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Standard Guide for Personal Protective Equipment for the Handling of Flat Glass¹

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1. Scope

1.1 This guide covers the minimum requirements for proper personal protective equipment (PPE) for the safe handling of flat glass.

1.2 *Purpose*—When engineering, administrative, and work practice controls are not feasible, the remaining hazard must be controlled with personal protective equipment (PPE). This guide will provide direction on what PPE should be utilized. Following this guidance will help to minimize the possibility or severity of injuries, or both, to personnel while working with or in the vicinity of flat glass.

1.3 Nothing in this guide shall be interpreted as requiring any action that violates any statute or requirement of any federal, state, or other regulatory agency.

1.4 This guide may be used by employers and employees. The required PPE shall be evaluated on a regular basis to determine suitability.

1.5 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.6 *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.*

1.7 *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.*

¹ This guide is under the jurisdiction of ASTM Committee E34 on Occupational Health and Safety and is the direct responsibility of Subcommittee E34.10 on Industrial Safety.

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2. Referenced Documents

2.1 *ASTM Standards*:²

C162 Terminology of Glass and Glass Products

E1542 Terminology Relating to Occupational Health and Safety

F1494 Terminology Relating to Protective Clothing

F1790 Test Method for Measuring Cut Resistance of Materials Used in Protective Clothing with CPP Test Equipment

2.2 *Other Standards*:

ANSI/ISEA 105 American National Standard for Hand Protection Selection Criteria³

EN 388 Protective Gloves Giving Protection from Mechanical Risks⁴

3. Terminology

3.1 *Definitions*—For additional definitions and terms relating to this guide, please refer to Terminologies C162, E1542, and F1494.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *flat glass, n*—general term covering glass in its annealed state, such as sheet glass, lite of glass, float glass, various forms of rolled glass, and raw products derived from glass.

3.2.1.1 *Discussion*—This definition is not intended to apply to heat-tempered or laminated glass products. With heat-tempered or laminated glass products, defer to your local risk assessment.

3.2.2 *lite, n*—another term for a pane or piece of glass. Sometimes spelled “light” in the industry literature, but spelled “lite” in this text to avoid confusion with light as in “visible light.”

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 the International Safety Equipment Association, 1901 N. Moore St., Arlington, VA 22209-1762.

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

4. Significance and Use

4.1 The goal of this guide is to aid in the selection of PPE for the handling of glass that will best protect the affected employee from the remaining hazards identified in the local hazard assessment process.

4.2 This guide assumes that a proper hazard assessment has been conducted, the hazards have been mitigated to the greatest extent possible by non-PPE means (engineering, administrative, or work practice controls), and a hazard still exists that can only feasibly be controlled by the use of PPE.

5. Level of Cut Protection

5.1 Cut-resistant clothing (gloves and body protection) is evaluated primarily by two standards: Test Method **F1790** and EN 388.

NOTE 1—The two standards are not interchangeable and need to be distinguished as to their unique testing outcomes.

NOTE 2—Cut ratings are a starting point for selecting the proper PPE. In general terms, a higher cut level means better cut protection, but that is not always the case. There will be some tasks where a “thicker” material with a lower level of cut protection may actually protect better than a “thinner” material with a higher level of cut protection. Introducing a change (process, job, equipment, etc.) or new PPE for a task should include the proper assessment and trials to ensure the garment does indeed get the desired result.

5.2 In Test Method **F1790**, cut-resistant material is evaluated. The process of evaluation or cut protection performance test (CPPT) involves the amount of pressure or gram weight applied to a razor blade while moving the blade over the fabric without cutting through for at least 20 mm [0.8 in.]. The higher the load in gram weight applied to the blade without cut-through for the prescribed distance of travel, the better the cut resistance of the fabric. This result is termed the cut or rating force of the fabric. Test Method **F1790** cut or rating force levels are listed in **Table 1**.

5.3 In EN 388 or the Couptest, cut-resistant material is evaluated. The process of the evaluation involves a constant weight on a circular blade that is moved back and forth across a test specimen by the test machine. The machine (Couptest) also rotates the blade against the direction that it is being moved, which intensifies the slicing action. The test indicates how many repetitive cuts on the same position are needed to cut through. The result of the test is termed the cut index, which informs of how much better the sample resists cut as compared to a reference cotton fabric. A performance level for the material is ranked from 0 to 5. The higher the number of cycles needed to cut through the material, the greater the cut resistance of the fabric. The EN 388 cut index levels are listed in **Table 2**.

TABLE 1 ANSI/ISEA 105 Cut Performance Levels

Performance	Weight in Grams ^A
0	0–199
1	200–499
2	500–999
3	1000–1499
4	1500–3499
5	3500–

^A 1 g = 0.035 oz.

TABLE 2 EN 388 Cut Performance Levels

Performance	Average Cut Index
1	1.2–2.4
2	2.5–4.9
3	5.0–9.9
4	10.0–19.9
5	20–

5.4 Primary fabrics that are available to meet the needs and demands of cut resistance are:

5.4.1 *Aramid Fibers*—Aramid fibers are a class of heat-resistant and strong synthetic fibers. They are used in aerospace and military applications, for ballistics-rated body armor fabric, and as an asbestos substitute. The name is a shortened form of aromatic polyamide. They are fibers in which the chain molecules are highly oriented along the fiber axis so the strength of the chemical bond can be exploited.

5.4.2 *High-Density Polyethylene Fibers*—Ultra-high molecular weight polyethylene (UHMWPE), also known as high-modulus polyethylene (HMPE) or high-performance polyethylene (HPPE), is a subset of the thermoplastic polyethylene. It has extremely long chains, with molecular weight numbering in the millions, usually between 2 and 6 million. The longer chain serves to transfer load more effectively to the polymer backbone by strengthening intermolecular interactions. The result is a very tough material, with the highest impact strength of any thermoplastic presently made. It is highly resistant to corrosive chemicals with the exception of oxidizing acids. It has extremely low moisture absorption and is highly resistant to abrasion (15 times more resistant to abrasion than carbon steel).

5.4.3 *Composite or Engineered Yarns*—Composite or engineered yarns consist of two or more components. These yarns are constructed to offer a higher level of cut resistance (ASTM Level 3 and above). The addition of a steel or fiberglass core with a fiber wrapped around it allows for a greater rating force than a singular component standing alone. Features of such combinations are strength, hardness, lubricity or slickness, and rolling action (knit construction theoretically creating a ball-bearing effect as the blade meets the knitted fabric). These features increase the rating force to Levels 3 and above on the ASTM scale.

NOTE 3—Test Method **F1790** CPPT tests for cut resistance only.

NOTE 4—The EN 388 test results in **Table 2** describe more than cut resistance. The test also describes puncture, tear and abrasion of the fabric, or physical and mechanical aggressions.

5.5 Working conditions will differ when examining the available cut-resistant fabrics currently on the market. Essentially, the differences are as follows:

5.5.1 *Para-Aramids:*

5.5.1.1 Natural and indoor light will reduce the “out of the box” cut level;

5.5.1.2 Laundering with bleach will nullify the cut level of para-aramids;

5.5.1.3 Para-aramids will abrade more rapidly than HPPE; and

5.5.1.4 Para-aramids are best for uses in which thermal issues exist.

5.5.2 *HPPE:*