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Standard Terminology Relating to Sieves, Sieving Methods, and Screening Media[1]

This standard is issued under the fixed designation E1638; 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.

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.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

E161 Specification for Precision Electroformed Sieves

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 Sieves

E2589 Terminology Relating to Nonsieving Methods of Powder Characterization

E2814 Guide for Industrial Woven Wire Filter Cloth

3. Terminology

3.1 *Definitions:*

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

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

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

[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.

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

bubble point test, *n*—capillary flow bubble point methods are based on the fact that the pressure required to force an air bubble through filter cloth wetted under a test liquid of known surface tension is inversely proportional to the pore size. **E2814**

DISCUSSION—The pressure observed at the first bubble location is considered the absolute micron retention rating.

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**

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**

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**

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. With the exception of reverse 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. **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*.

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**

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.

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.

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**

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**

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**

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**

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. **E1638**

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**

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

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. **E11**

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

pan (also **collection pan),** *n*—a device that collects all of the material that has passed the sieving process, typically used on the bottom of the sieve stack. **E161, E2427**

particle size analysis, *n*—the process by which the particle size distribution is determined. **E1638**

particle size distribution, *n—in sieve analysis*, the percentages, by mass or number, of all fractions into which various sizes of particles are classified. **E1638**

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 passes through the sieve after the test has been performed. **E1638**

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

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*.

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

rectangular (off-count) mesh, *n*—Either precrimp or double crimp wire cloth having a different number of wires in the warp and shute, producing rectangular openings; the diameter of the warp and shute wires may be the same or different. **E2016**

representative sample, *n*—a sample taken from a quantity of material that exhibits the characteristics of the original material from which it was taken. **E1638**

screen, *n*—(*1*) surface provided with apertures of uniform size and shape; (*2*) another term used interchangeably for woven wire cloth; (*3*) a machine provided with one or more screen surfaces. **E674, E2016**

screening, *v*—process of separating a mixture of different sizes by means of one or more screen surfaces. **E454, E674**

selvage, *n*—the edge or border of wire cloth finished off so as to prevent unraveling; examples of finished edges include looped selvage, folded selvage, cut and tucked, welded, plastic bonded, and bent-back picket, as opposed to a raw or cut edge. **E2016**

shute wires, *n*—the wires running the short way of, or across the cloth as woven (also referred to as the shoot, fill, or weft wires). **E2016**

sieve, *n*—an apparatus consisting of a media with regularly spaced apertures of uniform size, mounted in a suitable frame or holder, for use in separating material according to size. **E11, E1638**

sieve analysis, *n*—the act of obtaining a particle size distribution using test sieves. **E1638**

sieve cloth, *n*—woven wire cloth conforming to Specification E11. **E11**

sieve shaker, *n*—the mechanical device or method used to shake the sieves, excluding hand sieving. **E2427**

sleaziness, *n*—wire cloth that does not exhibit firmness. **E11, E2016**

smooth side or punch side, *n*—the surface of the plate that was the uppermost during the punching operation and through which the punch entered the plate. **E454, E674**

space cloth, *n*—wire cloth that is designated by the width of the open spaces between the inside faces of adjacent parallel wires, expressed in inches or the metric equivalent. **E2016**

square mesh, *n*—wire cloth having the same number of wires in both the warp and shute. **E11, E2016**

support grid, *n*—conductive metal grid mounted to the sieve sheet. **E161**

test sample, *n*—a quantity of material required for use directly in a testing procedure. **E1638**

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. **E161**

test sieve (perforated plate), *n*—a sieve manufactured by mounting perforated plate in a frame, designed for use in particle size analysis by sieving. **E161**

test sieve (wire cloth), *n*—a sieve manufactured by mounting sieve cloth in a frame, designed for use in particle size analysis by sieving. **E11**

triple shute, *n*—wire cloth woven with three shute wires inserted adjacent to each other, often constructed in conformance with precrimp rectangular. **E2016**

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

types of weaves—

double warp, n—filter cloth (either plain or twill) in which two warp wires are used instead of one for each warp pitch thus reducing the micron retention of a similar regular single-warp wire specification. **E2814**

herringbone twill, n—wire cloth in which the direction of a twilled weave is reversed at regular intervals to produce a striped or herringbone effect. **E2016**

plain, n—wire cloth in which the warp wires and shute wires pass over one and under one wire in both directions. **E11, E2016**

reverse weave, n—filter cloth in which the warp and shute wires are woven in a reverse configuration; not covered within Guide E2814. **E2814**

twill, n—wire cloth in which the warp wires and shute wires pass over two and under two wires in both directions. **E11, E2016**

unfinished end pattern, *n*—the condition that occurs with some specifications of staggered pattern perforations as a result of tool design. **E454, E674**

DISCUSSION—One end of the plate the pattern will appear to be incomplete due to unperforated holes in the even numbered rows. While on the other end of the same plate, the pattern will appear to be incomplete due to unperforated holes in the odd numbered rows.

warp wires, *n*—the wires running the long way of the cloth as woven. **E11, E2016**

weight per unit area, *n*—the weight per square foot for wire cloth can be approximated (without consideration for crimp) by the following equation: **E2016**

$$Wt/SqFt = \left(12\,M_w\left(12\pi\left(D_w^2/4\right)\rho\right)\right) + \left(12\,M_s\left(12\pi\left(D_s^2/4\right)\rho\right)\right)$$

where:

$Wt/SqFt$ = the weight (lb) per square foot,
M_w = the mesh warp,
M_s = the mesh shute;
D_w = the diameter warp wire,
D_s = the diameter shute wire,
ρ = the density of material (lb/in^3) (0.2836 for plain or carbon steel), and
π = the constant 3.1416.

which for square mesh wire cloth with the same wire diameter in both the warp and shute reduces to:

$$Wt/SqFt = 72\pi\rho MD^2$$

where:

Wt/SqFt = the weight (lb) per square foot,
M = the mesh, and
D = the diameter wire (in decimal parts of an inch).

width opening, *n*—distance between two parallel adjacent warp or shute wires, measured in the projected plane. **E2016**

$$Opn = (1/M) - D$$

where:

Opn = the width opening (in decimal parts of an inch),
M = the mesh, and
D = the diameter wire (in decimal parts of an inch).

4. Keywords

4.1 particle measurement; particle size; particles; particulate; screen; screening; sieve; sieve analysis; standard testing sieve