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Standard Terminology Relating to Sieves, Sieving Methods, and Screening Media¹

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INTRODUCTION

Particle size analysis through the use of standard test sieves, and particle separation through the use of screening media, are commonly adopted methods of achieving desired process specifications related to particles. To ensure a better understanding of sizing and separation systems and processes and to ensure appropriate comparison of data, terminology common to the processes must be documented and defined.

For Subcommittee E29.01 on Sieves, Sieving Methods, and Screening Media, this is an ongoing process of developing new related terms. Every effort has been made to ensure accuracy, precision, and clarity for the terms included. Suggestions and comments for additions, corrections, and revisions are welcomed.

1. Scope

1.1 This terminology includes all those terms used in all of the standards under the jurisdiction of Subcommittee E29.01. Terms are defined that are related to the manufacture of standard test sieves and screening media, as well as terms related to the methods, analysis, procedures, and equipment for sizing and separating particles.

1.2 Committee E29 on Particle and Spray Characterization feels that it is essential to include terms and definitions explicit to the scope, regardless of whether the terms appear in existing ASTM standards. Terms that are in common usage and appear in common-language dictionaries are generally not included.

1.3 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards*:²

- E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
- E161 Specification for Electroformed Material and Test Sieves
- E323 Specification for Perforated-Plate Sieves for Testing Purposes
- E454 Specification for Industrial Perforated Plate and Screens (Square Opening Series)
- E674 Specification for Industrial Perforated Plate and Screens (Round Opening Series)
- E2016 Specification for Industrial Woven Wire Cloth
- E2427 Test Method for Acceptance by Performance Testing for Test Sieves
- E2589 Terminology Relating to Nonsieving Methods of Powder Characterization
- E2814 Specification for Industrial Woven Wire Filter Cloth
- E3278 Test Method for Bubble Point Pressure of Woven Wire Filter Cloth
- E3315 Specification for Certification of Metallic Materials

3. Terminology

3.1 *Definitions*:

absolute filtration rating, n —largest pore size found in the test specimen. **E3278**

¹ This terminology 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.

agglomerate, *n*—two or more particles adhering together. **E1638**

aperture, *n*—the opening in a screening or sieving medium. **E11, E2016**

aperture size, *n*—the dimension defining an opening in a screening or sieving medium. **E11, E2016**

as reported, *v*—information based on a prior processing certification. **E3315**

DISCUSSION—Applicable to chemistry, mechanical, or other properties or processes.

as tested, *v*—information based on actual testing of the current processed material. **E3315**

DISCUSSION—Parameters to be tested must be specified.

backing cloth, *n*—a wire mesh support layer used directly under the sieve cloth with openings coarser than the sieve designation. **E11**

bar, *n*—the metal between perforations. **E454, E674**

blank, *n*—an unperforated area located other than along the perimeter of a plate. **E454, E674**

bolting grade wire cloth, *n*—wire cloth meeting a group of specifications that are typical for higher sifting capacities and which can speed the bolting action of vibratory screening machines, manufactured based on using a limited number of wire diameters for a large group of mesh designations. **E2016**

DISCUSSION—“Bolting Grade” designations are often misused; and should not be specified without a wire diameter, as the designations have become non-standard.

break-out, *v*—a term applied to the action that occurs ahead of the punch in its going through the plate. **E454, E674**

DISCUSSION—The fracturing of the material results in a tapered hole with the small dimensions on the punch side.

bubble point test, *n*—a capillary flow test method that measures the pressure required to force an air bubble through a filter cloth sample wetted under a test liquid of known surface tension. **E2814**

DISCUSSION—The pressure is inversely proportional to the pore size, should be standardized, and the pressure observed at the first bubble point location is considered the absolute rating. The test result pressure can be converted to a pore size or micron retention by applying a pore size calculation factor (see Test Method **E3278**).

bulk density, *n*—the mass per unit volume of a material, including voids inherent in the material as tested. **E1638**

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 in accordance with Specification **E11**, Table 1, in part based on the standard deviation of the 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**

DISCUSSION—Calibration sieves have had at least twice as many openings measured as Inspection sieves.

candidate test sieve, *n*—the test sieve to be performance tested. **E2427**

centers, *n*—the dimensional sum of one perforation and one bar, or the dimensional distance from the center of one perforation to the center of an adjacent perforation. **E454, E674**

certificate of compliance, *n*—an attestation document in accordance with 5.1.1. **E3315**

DISCUSSION—Informally also known as *certificate of conformance* or *C of C*.

DISCUSSION—While generally these terms are considered synonymous and used interchangeably, there is also argument that compliance is a more binding term when used in reference to an external specification (for example, wire in accordance with Specification A478), while conformance may be used in reference to an internal specification (for example, quality system in accordance with AS9100).

cloth thickness, *n*—overall thickness of the filter cloth, nominally estimated by adding the warp wire diameter plus two times the shute wire diameter. **E2814**

country of melt origin, *n*—the country where the original raw material was melted/smelted. **E3315**

DISCUSSION—Just the term country of origin is a vague clause subject to interpretation without qualification; see Defense Federal Acquisition Regulation Supplement (DFARS), Supplementary Requirements section.

compliance test sieve, *n*—a test sieve manufactured using sieve cloth which has been inspected prior to being mounted in the sieve frame, and that meets the requirements in accordance with Specification **E11**, Table 1, in part based on the standard deviation of the required number of sample openings per 100 square feet of sieve cloth (Column 7) not exceeding the maximum allowable for a confidence level of 66 % (Column 8). **E11**

crimp, *n*—the corrugation in the warp or shute wire, or both.

DISCUSSION—The crimp in the wires is formed either during the weaving process, or with a crimping machine prior to weaving. If formed during the weaving process, the tension existing between the warp and the shute wires fundamentally determines the respective amount of depth of crimp, which locks the wires in place and in part establishes the firmness of the sieve cloth. **E11, E2016**

DISCUSSION—The crimp in the wires is formed during the weaving process, and the tension existing between the warp and shute wires fundamentally determines the respective amount or depth of crimp, which in part establishes the firmness of the filter cloth. In standard filter cloth, the warp wire is tensioned such that it only crimps minimally if at all, and the shute wire crimps predominately around the warp wire. In reverse filter cloth, the warp wire is held under reduced tension as it does crimp around the shute wire, but the shute wire remains predominately straight. **E2814**

cumulative retained distribution graph, *n*—a graph obtained by plotting the total (cumulative) percentage by the mass retained on each of a set of sieves versus the corresponding aperture sizes. **E1638**

DISCUSSION—Also known as *cumulative oversize distribution graph*.

cumulative passing distribution graph, *n*—a graph obtained by plotting the total (cumulative) percentage by the mass

passing each of a set of sieves versus the corresponding aperture sizes. **E1638**

DISCUSSION—Also known as *cumulative undersize distribution graph*.

cut point, *n*—the particle size above which 97 % of the particles are trapped by the filter. **E2814**

DFARS, *n*—Defense Federal Acquisition Regulation Supplement. **E3315**

die side, *n*—the surface of the plate that was against the die during the punching operation. **E454, E674**

double crimp wire cloth, *n*—wire cloth woven with approximately equal corrugations in both the warp and shute wires to lock the wires in position. **E11, E2016**

Dutch weave, *n*—see **filter cloth**.

electroformed material, *n*—electrodeposited grid material consisting of precision openings used as the base material for electroformed sieves. **E161**

electroformed sieves, *n*—see **test sieves** (electroformed). **E161**

endpoint, *n*—point at which no more material falls through the sieve concluding the sieving, taking into account sample degradation. **E2427**

filter cake (surface cake), *n*—material that is retained on the filter cloth during processing. **E2814**

DISCUSSION—The filter cake forms and builds up as particulate is retained, until the increased flow resistance of the filter cake requires it be removed from the filter cloth, typically by backflushing. The deposition of material forming the filter cake can aid in filtration by providing depth filtration, which results in a lower micron retention.

filter cloth, *n*—a special type of woven wire cloth, also referred to as Dutch weave, with a greater number of wires in one direction than the other, and utilizing two different wire diameters. **E2814**

finished end pattern, *n*—the condition that occurs with some specifications of staggered pattern perforations as a result of tool design where the pattern is completed on both ends of the plate. **E454, E674**

firmness, *n*—a subjective term referring to the planar rigidity of wire cloth (as a roll good, not mounted in a frame). **E11, E2016**

DISCUSSION—Firmness is established by the tensile strength of the material, the relationship of the mesh to wire diameters, the type of weave, and amount of crimp in the wires. The absence of firmness in wire cloth is termed **sleaziness**.

flat top wire cloth, *n*—wire cloth with deep crimps, as in lock crimp, except that all crimps are on the under side of the cloth, leaving the top surface all in one plane. **E2016**

DISCUSSION—Sometimes designated *smooth top*.

gage (also gauge), *n*—a number designating a specific thickness of metal sheet tabulated in a standardized series, each of which represents a decimal fraction of an inch. **E454**

glass bead test, *n*—method for determining the filtration rating of filter cloth using a set of presorted precisely sized spherical glass beads, passing them through the filter cloth, and examining the beads passed or captured. **E2814**

DISCUSSION—The largest bead passed is considered the absolute micron retention rating.

heat number, *n*—traceable reference as established by the original melt mill. **E3315**

DISCUSSION—For some products, it is common that multiple heats of material may be used in their manufacture.

hydraulic diameter, *n*—the diameter equal to four times the pore throat area divided by the pore throat perimeter. **E3278**

DISCUSSION—This diameter can be generated using the PoroDict module in the software GeoDict4,5 (see 4.2.2).

hydraulic diameter bubble point pressure, *n*—a pressure calculated using the hydraulic diameter. **E3278**

DISCUSSION—This pressure can be generated using the PoroDict module in the software GeoDict (see 4.2.2), and is based on a statistically fitted bubble contact angle of 40 degrees and the hydraulic diameter.

inspection report, *n*—a document that states dimensional inspection result data. **E3315**

inspection 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 in accordance with Specification **E11**, Table 1, 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**

intermediate crimp wire cloth, *n*—precrimped wire cloth with extra crimps or corrugations between the points of intersection. **E2016**

DISCUSSION—Sometimes designated *intercrimp* or *multiple crimp*.

lock crimp wire cloth, *n*—precrimped wire cloth with deep crimps at the points of intersection to lock the wires securely in place. **E2016**

lot number, *n*—traceable reference used by any processor of the material. **E3315**

DISCUSSION—This is also known as batch, charge, roll, work, etc., number, but not in lieu of heat number if traceability is required.

margin or border, *n*—an unperforated area located along the perimeter of a plate. **E454, E674**

market grade wire cloth, *n*—wire cloth meeting a group of specifications that are typical for use in the general industrial market, manufactured based on using a different wire diameter for each of the common mesh designations. **E2016**

DISCUSSION—“Market Grade” designations are often misused; and should not be specified without a wire diameter, as the designations have become non-standard.

matched test sieve, *n*—a test sieve that reproduces the performance results of another test sieve within user defined limits for a designated material (for information only and may not be in compliance with Specification **E11**). **E11**

material certification, *n*—an attestation document in accordance with 5.1.2 and, if applicable, 5.1.3. **E3315**

median particle size, *n*—the particle size at which half the distribution (by mass, volume, number, etc.) is larger than and half smaller than the stated size. **E1638, E2589**

melt mill certification, *n*—a chemical attestation document from the original melt mill for the heat number. **E3315**

DISCUSSION—Just the term *mill certification* is a vague clause subject to interpretation without qualification; for example, certifications from rolling, wire, weaving, or other processing mills (see *traceability*).

mesh, *n*—the number of wires or openings per linear inch (25.4 mm), counted from the center of any wire to a point exactly one inch (25.4 mm) distant, including the fractional distance between either thereof. **E11, E2016, E2814**

micron, *n*—common filtration reference to a particle size, properly defined as a micrometre. **E2814**

micron retention, *n*—separation particle size of the filter cloth expressed as a diameter in micrometres. **E2814**

micron retention, absolute, *n*—diameter of the largest spherical particle that will pass through the filter cloth under laboratory conditions representing the maximum pore size. **E2814**

micron retention, nominal, *n*—subject to user definition, an indication of the average pore size of the filter cloth. **E2814**

DISCUSSION—The nominal rating may refer to: (1) the glass bead or particle size the filter cloth will retain 90 % of by weight; (2) the bubble point pore size when the tenth bubble location appears; or (3) the degree of filtration achieved under specific process conditions such as operating pressure, concentration of contaminant, and the buildup of filter cake, such that 94 % to 98 % of all particles of the nominal value will be retained after a given working period.

mill grade wire cloth, *n*—wire cloth meeting a group of specifications that are typical for milling grain and other light screening, manufactured based on using a different wire diameter for each of the common mesh designations. **E2016**

DISCUSSION—“Mill Grade” designations are often misused; and should not be specified without a wire diameter, as the designations have become non-standard.

near size particle, *n*—a particle of a size approximately equal to the aperture size of the sieve that may block an opening.

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. **E161**

non standard frames (wire cloth), *n*—sieve frames other than as specified in accordance with Table 2 of Specification **E11** that may be circular, square, rectangular, or non-metal.

DISCUSSION—The frame may have the sieve cloth permanently attached, or it may be designed so the sieve cloth is removable.

pan (also collection pan), *n*—a device that collects all of the material that has passed the sieving process.

particle size analysis, *n*—the process by which the particle size distribution is determined.

particle size distribution, *n*—*in sieve analysis*, the percentages, by mass or number, of all fractions into which various sizes of particles are classified.

percent open area, *n*—the ratio of the area of the openings to the total area expressed as a percentage, that theoretically can be calculated as follows for wire cloth:

$$OA = (1 - M_w D_w)(1 - M_s D_s)(100)$$

where:

OA = the percent open area,
 M_w = the mesh warp,
 M_s = the mesh shute,
 D_w = the diameter warp wire, and
 D_s = the diameter shute wire.

E2016

DISCUSSION—Because of the irregular triangular-shaped opening formed at an angle to the plane of the filter cloth surface, the percent open area is generally not a specified parameter. **E2814**

percent passing, *n*—mass fraction percentage of material that has passed through the sieve after the test has been performed.

percent retained, *n*—mass fraction percentage of material that is left upon or retained by the sieve after the test has been performed. **E2427**

percolation path fitting particle diameter, *n*—the maximum pore diameter based on the percolation path geometric pore size analysis. **E3278**

DISCUSSION—This diameter can be generated using the PoroDict module in the software GeoDict (see 4.2.2), and which results have been shown to correspond to the results of glass bead testing (see Specification **E2814**, Table 1).

perforated pattern, *n*—the pattern that the perforations are arranged in, usually in a staggered pattern with midpoints nominally at the vertices of isosceles triangles or square patterns arranged in line with their midpoints nominally at the vertices of squares. **E454**

plain weave, *n*—see **types of weaves**, *plain*.

pore size, *n*—the maximum equivalent spherical diameter of an opening in the filter cloth. **E3278**

pore size calculation factor (CF), *n*—a factor calculated using the hydraulic diameter bubble point pressure and the percolation path fitting particle diameter. **E3278**

DISCUSSION—This factor can be generated using the PoroDict module in the software GeoDict (see 4.2.2), and is used to calculate the pore size from the bubble point pressure.

porosity, *n*—ratio of the void volume to the total volume. **E1638**

precrimp, *n*—wire cloth woven with both the warp and shute wires crimped before weaving. **E11, E2016**

rectangular (off-count) mesh, *n*—either precrimp or double crimp wire cloth having a different number of wires in the