Designation: E2814 – 11

Standard Guide for Industrial Woven Wire Filter Cloth[1]

This standard is issued under the fixed designation E2814; 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

Industrial metal filter cloth is a special type of woven wire cloth that can be produced in many specifications, often proprietary in nature. Sometimes referred to as Dutch weave or Hollander weave, filter cloth can be woven in a variety of metals and is woven with a greater number of wires in one direction than the other, and utilizing two different wire diameters. This guide covers woven wire filter cloth for industrial use, which is commonly rated by its micron retention capability. Its purpose is to introduce standard terms and definitions, to observe common technical considerations that a user should be aware of, and to present a mathematical model that can be used to predict the micron retention of a filter cloth specification. It should be noted this guide excludes standard industrial woven wire cloth and sieve cloth from its scope, since these are covered under Specifications E2016 and E11, respectively, as well as excludes plastic and synthetic filter cloth.

1. Scope

1.1 This guide covers the special grade of industrial woven wire cloth, referred to as filter cloth, for general filtration including the separation of solids from fluids (liquids or gases), based on a desired particle size retention. Filter cloth can be made of any primary metal or metal alloy wire that is suitable for weaving.

1.2 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.

1.3 *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:*[2]

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

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

E2016 Specification for Industrial Woven Wire Cloth

F316 Test Methods for Pore Size Characteristics of Membrane Filters by Bubble Point and Mean Flow Pore Test

2.2 *SAE Standards:*[3]

ARP901 Bubble-Point Test Method

3. Terminology

3.1 *Definitions:*

3.1.1 For additional terminology, refer to Terminology E1638.

3.1.2 *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.

3.1.2.1 *Discussion*—The pressure observed at the first bubble location is considered the absolute micron retention rating (see Test Method F316).

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

3.1.4 *crimp, n*—corrugation in the warp and shute wires.

3.1.4.1 *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

[1] This guide 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.

Current edition approved April 1, 2011. Published July 2011. DOI: 10.1520/E2814-11.

[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.

[3] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

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.

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

3.1.5.1 *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.

3.1.6 *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.

3.1.6.1 *Discussion*—The largest bead passed is considered the absolute micron retention rating.

3.1.7 *mesh, n*—number of wires or openings per linear inch or 25.4 mm counted from the center of any wire to a point exactly 1 in. or 25.4 mm distant, including the fractional distance between either thereof.

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

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

3.1.10 *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.

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

3.1.11.1 *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.

3.1.12 *percent open area, n*—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.

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

3.1.14 *types of weaves, n*—

3.1.14.1 *double warp, adj*—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 (see Fig. 1).

3.1.14.2 *plain, adj*—filter cloth in which the shute wires pass over one and under one warp wire (see Fig. 2).

3.1.14.3 *reverse weave, adj*—filter cloth in which the warp and shute wires are woven in a reverse configuration; not covered within this guide (see Fig. 3).

3.1.14.4 *twill, adj*—filter cloth in which the shute wires pass over two and under two wires (see Fig. 4).

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

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

$$Wt/ft^2 = \left[12 M_w \left(12\pi \left(D_w^{\,2}/4\right)\rho\right)\right] + \left[12 M_s \left(12\pi \left(D_s^{\,2}/4\right)\rho\right)\right] \quad (1)$$

where:

Wt/ft^2 = weight (lb) per square foot,
M_w = mesh warp,
M_s = mesh shute,
D_w = diameter warp wire,
D_s = diameter shute wire,
ρ = density of material (lb/in.^{3}) (0.2836 for stainless steel 304),
π = constant 3.1416.

3.1.16.1 *Discussion*—The theoretical mass per unit area can be similarly calculated with SI units or an approximate multiplier factor of 4.8824 can be used to obtain kilograms per square metre.

3.1.17 *wire diameter, n*—wire diameter shall be expressed in decimal parts of an inch or the metric equivalent.

4. Significance and Use

4.1 Industrial filter cloth is a specialized product that can be manufactured in many specifications. The purpose of this guide is to (*1*) introduce standard terms and definitions associated with wire filter cloth, (*2*) observe common technical considerations that a user should be aware of, and (*3*) present a mathematical model that can be used to predict the micron

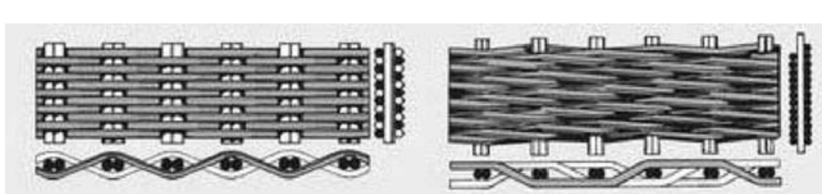

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FIG. 1 Double Warp Plain and Double Warp Twill Weave

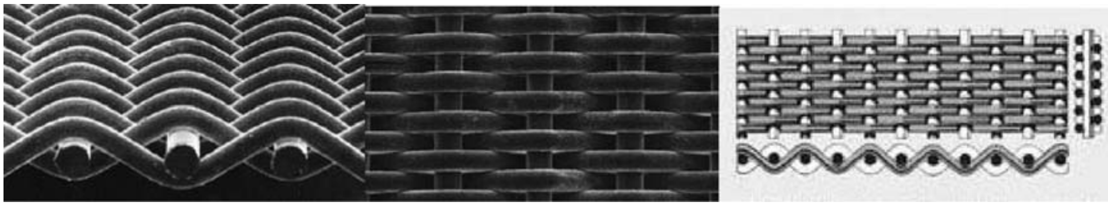

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FIG. 2 Plain Weave

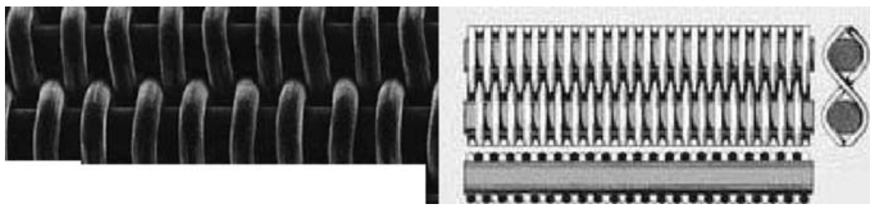

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FIG. 3 Reverse Plain Weave

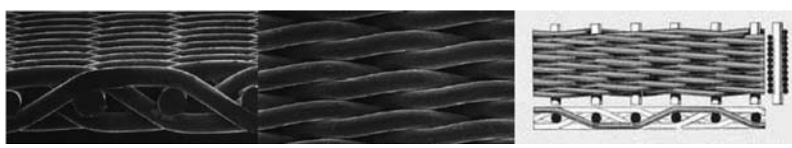

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FIG. 4 Twill Weave

retention of a filter cloth specification. As often numerous specifications may be developed to result in a common micron retention by varying the weave type, mesh count, and wire diameters, it is recommended that the user consult with their filter cloth supplier regarding specific filter cloth specifications of interest and include in their discussions durability, pressure drop, and cleaning capability requirements. The purpose of this guide is not to suggest a limited selection of specifications.

4.2 The micron retention of a filter cloth specification can be mathematically modeled as well as determined by the use of a glass bead test or the bubble-point test method or both depending on the degree of fineness. Typical standard bubble-point test methods (porometry) include Test Methods F316 and SAE ARP901.

5. Filter Cloth Specifications

5.1 Filter cloth is woven in a variation of sometimes proprietary parameters based on often common nominal mesh count specifications. This is due to minor variations in mesh count and wire diameters used to affect micron retention, porosity, and other factors related to specific operating conditions, as well as possibly for manufacturing convenience. Therefore, it is not appropriate to provide a comprehensive table of common filter specifications stating construction requirements and resulting parameters. Instead, a mathematical model is presented that can be used to predict the micron retention or separation particle size of any filter cloth specification a user and producer wish to develop.

5.2 This mathematical model is presented by Reiner Tittel and Rolf Berndt[4] with further conclusions by Denis Blackmore (see Appendix X1). The model assumes rigid, spherical particles that pass through various planes or cross sections of the filter cloth created by shute wires stretched around warp wires and positioned geometrically adjacent to one another. The separation particle size is determined for the applicable geometric plane based on the weave type and specification ratios.

5.3 While five geometric planes of the filter cloth are considered (three of interest as the outer two are symmetrical), Plane 3, designated the geometric middle plane of the filter cloth, is the primary plane of interest. Accordingly, the separation particle size (dTr_3) is determined for plain weave with warp wire to shute wire diameter ratios within the range 1.00 to 1.50 (see Annex A1). For twill weave with warp pitch to warp wire diameter ratios greater than 3.22, Plane 2 is considered and the separation particle size (dTr_2) is determined. For the calculation of dTr_2, Blackmore concludes that for the equated Tittel and Berndt equations, the coordinate origin ratio (t/t_1) and the geometric dimension (x) can both be expressed as a function of the warp-to-shute-wire diameters (b) (see Annex A2). The model is not applicable for reverse weave filter cloth.

5.4 A selection of typical woven wire filter cloth specifications are presented with their particle size retentions as determined by the Tittel and Berndt model in conjunction with

[4] Tittel, R. and Berndt, R., "Zur bestimmung der trennteilchengr ße von filtergeweben," *Faserforschung und Textiltechnik* , Vol 24, 1973, pp. 505–510.