieve cloth; sieve testing; test sieves

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:E29-1001. Contact ASTM Customer Service at service@astm.org.

TABLE 1 Difference Between Calibration and Working Sieves (%) Retained

Material	Average[A] $\bar{X}$	Repeatability Standard Deviation S_r	Reproducibility Standard Deviation S_R	Repeatability Limit r	Reproducibility Limit R
120 Garnet Master Sand	0.7648	0.4197	0.6214	1.1751	1.7399

[A] The average of the laboratories' calculated averages.

ANNEX

(Mandatory Information)

A1. SIEVE ANALYSIS

A1.1 See Table A1.1 and Table A1.2.

TABLE A1.1 Suggested Bulk Volume of Test Sample for Sieve Analysis with 8-in. and 200-mm Round Sieves[A]

NOTE 1—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 centimetre of the material rounded out within a tolerance of ±25 %. If the density figure for the material being tested is not readily available, use the factor of the nearest similar material shown in Table A1.2.

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 mm	1 in.	1800 cm^3	900 cm^3
22.4 mm	⅞ in.	1600 cm^3	800 cm^3
19 mm	¾ in.	1400 cm^3	700 cm^3
16 mm	⅝ in.	1000 cm^3	500 cm^3
12.5 mm	½ in.	800 cm^3	400 cm^3
11.2 mm	7/16 in.	800 cm^3	400 cm^3
9.5 mm	⅜ in.	600 cm^3	300 cm^3
8 mm	5/16 in.	500 cm^3	250 cm^3
6.3 mm	¼ in.	400 cm^3	200 cm^3
5.6 mm	No. 3, ½ in.	400 cm^3	200 cm^3
4 mm	No. 5	350 cm^3	150 cm^3
2.80 mm	No. 7	240 cm^3	120 cm^3
2 mm	No. 10	200 cm^3	100 cm^3
1.40 mm	No. 14	160 cm^3	80 cm^3
1 mm	No. 18	140 cm^3	70 cm^3
710 µm	No. 25	120 cm^3	60 cm^3
500 µm	No. 35	100 cm^3	50 cm^3
355 µm	No. 45	80 cm^3	40 cm^3
250 µm	No. 60	70 cm^3	35 cm^3
180 µm	No. 80	60 cm^3	30 cm^3
125 µm	No. 120	50 cm^3	25 cm^3
90 µm	No. 170	40 cm^3	20 cm^3
63 µm	No. 230	25 cm^3	17 cm^3
45 µm	No. 325	30 cm^3	15 cm^3
38 µm	No. 400	25 cm^3	12 cm^3

[A] Reprinted with permission from MNL 32, Manual on Test Sieving Methods Guidelines for Establishing Sieve Analysis Procedures, 4th ed., L.R. Pope and C.W. Ward, Eds., ASTM International: West Conshohocken, PA, 1998, pp. 30–31.

TABLE A1.2 Typical Bulk Densities of Various Particulate Materials[A]

NOTE 1—Weights, per unit of volume, are of divided, crushed, or pulverized materials in freely poured conditions.

Material	Average Weight g/cm^3	Average Weight lb/ft^3
Alumina	1.23	44
Aluminum, calcined	2.05	128
Aluminum oxide	1.96	122
Aluminum shot	1.54	96
Ammonium nitrate	0.77	48
Ammonium sulfate	0.98	61
Asbestos ore	0.87	54
Bagasse	0.09	6
Bauxite ore	1.20 to 1.36	75 to 85
Bentonite	0.80 to 1.04	50 to 65
Bicarbonate of soda	0.91	57
Borax	0.80 to 0.98	50 to 61
Boric acid	0.93	58
Calcite	1.44 to 1.68	90 to 105
Calcium carbide	1.20	75
Calcium carbonate	0.79	49
Calcium chloride	1.03	64
Calcium phosphate	0.91	57
Carbon black	0.33	24
Cellulose powder	0.26	16
Cement clinker	1.20 to 1.28	75 to 80
Cement, portland	1.44 to 1.60	90 to 100
Chrome ore	2.25	140
Clay	0.48 to 1.20	30 to 75
Coal, anthracite	0.88	55
Coal, bituminous	0.88	50
Coke breeze	0.40 to 0.56	25 to 35
Coke, petroleum	0.40 to 0.64	25 to 40
Copper ore	1.60 to 2.40	100 to 150
Coquina shell	1.28	80
Corn starch	0.64	40
Diatomaceous earth	0.50	31
Dicalcium phosphate	1.03	64
Dolomite, crushed	1.44 to 1.60	90 to 100
Feldspar, crushed	1.04 to 1.35	65 to 84
Ferrophosphorous	3.14	196
Fire clay	1.28	80
Flour, wheat	0.38	24
Flour, maize	0.59	37
Fluorspar	1.44 to 1.92	90 to 120
Fly ash	0.79	49
Fullers earth	0.48 to 0.61	30 to 40
Garnet	2.69	168
Glass beads	1.22	76

TABLE A1.2 *Continued*

Material	Average Weight g/cm^3	Average Weight lb/ft^3
Glass, crushed	1.52 to 1.60	95 to 100
Glass cullet	1.49	93
Granite, crushed	1.52 to 1.60	95 to 100
Gravel	1.44 to 1.60	90 to 100
Gypsum, calcined	0.93	58
Gypsum, crushed	1.44 to 1.60	90 to 100
Iron ore	1.92 to 2.40	120 to 150
Kaolin	2.25	160
Kyanite	1.09	68
Lime, ground	0.96	60
Lime, hydrated	0.40	25
Limestone, agricultural	1.12	70
Limestone, crushed	1.36 to 1.60	85 to 100
Magnesite	1.70	106
Magnetite	2.49	155
Manganese ore	1.92 to 2.18	120 to 136
Marble, crushed	1.44 to 1.52	90 to 95
Metals, powdered		
Aluminum	1.28	80
Copper	2.71	169
Copper-lead	5.84	364
Iron	3.90	243
Nickel	4.22	263
Stainless steel	3.85	240
Tantalum	4.80	300
Mica	0.67	42
Ore, sintered	1.83	114
Oyster shells, ground	0.47	29
Perlite ore	1.04 to 1.20	65 to 75
Phosphate rock	1.20 to 1.36	75 to 85
Plaster, calcined	1.03	64
Polyethylene pellets	0.58	36
Polyethylene powder	0.29	18
Poly (vinyl chloride)	0.48	30
Potash	1.23	77
Potassium carbonate	1.27	79
Pumice	0.64	40
Rubber, chopped	0.58	36
Rubber, ground	0.32	20
Salt, flake	0.98	61
Salt, rock	1.06	66
Salt, table	1.20	75
Sand	1.44 to 1.60	90 to 100
Sand, silica	1.44 to 1.60	90 to 100
Sawdust	0.29	18
Seacoal	0.67	42
Shale	1.60	100
Shot, metal	3.69	230
Silica flour	0.43	27
Silica gel	0.72	45
Soapstone, pulverized	0.64	40
Soda ash, heavy	0.88 to 1.04	55 to 65
Soda ash, light	0.40 to 0.56	25 to 35
Soda, bicarbonate	0.91	57
Sodium nitrate	1.25	78
Sodium phosphate	0.69	43
Sodium sulfate	1.54	96
Steel grit	3.66	228
Stone, crushed	1.36 to 1.52	85 to 95
Sugar, granulated	0.80	50
Sugar, powdered	0.59	37
Sulfur, crushed	0.80 to 1.04	50 to 65
Talc, granular	0.71	44
Talc, powder	0.55	34
Traprock, crushed	1.68 to 1.76	105 to 110
Triple superphosphate, granular	1.03	64
Tungsten carbide	8.82	550
Urea prills	0.69	43
Vermiculite ore	1.28	80
Wood chips	0.21	13
Zinc dust	2.31	144
Zirconium oxide	3.22	200
Zirconium sand	2.60	162

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APPENDIX

(Nonmandatory Information)

X1. SIEVE CLEANING INFORMATION

X1.1 Sieves shall be cleaned before each test. Most particles that block the sieve apertures can usually be removed by inverting the sieve and gently tapping the frame. Alternately, the underside of the sieve may be stroked gently with a soft brush. Washing in warm water or using an ultrasonic cleaner containing a synthetic detergent may also clean sieves. The apertures shall not be blocked by test material as this may contaminate the reference material and produce unreliable measurements.

X1.2 The sieve shall be rinsed thoroughly in clean water and dried in a warm atmosphere. To avoid distortion, the sieve shall not be heated above 80°C (176°F). Sieves that have been used for wet sieving shall not be allowed to dry out before attempting to clean, as material caught in the sieve may become permanently trapped. Acid or alkaline cleaning treatment is not generally recommended.