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Standard Test Method for Protective Clothing Material Resistance to Hypodermic Needle Puncture[1]

This standard is issued under the fixed designation F2878; 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

Occupational exposures to bloodborne pathogens (BBP) caused by needlestick injuries are a concern for healthcare professionals, law enforcement officers, first responders and others.

Transmission of diseases such as Human Immunodeficiency Virus (HIV) and Hepatitis C (Hep C) as a result of percutaneous needlestick injuries have been documented worldwide. These diseases can lead to life-long chronic health problems and possibly death.

Work practice safety procedures, including the use of personal protective equipment (PPE) such as gloves, aprons, and sleeves, are used to diminish the risk of occupational exposure to BBP's through needlestick injury.

The purpose of this standard is to measure relative hypodermic needle puncture resistance offered by various materials based on the conditions specified within the standard. This standard does not attempt to simulate all use conditions. A number of variables which impact puncture resistance are not addressed by this standard. For example, stiffness of backing materials, presence of lubricants, and tension on the specimen may all impact puncture resistance, but are not considered by this standard.

This standard defines three common hypodermic needles to evaluate puncture resistance. Through development of this standard, it has been observed that needle diameter has an effect on puncture resistance. Therefore needles of various diameters have been specified. Users of this method may specify testing with one or more of the needles defined within the standard.

The hypodermic needles referenced have been selected with consideration to three main points:

(*1*) As needle gauge increases the load required to puncture materials taken from commonly available hypodermic needle resistant PPE increases. The performance is not linear and therefore relatively large gauge (21 g) and small gauge (28 g) needles are provided to better understand a material's performance against one end of the spectrum or the other.

(*2*) Certain end-use applications are concerned with protection from either large gauge needles or small gauge needles. For example, police officers searching suspected intravenous drug users are most commonly at risk of injury from fine gauge needles (28 g), but not large gauge needles. Whereas, workers inoculating poultry on commercial farms may be concerned with large gauge needles (21 g), but not small gauge needles.

(*3*) Certain materials are optimized to resist either large gauge or small gauge needles and testing against the other would not be useful. Other materials may be engineered for resistance to the full breadth of the gauge spectrum. For example, in applications, such as healthcare, where a broad range of needle gauges are expected, testing against both ends of the spectrum allows for a better understanding of robustness.

[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 F23.20 on Physical.

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1. Scope

1.1 This test method is used to determine the force required to cause a sharp-edged puncture probe (hypodermic needle) to penetrate through protective clothing material. The standard describes three test probes that may be used: 21-, 25-, or 28-gauge needles.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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]

D1776 Practice for Conditioning and Testing Textiles
D1777 Test Method for Thickness of Textile Materials
D2000 Classification System for Rubber Products in Automotive Applications
D2582 Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting
E4 Practices for Force Verification of Testing Machines
F1342 Test Method for Protective Clothing Material Resistance to Puncture

3. Terminology

3.1 *Definitions:*

3.1.1 *protective clothing material, n*—any material or combination of materials used in an item of clothing for the purpose of isolating parts of the wearer's body from a potential hazard.

3.1.2 *hypodermic needle, n*—a hollow bore stainless steel cylinder with a beveled tip used to penetrate the skin by cutting; often used in conjunction with a syringe for injecting or withdrawing fluids.

4. Summary of Test Method

4.1 A material specimen is placed in a support assembly (see Fig. 1) that is affixed to the upper or lower arm, depending on machine configuration, of a tension testing machine. Some materials have different performance based on which face is presented toward the needle. Care should be taken when mounting to ensure the needle initiates puncture on the desired face. When reporting results include which side was facing the needle.

4.2 A pointed puncture probe of set dimensions is mounted to the penetrometer stand and the whole assembly is attached to the compression cell of the tension testing machine.

4.3 The puncture probe which is positioned perpendicular to the specimen is moved at a constant velocity until the tip of the probe perforates the backside of the material specimen.

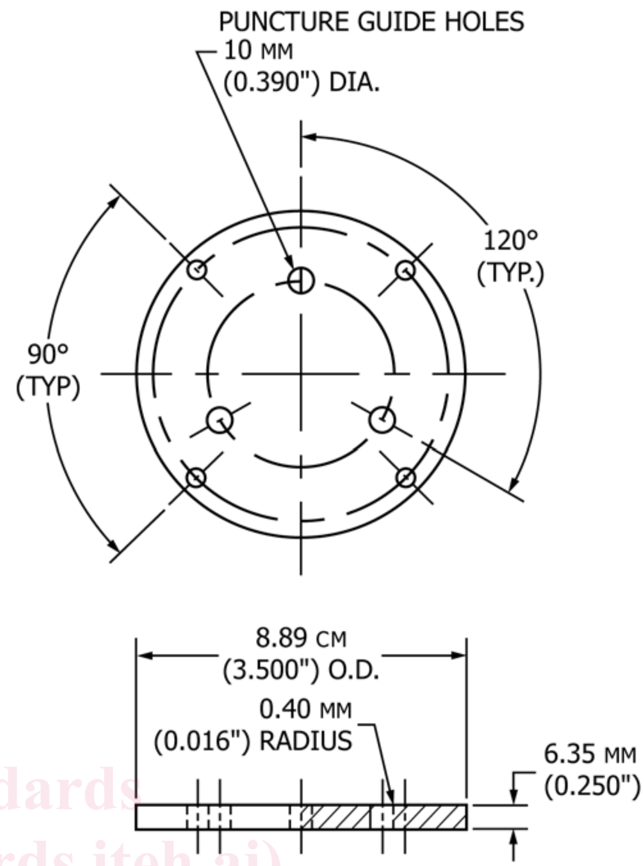

FIG. 1 Specimen Support Assembly (Two needed)

4.4 The maximum force required to puncture the material specimen is measured by the compression cell.

4.4.1 The average of twelve test replicates is reported as the puncture resistance.

5. Significance and Use

5.1 This test method evaluates puncture resistance of protective clothing materials which may include: plastics or elastomeric films, coated fabrics, flexible materials, laminates, leathers or textile materials.

5.1.1 This test method uses hypodermic needles with specified dimensions as puncture probes.

5.1.2 This test method evaluates puncture resistance of protective clothing materials, perpendicular to the material's surface and with no supporting structure under/behind the material specimen.

5.1.3 Evaluation of puncture resistance for snag-type puncture should be performed in accordance with Test Method D2582.

5.1.4 Evaluation of puncture resistance for non-cutting puncture should be performed in accordance with Test Method F1342.

6. Apparatus

6.1 *Thickness Gauge,* suitable for measuring thickness to the nearest 0.01 mm, as specified in Test Method D1777 shall be used to determine the thickness of each protective clothing specimen tested.

[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.