



Designation: F1819 – 24

Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Synthetic Blood Using a Mechanical Pressure Technique¹

This standard is issued under the fixed designation F1819; 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

Workers, primarily those in the healthcare profession, involved in treating and caring for individuals injured or sick, can be exposed to biological liquids capable of transmitting disease. These diseases, which may be caused by a variety of microorganisms, can pose significant risks to life and health. This is especially true of blood-borne viruses which cause Hepatitis (Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV)) and acquired immune deficiency syndrome (AIDS) (human immunodeficiency viruses (HIV)). Since engineering controls cannot eliminate all possible exposures, attention is placed on reducing the potential for direct skin contact through the use of protective clothing that resists penetration (29 CFR Part 1910.1030). This test method was developed to help assess the effectiveness of materials used in protective clothing for protecting the wearer against contact with body fluids that potentially contain blood-borne pathogens. Using synthetic blood, this test method is intended to determine the amount of mechanical pressure that will cause penetration of a liquid through a material used in protective clothing.

1. Scope

1.1 This test method is used to evaluate the resistance of materials used in protective clothing to synthetic blood under the conditions of liquid contact and increasing direct mechanical pressure. The penetration resistance of protective clothing is based on visual detection of synthetic blood penetration at a specific applied mechanical pressure.

1.2 This test method does not apply to all forms or conditions of blood-borne pathogen exposure. Users of the test method must review modes for work/clothing exposure and assess the appropriateness of this test method for their specific application.

1.3 This test method addresses only the performance of materials or certain material constructions (for example, seams) used in protective clothing. This test method does not address the design, overall construction, components, or interfaces of garments, or other factors which may affect the overall protection offered by the protective clothing.

¹ This test method is under the jurisdiction of ASTM Committee F23 on Personal Protective Clothing and Equipment and is the direct responsibility of Subcommittee F23.40 on Biological.

Current edition approved Nov. 1, 2024. Published November 2024. Originally approved in 1997. Last previous edition approved in 2019 as F1819 – 19. DOI: 10.1520/F1819-24.

1.4 The values in SI units or in other units shall be regarded separately as standard. The values stated in each system must be used independently of the other, without combining values in any way.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *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

D1331 Test Methods for Surface and Interfacial Tension of Solutions of Paints, Solvents, Solutions of Surface-Active Agents, and Related Materials

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

D1777 Test Method for Thickness of Textile Materials
D3776/D3776M Test Methods for Mass Per Unit Area (Weight) of Fabric
E105 Guide for Probability Sampling of Materials
E171/E171M Practice for Conditioning and Testing Flexible Barrier Packaging
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
F1494 Terminology Relating to Protective Clothing
F1670/F1670M Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Synthetic Blood
F1671/F1671M Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration as a Test System

2.2 ANSI/ASQC Standards:³

ANSI/ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes

2.3 ISO Standard:⁴

ISO 2859-1 Sampling Plans for Inspection by Attributes

2.4 Military Standard:⁵

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

2.5 OSHA Standard:⁶

CFR Part 1910.1030 Occupational Exposure to Blood-Borne Pathogens: Final Rule, *Federal Register*, Vol 56, No 235, Dec. 6, 1991, pp. 64175–64182.

3. Terminology

3.1 Definitions:

3.1.1 blood-borne pathogen, *n*—an infectious bacterium, virus, or other disease-inducing microbe carried in blood or other potentially infectious body fluids.

3.1.2 body fluid, *n*—any liquid produced, secreted, or excreted by the human body.

3.1.2.1 Discussion—In this test method, body fluids include those liquids potentially infected with blood-borne pathogens, including, but not limited to: blood, semen, vaginal secretions, cerebrospinal fluid, synovial fluid and peritoneal fluid, amniotic fluid, saliva in dental procedures, and any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids (see 29 CFR Part 1910.1030).

3.1.3 body fluid simulant, *n*—a liquid which is used to act as a model for human body fluids.

³ Available from American Society for Quality (ASQ), 600 N. Plankinton Ave., Milwaukee, WI 53203, <http://www.asq.org>.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

⁶ Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

3.1.4 hydrostatic pressure, *n*—the force exerted by a static liquid (1).⁷

3.1.5 mechanical pressure, *n*—the force exerted by one solid object upon another that it is touching (1).

3.1.6 penetration, *n*—the movement of matter through closures, porous materials, seams, and pinholes or other imperfections in protective clothing on a nonmolecular level.

3.1.6.1 Discussion—For this test method, the specific matter is synthetic blood.

3.1.7 protective clothing, *n*—an item of clothing that is specifically designed and constructed for the intended purpose of isolating all or part of the body from a potential hazard; or, isolating the external environment from contamination by the wearer of the clothing.

3.1.7.1 Discussion—In this test method, the potential hazard of contact with blood or other body fluids is simulated.

3.1.8 synthetic blood, *n*—a mixture of a red dye/surfactant, thickening agent, and distilled water having a surface tension and viscosity representative of blood and some other body fluids, and the color of blood.

3.1.8.1 Discussion—The synthetic blood in this test method does not simulate all of the characteristics of real blood or body fluids, for example, polarity (a wetting characteristic), coagulation, content of cell matter.

3.1.9 For definitions of other protective clothing-related terms used in this test method, refer to Terminology **F1494**.

4. Summary of Test Method

4.1 Using a special test apparatus, a specimen is contacted with synthetic blood under a continuously increasing mechanical pressure until the synthetic blood penetrates the specimen or a load of 90.7 kg (200 lb) is applied to a 57.2 mm (2.25 in.) diameter portion of the specimen achieving a pressure on the tested specimen of 345 kPa (50 psig).

4.2 The specimen's non-contact side is observed to determine if visual penetration occurs, and if so, at what mechanical pressure the penetration occurs.

4.3 In conducting a test, the cover plate containing a test head is locked on the two side supports of the base plate of the test apparatus, the multi-position switch is turned to the MANUAL UP position, and the test button on top of the control box is held down until visible penetration of the test specimen by synthetic blood is observed through the circular test head. Releasing the button stops the drive motor, and the penetration pressure is shown digitally on the display unit and recorded by the technician.

5. Significance and Use

5.1 This test method was modeled after a procedure commonly known as the Elbow Lean Test.⁸ The Elbow Lean Test involves the application of synthetic blood to an ink pad, placement of sample fabric over the blood-soaked pad, placement of a blotter over the sample fabric, and applying elbow or

⁷ The boldface numbers in parentheses refer to the list of references at the end of this standard.

⁸ Originally developed by W. L. Gore and Assoc. Inc., Elkton, MD 21921.