



Standard Guide for Determining the Mean Darcy Permeability Coefficient for a Porous Tissue Scaffold¹

This standard is issued under the fixed designation F2952; 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 guide describes test methods suitable for determining the mean Darcy permeability coefficient for a porous tissue scaffold, which is a measure of the rate at which a fluid, typically air or water, flows through it in response to an applied pressure gradient. This information can be used to optimize the structure of tissue scaffolds, to develop a consistent manufacturing process, and for quality assurance purposes.

1.2 The method is generally non-destructive and non-contaminating.

1.3 The method is not suitable for structures that are easily deformed or damaged. Some experimentation is usually required to assess the suitability of permeability testing for a particular material/structure and to optimize the experimental conditions.

1.4 Measures of permeability should not be considered as definitive metrics of the structure of porous tissue scaffolds and should complement measures obtained by other investigative techniques e.g., scanning electron microscopy, gas flow porometry and micro-computer x-ray tomography (ASTM F2450).

1.5 *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

D4525 Test Method for Permeability of Rocks by Flowing Air

F2450 Guide for Assessing Microstructure of Polymeric Scaffolds for Use in Tissue-Engineered Medical Products

F2603 Guide for Interpreting Images of Polymeric Tissue Scaffolds

2.2 *American Petroleum Institute (API) Document:*³

RP-27 Recommended Practice for Determining Permeability of Porous Media

3. Terminology

3.1 *Definitions:*

3.1.1 *tortuosity, n* —the ratio of the actual path length through connected pores to the Euclidean distance (shortest linear distance).

4. Significance and Use

4.1 This document describes the basic principles that need to be followed to obtain a mean value of the Darcy permeability coefficient for structures that consist of a series of interconnected voids or pores. The coefficient is a measure of the permeability of the structure to fluid flowing through it that is driven by a pressure gradient created across it.

4.2 The technique is not sensitive to the presence of closed or blind-end pores (Fig. 1).

4.3 Values of the permeability coefficient can be used to compare the consistency of manufactured samples or to determine what the effect of changing one or more manufacturing settings has on permeability. They can also be used to assess the homogeneity and anisotropy of tissue scaffolds. Variability in the permeability coefficient can also be indicative of:

4.3.1 Internal damage within the sample e.g., cracking or permanent deformation.

4.3.2 The presence of large voids, including trapped air bubbles, within the structure.

4.3.3 Surface effects such as a skin formed during manufacture.

4.3.4 Variable sample geometry.

4.4 This test method is based on the assumption that the flow rate through a given sample subjected to an applied pressure gradient is constant with time.

NOTE 1—If a steady state flow condition isn't reached, then this could

¹ This test method is under the jurisdiction of ASTM Committee F04 on Medical and Surgical Materials and Devices and is the direct responsibility of Subcommittee F04.42 on Biomaterials and Biomolecules for TEMPs.

Current edition approved March 1, 2014. Published April 2014. DOI: 10.1520/F2952-14.

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 American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, <http://www.api.org>.