
American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways – Safety Standard

Standard
ANSI/SAE Z26.1-1996

**Approved by American National Standards Institute
(August 11, 1997)**

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ANSI/SAE Z26.1-1996**

**Approved by American National Standards Institute
(August 11, 1997)**

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Foreword

(This foreword is not part of American National Safety Standard Z26.1-1996.)

The American National Standard Safety Standard, Z26.1-1938, was developed by a sectional committee, national in scope, functioning under the procedure of the American National Standards Association and under the joint sponsorship of the National Bureau of Casualty and Surety Underwriters (now the American Insurance Association) and the National Bureau of Standards. It was the first of several separate standards to be developed within the scope of Standards Committee Z26 on Specifications and Methods of Test for Safety Glazing Materials. That scope is as follows:

Specifications and methods of test for safety glazing material (glazing material designed to promote safety and reduce or minimize the likelihood of personal injury from flying glazing material when the glazing material is broken) as used for windshields, windows, and partitions of land and marine vehicles and aircraft.

Since the original formulation of the American National Safety Standard, Z26.1-1938, the development of synthetic plastic materials has so far advanced that a number of them appear to be practical for certain uses as safety glazing materials for glazing motor vehicles operating on land highways; therefore, in the 1966 edition of this standard the foreword and code were modified to the extent necessary to include these synthetic plastic materials along with glass under the general term of "safety glazing materials" reserving the use of the word "glass" as applying only to the ceramic material, and of the word "plastic" as applying only to synthetic, organic, plastic materials.

Early in its deliberations, the Z26 Committee recognized the fact that no one set of specifications or methods of test could well apply to safety glazing materials as used for all purposes. Therefore, the members decided to prepare a separate standard for each of the major usages included in the scope of the main project. In keeping with that decision, this standard, as its title indicates, pertains only to "Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways." Such motor vehicles and motor vehicle equipment shall include passenger cars, multipurpose passenger vehicles, trucks, buses, motorcycles, slide-in campers, pickup covers designed to carry persons while in motion, motorhomes, and trailers.

It is hoped that the test procedures and performance requirements detailed in this standard may be uniformly adopted by motor vehicle commissioners and other interested regulatory officials as the basis for their approval of the safety glazing materials in motor vehicles and motor vehicle equipment coming within their jurisdiction, or for incorporation in their regulations; that they may serve as a guide to automobile manufacturers as to the safety glazing materials which will be acceptable to such officials; and that they may enable the consumer (the commercial operator and the general public) to have assurance that the safety glazing materials in the motor vehicle that is purchased should reduce, in comparison with glazing of ordinary types, the likelihood of injury to persons riding in such motor vehicles and motor vehicle equipment by these safety glazing materials whether they may be broken or unbroken.

It is the fundamental purpose of this standard to prescribe the functional properties of safety glazing materials in such a manner that they can be used in any place in motor vehicles and motor vehicle equipment for which they possess those mechanical or optical properties, or both, that are requisite and appropriate. For example, safety glazing materials for windshields must pass a specified group of test requirements, all of which currently can be met only by certain laminated safety glazing; however, if and when other safety glazing materials are developed which possess properties such that they, too, fulfill the requirements of the prescribed tests for this location, they may also be used; and similar reasoning would apply for other locations. This standard is designed to serve two purposes: (1) to afford a basis for standards for adoption in regulations by governmental regulatory bodies; or (2) for use by motor vehicle commissioners or others as reference standards in such cases as they may have discretionary authority to adopt these or other standards in connection with the approval of safety glazing materials or other items of use in or on motor vehicle equipment.

This standard does not state that safety glazing materials shall be used or to what extent they shall be used in glazing motor vehicles and motor vehicle equipment. Such requirements rest with either the legislative or administrative authority. When by law or regulation escape or emergency egress openings are required and when such requirement is met by use of glazed openings, Test 25 (see 5.25) is provided as a means of measuring and establishing the escape value of the safety glazing material.

This standard, which is the result of extended and careful consideration of available knowledge and experience on the subject, is intended to provide minimum requirements that are recommended for use, adoption, and enforcement by federal, state, and local administrative authorities.

Caution should be exercised not to make laws and regulations dealing with this subject so inflexible as to preclude subsequent adoption of technological advancements in the development of safety glazing materials.

Except for special requirements for specified locations, safety glazing materials of seven general types can meet some or all requirements detailed in this standard. All seven types are commercially feasible today. Each of them possesses its own distinctive safety characteristics. The seven types are listed below and are described in Section 1.

- (1) Laminated Glass

(2) Glass-Plastic Glazing Material

(3) Tempered Glass

(4) Plastic
- (5) Multiple Glazed Unit (Class 1 and Class 2)

(6) Bullet-Resistant Glazing

(7) Bullet-Resistant Shield

The Z26 Committee and the Secretariat believe that this standard reflects the best current technology in the art of automotive glazing. It is recognized that new developments are to be expected in safety glazing materials, and that revisions of the standard will be necessary as the art progresses and as further experience is gained. It is felt, however, that uniform requirements are very much needed, that the standard in its present form permits the use of the more desirable types of safety glazing materials now commercially available, and that it distinguishes between the better and the poorer grades of those types, as well as prescribing and, in some cases, limiting the places at which certain types may be used.

Definitions are provided in Section 1.

Footnotes to this standard are included for purposes of clarification.

Suggestions for improvement of this standard will be welcome. They should be sent to the Secretariat at the Society of Automotive Engineers, Inc., 3001 W. Big Beaver Road, Suite 320, Troy, Michigan 48084.

This standard was processed and approved for submittal to ANSI by the Society of Automotive Engineers/American National Standards Committee on Specifications and Methods of Test for Safety Glazing Material, Z26. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the Z26 Committee had the following members:

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1. Definitions

1.1 Bullet-Resistant Glazing

The term “bullet-resistant glazing” means a glazing material comprised of one or more layers of glass bonded together with one or more layers of transparent plastic or plastic material, solid or laminated, that can meet the requirements for bullet resistance of this standard (Test 27, Ballistics).

Bullet-resistant glazing for motor vehicles operating on land highways is available in four types:

- (1) Type MP glazing, ballistically resistant to 9 mm full metal copper jacket with lead core medium-power small arms ammunition; muzzle velocity 358 m/s (1175 ft/s).
- (2) Type HP glazing, ballistically resistant to .357 Magnum jacketed lead soft point high-power small arms ammunition; muzzle velocity 381 m/s (1250 ft/s).
- (3) Type SP glazing, ballistically resistant to .44 Magnum lead semi-wadcutter gas checked super-power small arms ammunition; muzzle velocity 411 m/s (1350 ft/s).
- (4) Type RR glazing, ballistically resistant to high-power rifle ammunition; .30 caliber rifle lead core soft point: muzzle velocity 774 m/s (2540 ft/s). Laminates or homogeneous glazing materials that meet the appropriate requirements of this standard in the location as specified may be used as bullet-resistant glazing for the foregoing types provided that they satisfactorily meet the requirements of 1.1 through 3.1 and 13.1 through 13.3 of UL 752 1995, Standard for Bullet-Resistant Equipment.

1.2 Bullet-Resistant Shield

The term “bullet-resistant shield” means a shield or barrier that is installed completely inside a motor vehicle behind and separate from glazing materials that independently comply with the requirements of this standard.

1.3 Bus

The term “bus” means a motor vehicle with motive power (except a trailer) designed to carry more than ten persons¹.

1.4 Camper

The term “camper” means a structure designed to be mounted in the cargo area of a truck, or attached to an incomplete vehicle with motive power, for purposes of providing shelter for persons.

1.5 Glass-Plastic Glazing Material

The term “glass-plastic glazing material” means a laminate of one or more layers of glass and one or more layers of plastic in which a plastic surface of the glazing faces inward when the glazing is mounted in a vehicle.

1.6 Laminated Glass

The term “laminated glass” means two or more pieces of sheet, plate, or float glass bonded together by an intervening layer or layers of plastic material. It will crack or break under sufficient impact, but the pieces of glass tend to adhere to the plastic. If a hole is produced, the edges are likely to be less jagged than would be the case with ordinary annealed glass.

1.7 Manufacturer

The term “manufacturer” means a person who fabricates, laminates, or tempers safety glazing material.

1.8 Model Number

The term “model number” means a designation assigned by a glazing manufacturer to a specific safety glazing material and related by that manufacturer to a detailed description of that safety glazing material.

1.9 Motorhome

The term “motorhome” means a multipurpose passenger vehicle that provides living accommodations for persons.

1.10 Motor Vehicle

The term “motor vehicle” means a vehicle driven or drawn by mechanical power and manufactured primarily for use on public streets, roads, and highways, but does not include a vehicle operated only on a rail line.

1.11 Multiple Glazed Unit

The term “multiple glazed unit” means two or more sheets of glazing material separated by an airspace or spaces and glazed in a common mounting. For the purposes of this standard, multiple glazed units are divided into two classes:

- (a) Class 1 comprises multiple glazed units in which each component single layer or laminated layer complies with the appropriate requirements of this standard.
- (b) Class 2 comprises multiple glazed units in which any component single layer or laminated layer does not comply with the appropriate requirements of this standard.

¹ “Persons” are every natural person, firm, co-partnership, association or corporation.

1.12 Multipurpose Passenger Vehicle (MPV)

The term "multipurpose passenger vehicle (MPV)" means a motor vehicle with motive power, except a trailer, designed to carry ten persons or less which is constructed either on a truck chassis or with special features for occasional off-road operation.

1.13 Passenger Car

The term "passenger car" means a motor vehicle with motive power, except a multipurpose passenger vehicle, motorcycle, or trailer, designed for carrying ten persons or less.

1.14 Pickup Cover

The term "pickup cover" means a camper having a roof and sides but without a floor, designed to be mounted on and removable from the cargo area of a truck by the user.

1.15 Plastic

The term "plastic" means a material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and, at some stage in its manufacture or processing into finished articles, can be shaped by flow.

1.16 Readily Removable Windows

The term "readily removable windows" means windows that can be quickly and completely removed from the motor vehicle without tools. Readily removable windows in buses having a GVWR of more than 4540 kg (10 000 lbs), which are required to include push-out windows and windows mounted in emergency exits that can be manually pushed out of their location in the vehicle without the use of tools, regardless of whether such windows remain hinged at one edge.

1.17 Safety Glass

The term "safety glass" means safety glazing materials predominantly ceramic in character that meet the appropriate requirements of this standard, including (but not limited to) laminated glass and tempered glass.

1.18 Safety Glazing Materials

A product consisting of organic and/or inorganic materials so constructed or treated to reduce, in comparison with annealed sheet, plate, or float glass, the likelihood of injury to persons as a result of contact with these safety glazing materials when used in a vehicle, whether they may be broken or unbroken, and for which special requirements regarding visibility, strength and abrasion resistance are set-forth.

1.19 Safety Glazing Plastics

The term "safety glazing plastics" includes any safety glazing material, predominantly synthetic organic in character, that meets the appropriate requirements of this standard,

including single-ply and laminated products whether rigid or flexible.

1.20 Slide-in Camper

The term "slide-in camper" means a camper having a roof, floor, and sides, designed to be mounted on and removable from the cargo area of a truck by the user.

1.21 Tempered Glass

The term "tempered glass" means a single piece of specially treated sheet, plate, or float glass possessing mechanical strength substantially higher than annealed glass. When broken at any point, the entire piece breaks into small pieces that have relatively dull edges as compared to those of broken pieces of annealed glass.

(Other terms such as "heat treated glass," "toughened glass," "case hardened glass," and "chemically tempered glass" are used also).

1.22 Trailer

The term "trailer" means a motor vehicle with or without motive power, designed for carrying persons or property and for being drawn by another motor vehicle.

1.23 Truck

The term "truck" means a motor vehicle with motive power (except a trailer) designed primarily to transport property or special purpose equipment.

2. General

2.1 Use of Descriptive Terms

As the definition indicates, safety glazing materials, in comparison with annealed sheet glass, plate glass, or float glass, are intended to reduce the likelihood of injury or the severity of injury in the event of their breakage. Therefore, terms such as "nonbreakable," "nonscatterable," and "nonsplinterable" should not be interpreted by the driving public as meaning that absolute protection is afforded to the occupants of the vehicle by the safety glazing materials so described, as the descriptive terms might seem to warrant. No such terms are used in this standard.

Bullet-resistant glazing should not be termed "bullet-proof," since no bullet-resistant glazing is completely resistant to penetration by all types of missiles fired from all types of armament.

2.2 Degree of Safety

One safety glazing material may be superior for protection against one type of hazard, whereas another may be superior against another type. Since accident conditions are not standardized, no one type of safety glazing material can be shown to possess the maximum degree of safety under all conditions, against all conceivable hazards.

2.3 Purpose of Tests

The tests described in Section 5 of this standard are for the purpose of determining whether a safety glazing material has certain desirable and obtainable qualities for its acceptance under this standard. Many of the tests are of such severity that even a satisfactory product will show occasional failures to an extent limited by the requirements of the test.

2.4 Referenced Standards

This standard is intended for use in conjunction with the following standards:

- ASTM D 362-84, Standard Specification for Industrial Grade Toluene²
- ASTM D 618-95, Methods of Conditioning Plastics and Electrical Insulating Materials for Testing²
- ASTM D 1003-92, Method of Test for Haze and Luminous Transmittance of Transparent Plastics²
- ASTM D 1044-94, Method of Test for Haze and Luminous Transmittance of Transparent Plastics²
- ASTM D 2240-91, Standard Method of Test for Durometer Hardness of Rubber Property²
- ASTM D 3699-92, Specification for Kerosene²
- ASTM D 4329-92 Standard Practice for Operating Light and Water Apparatus (Fluorescent UV and Condensation Type) for Exposure of Plastics²
- ASTM G 53-88 Standard Practice for Operating Light and Water Exposure Apparatus (Fluorescent UV and Condensation Type) for Exposure of Nonmetallic Materials²
- 1985 Annual Book of ASTM Standards²
- SAE J673 APR93, Automotive Safety Glazing³
- SAE J2020 JUN89 Accelerated Exposure of Automotive Exterior Materials Using a Fluorescent UV and Condensation Apparatus³
- ISO 3536/1-92 Road vehicles - Safety glazing materials - Vocabulary - Part 1⁴
- ISO 3537-93 Road vehicles - Safety glazing materials - Test methods for mechanical properties⁴
- ISO 3538-78 Road vehicles - Safety glazing materials - Test methods for optical properties⁴
- ISO 3917-92 Road vehicles - Safety glazing materials - Test methods for resistance to radiation, High temperature, humidity, fire, and simulated weathering⁴

ISO 4892-1 Plastics—Methods of exposure to laboratory light sources—Part 1: General guidance⁴

ISO 4892-2 Plastics—Methods of exposure to laboratory light sources—Part 2: Xenon-arc sources⁴

ISO 4893-3 Plastics—Methods of exposure to laboratory light sources—Part 3: Fluorescent UV lamps⁴

ISO 4892-4:1994 Methods of exposure to laboratory light sources—Part 4: Open-flame carbon-arc lamps⁴

FMVSS 210, 49 CFR 571.210 Seat Belt Assembly Anchorages⁵

OSHA Standard 29 CFR 1910.106 - "Handling Storage and Use of Flammable Combustible Liquids"⁶

UL 752-1995, Safety Standard for Bullet Resistant Equipment⁷

3. Specimens To Be Tested

3.1 General

3.1.1 Variation in Required Specimens. The specimens required vary according to the different groups of tests that must be met by safety glazing materials. Sufficient specimens to meet these various tests shall be furnished, as described in 3.2 to 3.9.

3.1.2 Requirements for All Specimens. All specimens of safety glazing materials shall be furnished representative of the model number with the edges finished, holes drilled where necessary, and masked, if desired, in accordance with the commercial practice of the manufacturer. The specimens shall have the interior or exterior surface so identified if necessary to identify mounted orientation in a vehicle.

3.2 Tempered Glass

3.2.1 The following specimens shall be submitted in the case of tempered glass:

- (1) Twenty 305 mm x 305 mm (12 in x 12 in), substantially flat specimens or, optionally, seventeen 305 mm x 305 mm (12 in x 12 in) and three 76 mm x 305 mm (3 in x 12 in), substantially flat specimens.

² Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

³ Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

⁴ Available from ANSI, 11 West 42nd Street, New York, NY 100360-8002.

⁵ Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

⁶ Available from OSHA Publication Office, Room S-4203, 200 Constitution Avenue, NW, Washington, DC 20210.

⁷ Available from Underwriters Laboratories Inc., Publications, 333 Pfingsten Road, Northbrook, IL 60062.



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- (2) Three 102 mm x 102 mm (4 in x 4 in), flat specimens⁸ having both surfaces substantially plane and parallel, with a 6.35 mm (¼ in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (¼ in) hole is not necessary.
- (3) Six production parts representing each model number construction for Fracture, Test 7.

3.3 Laminated Glass

3.3.1 The following specimens shall be submitted in the case of laminated glass for windshield use:

- (1) Thirty-six 305 mm x 305 mm (12 in x 12 in), substantially flat specimens or, optionally, thirty-three 305 mm x 305 mm (12 in x 12 in) and three 76 mm x 305 mm (3 in x 12 in), substantially flat specimens.
- (2) Three 102 mm x 102 mm (4 in x 4 in), flat specimens having both surfaces substantially plane and parallel, with a 6.35 mm (¼ in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (¼ in) hole is not necessary.
- (3) Where curved laminated safety glass is proposed for use in windshields, three additional specimens shall be submitted. These specimens shall be approximately 305 mm x 305 mm (12 in x 12 in) in size and shall be cut from the windshield at the section of greatest curvature (minimum radius).

3.3.2 The following specimens shall be submitted in the case of laminated glass for glazing applications other than windshields:

- (1) Twenty-six 305 mm x 305 mm (12 in x 12 in), substantially flat specimens, or, optionally, twenty-three 305 mm x 305 mm (12 in x 12 in) and three 76 mm x 305 mm (3 in x 12 in), substantially flat specimens.
- (2) Three 102 mm x 102 mm (4 in x 4 in), flat specimens having both surfaces substantially plane and parallel, with a 6.35 mm (¼ in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (¼ in) hole is not necessary.

3.4 Glass-Plastic Glazing Materials⁹

3.4.1 The following specimens shall be submitted in the case of glass-plastic glazing materials for windshield use:

- (1) Thirty-eight 305 mm x 305 mm (12 in x 12 in), substantially flat specimens, or optionally, thirty-five

305mm x 305 mm (12 in x 12 in) and three 76 mm x 305mm (3 in x 12 in), substantially flat specimens.

- (2) Six 102 mm x 102 mm (4 in x 4 in), flat specimens having both surfaces substantially plane and parallel, with a 6.35 mm (¼ in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (¼ in) hole is not necessary.
- (3) Three 102 mm x 102 mm (4 in x 4 in), flat specimens representing the face that would be mounted to the exterior of the vehicle.
- (4) Ten 25 mm x 178 mm (1 in x 7 in), substantially flat specimens.
- (5) Three 13 mm x 152 mm (1/2 in x 6 in), substantially flat specimens.
- (6) Where curved glass-plastic glazing material is proposed for use in windshields, three additional specimens shall be submitted. These specimens shall be approximately 305 mm x 305 mm (12 in x 12 in) in size and shall be cut from the windshield at the section of greatest curvature (minimum radius).

3.4.2 The following specimens shall be submitted in the case of glass-plastic materials for glazing applications other than windshields:

3.4.2.1 In the case of glass-plastic glazing materials for use in areas requisite for driving visibility.

- (1) Twenty-eight 305 mm x 305 mm (12 in x 12 in), substantially flat specimens or, optionally, twenty-five 305 mm x 305 mm (12 in x 12 in) and three 76 mm x 305 mm (3 in x 12 in), substantially flat specimens.
- (2) Six 102 mm x 102 mm (4 in x 4 in), flat specimens having both surfaces substantially plane and parallel, with a 6.35 mm (¼ in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (¼ in) hole is not necessary.
- (3) Three 102 mm x 102 mm (4 in x 4 in), flat specimens representing the face that would be mounted to the exterior of the vehicle.
- (4) Ten 25 mm x 178 mm (1 in x 7 in), substantially flat specimens.
- (5) Three 13 mm x 152 mm (1/2 in x 6 in), substantially flat specimens.
- (6) In addition, for tempered glass-plastic glazing materials, for Fracture, Test 7, six production parts representing each model construction shall be furnished for the test.

⁸ Not required for glazings used in areas not requisite for driving visibility.

⁹ The inward facing surface of each glass-plastic laminated glazing specimen as mounted in the vehicle, shall be identified.

3.4.2.2 In the case of glass-plastic glazing materials for use in areas not requisite for driving visibility.

- (1) Twenty-five 305 mm x 305 mm (12 in x 12 in), substantially flat specimens.
- (2) Three 102 mm x 102 mm (4 in x 4 in), flat specimens representing the face that would be mounted to the exterior of the vehicle.
- (3) Ten 25 mm x 178 mm (1 in x 7 in), substantially flat specimens.
- (4) Three 13 mm x 152 mm (1/2 in x 6 in), substantially flat specimens.
- (5) In addition, for tempered glass-plastic glazing materials, for Fracture, Test 7, six production parts representing each model construction shall be furnished for the test.

3.5 Multiple Glazed Units

In the case of multiple glazed units, which for the purposes of this standard are divided into two classes, the specimens described in 3.5.1 and 3.5.2 shall be furnished as unitary structures in accordance with the commercial practice of the manufacturer.

3.5.1 Class 1. If each of the individual components of the multiple glazed unit comply with this standard, the specimens described in 3.5.1.1 and 3.5.1.2 are required.

3.5.1.1 For Windshield Use:

- (1) Ten 305 mm x 305 mm (12 in x 12 in), substantially flat specimens, or, optionally, seven 305 mm x 305 mm (12 in x 12 in) and three 76 mm x 305 mm (3 in x 12 in), substantially flat specimens shall be furnished.
- (2) Where curved multiple glazed units are proposed for use in windshields, three additional specimens shall be furnished. These specimens shall be complete windshields with an area approximately 305 mm x 305 mm (12 in x 12 in) outlined at the section of greatest curvature (minimum radius).

3.5.1.2 For glazing applications other than windshields, three 305 mm x 305 mm (12 in x 12 in), substantially flat specimens, or, optionally, three 76 mm x 305 mm (3 in x 12 in), substantially flat specimens shall be furnished.

3.5.2 Class 2. If any of the individual components of the multiple glazed unit do not comply with this standard, the specimens described in 3.5.2.1 through 3.5.2.3 are required.

3.5.2.1 For Windshield Use:

- (1) Forty-five 305 mm x 305 mm (12 in x 12 in), substantially flat specimens shall be furnished. Where multiple glazed units are nonsymmetrical in construction rather than shape, twelve additional 305 mm x 305 mm (12 in x 12 in), substantially flat specimens are required.

- (2) Three 102 mm x 102 mm (4 in x 4 in), flat glazing specimens representing the exterior component, in relation to the vehicle, of the multiple glazed unit shall be furnished. These specimens shall have both surfaces substantially plane and parallel, with a 6.35 mm (1/4 in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (1/4 in) hole is not necessary.
- (3) Where curved multiple glazed units are proposed for use in windshields, three additional specimens shall be furnished. These specimens shall be complete windshields with an area approximately 305 mm x 305 mm (12 in x 12 in) outlined at the section of greatest curvature (minimum radius).

3.5.2.2 For Glazing Applications Other Than Windshields in the First Group Under Class 2:

- (1) Thirty-five 305 mm x 305 mm (12 in x 12 in), substantially flat specimens shall be furnished. Where multiple glazed units are nonsymmetrical in construction rather than shape, twelve additional 305 mm x 305 mm (12 in x 12 in), substantially flat specimens are required.
- (2) Three 102 mm x 102 mm (4 in x 4 in), flat glazing specimens representing the exterior component, in relation to the vehicle, of the multiple glazed unit shall be furnished. These specimens shall have both surfaces substantially plane and parallel, with a 6.35 mm (1/4 in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (1/4 in) hole is not necessary.

3.5.2.3 For Glazing Applications Other Than Windshields in the Second Group Under Class 2:

- (1) Thirty-five 305 mm x 305 mm (12 in x 12 in), substantially flat specimens shall be furnished. Where multiple glazed units are nonsymmetrical in construction rather than shape, twelve additional 305 mm x 305 mm (12 in x 12 in), substantially flat specimens are required.
- (2) Three 102 mm x 102 mm (4 in x 4 in), flat glazing specimens representing the exterior component, in relation to the vehicle, of the multiple glazed unit shall be furnished. These specimens shall have both surfaces substantially plane and parallel, with a 6.35 mm (1/4 in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (1/4 in) hole is not necessary.
- (3) Six production parts representing each model number construction for Fracture, Test 7.

3.6 Plastics More Than 1.27 mm (0.050 in) in Thickness

For plastics more than 1.27 mm (0.050 in) in thickness, the following specimens are required:

- (1) Seventeen 305 mm x 305 mm (12 in x 12 in), substantially flat specimens.
- (2) Six (nine for Item 4A) 102 mm x 102 mm (4 in x 4 in), flat specimens having both surfaces substantially plane and parallel, with a 6.35 mm (¼ in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (¼ in) hole is not necessary.
- (3) Eighteen 25 mm x 178 mm (1 in x 7 in), substantially flat specimens.
- (4) Two 152 mm x 152 mm x 6.35 mm (6 in x 6 in x ¼ in), substantially flat specimens.
- (5) Three 13 mm x 152 mm (1/2 in x 6 in), substantially flat specimens.
- (6) Three 102 mm x 102 mm (4 in x 4 in), flat specimens representing the face that would be mounted to the exterior of the vehicle.

3.7 Plastics 1.27 mm (0.050 in) in Thickness or Less

For plastics 1.27 mm (0.050 in) in thickness or less, the following specimens are required:

- (1) Three 102 mm x 102 mm (4 in x 4 in), flat specimens representing the face that would be mounted to the exterior of the vehicle.
- (2) Eighteen 25 mm x 178 mm (1 in x 7 in), substantially flat specimens.
- (3) Two 64 mm x 254 mm (2½ in x 10 in), substantially flat specimens.
- (4) Six 318 mm x 25 mm (12½ in x 1 in), substantially flat specimens.

3.8 Bullet-Resistant Glazing

3.8.1 For Laminated Glass:

- (1) Twelve 305 mm x 305 mm (12 in x 12 in), substantially flat specimens shall be furnished.
- (2) Where curved bullet-resistant glazings are proposed for use in windshields, three additional specimens shall be furnished. These specimens shall be complete windshields with an area approximately 305 mm x 305 mm (12 in x 12 in) outlined at the section of greatest curvature (minimum radius), or the outlined area itself cut from the curved windshield.
- (3) Three 102 mm x 102 mm x 6.35 mm (4 in x 4 in x ¼ in), flat specimens representing the face that would be mounted to the exterior of the vehicle shall be furnished. These specimens shall have both surfaces substantially plane and parallel, with a 6.35 mm (¼ in) diameter hole

centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (¼ in) hole is not necessary.

3.8.2 For Plastic:

- (1) Ten 305 mm x 305 mm (12 in x 12 in), substantially flat specimens shall be furnished. Where bullet-resistant plastic glazing (see Item 11b) is of a monolithic configuration, only five 305 mm x 305 mm (12 in x 12 in), specimens are required.
- (2) Three 102 mm x 102 mm (4 in x 4 in), flat glazing specimens of 6.35 mm (¼ in), flat specimens representing the face that would be mounted to the exterior of the vehicle shall be furnished. These specimens shall have both surfaces substantially plane and parallel, with a 6.35 mm (¼ in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (¼ in) hole is not necessary.
- (3) Three 102 mm x 102 mm (4 in x 4 in), flat specimens representing the face that would be mounted to the exterior of the vehicle.
- (4) Eighteen 25 mm x 178 mm (1 in x 7 in), substantially flat representative specimens of 6.35 mm (¼ in) thickness shall be furnished.
- (5) Two 152 mm x 152 mm (6 in x 6 in), substantially flat specimens shall be furnished. Where the bullet-resistant glazing is of monolithic configuration, these specimens shall be of 6.35 mm (1/4 in) thickness.
- (6) Three 152 mm x 152 mm x 6.35 mm (6 in x 6 in x ¼ in), substantially flat specimens shall be furnished. Where the bullet-resistant glazing is of monolithic configuration, these specimens shall be of 6.35 mm (¼ in) thickness.

3.8.3 For Bullet-Resistant Shields:

- (1) Ten 305 mm x 305 mm (12 in x 12 in), substantially flat specimens shall be furnished. Where bullet-resistant shields (see Item 11c) are of a monolithic configuration only, five 305 mm x 305 mm (12 in x 12 in), specimens are required.
- (2) Where curved bullet-resistant shields are proposed for use in conjunction with windshields, three additional specimens shall be furnished. These specimens shall be complete bullet-resistant shields with an area approximately 305 mm x 305 mm (12 in x 12 in) outlined at the section of greatest curvature (minimum radius), or the outlined area itself cut from the curved bullet-resistant shields.
- (3) Three 102 mm x 102 mm (4 in x 4 in), flat glazing specimens of 6.35 mm (¼ in), flat specimens representing the face that would be glazed to the outside of the vehicle shall be furnished. These specimens shall have both surfaces substantially plane and parallel, with a

6.35 mm (¼ in) diameter hole centrally drilled therethrough. Where fixturing for mounting specimens on a Taber Abraser is available, the 6.35 mm (¼ in) hole is not necessary.

- (4) Three 102 mm x 102 mm (4 in x 4 in), flat specimens representing the face that would be mounted to the exterior of the vehicle.
- (5) Twenty 25 mm x 178 mm (1 in x 7 in), substantially flat representative specimens of 6.35 mm (¼ in) thickness shall be furnished.
- (6) Two 152 mm x 152 mm (6 in x 6 in), substantially flat specimens shall be furnished. Where the bullet-resistant shield glazing is of monolithic configuration, these specimens shall be of 6.35 mm (¼ in) thickness.
- (7) Three 13 mm x 152 mm (½ in x 6 in), substantially flat specimens shall be furnished.

3.9 Specimens for Egress Test 25

When safety glazing material is to be tested for compliance with Test 25 (see 5.25), five specimens of the safety glazing material to be tested and five specimens of laminated safety glass of identical size and shape and meeting the requirements given in 5.25.2 are required. In addition, the vehicle body, a section of vehicle body including the opening for which the specimens are designed, or an equivalent framing, rigidly supported, shall be provided.

4. Application of Tests

4.1 Condition of Specimens

Tests shall be applied to specimens only when in the condition as shipped by the manufacturer, except that any protective masking material shall be removed prior to making the tests.

4.2 Grouping of Tests

The groups of tests listed in this subsection and shown in Table 1, item by item, are deemed adequate for determining the locations in the motor vehicle for which the various safety glazing materials that qualify under this standard may be suitable. The different characteristics of the various safety glazing materials that qualify under this standard make specific groupings of tests necessary, and individual tests in one group may not be substituted for individual tests in another group.

Safety glazing materials in motor vehicles shall comply with the applicable requirements listed in this subsection and shown in Table 1, item by item, in definite groupings of tests that are appropriate for the safety glazing material in question, and the location in the motor vehicle in which it is intended to be used. Additionally, safety glazing materials shall comply with the marking and labeling requirements appropriate for the given safety glazing material as shown in Section 7, Marking of Safety Glazing Materials.

Item 1. Safety Glazing Material for Use Anywhere in Motor Vehicle. Safety glazing materials that comply with the following may be used anywhere in a motor vehicle:

- (a) Tests 1, 2¹⁰, 3, 4, 9, 12, 15, 18, and 26; or
- (b) Multiple glazed units, Class 1¹¹, that comply with the sets of tests designated in (a), and the assembled unit of which complies with Tests 1, 2¹⁰, and 15; or
- (c) Multiple glazed units, Class 2¹¹, that comply with Tests 1, 2¹⁰, 3, 5, 9, 12, 14, 15, 18, and 26.

Item 2. Safety Glazing Material for Use Anywhere in Motor Vehicle Except Windshields. Safety glazing materials that comply with the following may be used anywhere in a motor vehicle except windshields:

- (a) Tests 1, 2¹⁰, 3, 4, 9, 12, and 18; or
- (b) Tests 1, 2¹⁰, 6, 7, 8, and 18; or
- (c) Multiple glazed units, Class 1¹¹, the individual component units of which comply with one or another of the sets of tests immediately above designated; and the assembled unit of which complies with Tests 1 and 2¹⁰; or
- (d) Multiple glazed units, Class 2¹¹, that comply with Tests 1, 2¹⁰, 3, 5, 9, 12, 14, and 18; or Tests 1, 2¹⁰, 3, 5, 6, 7, 8, 14, and 18.

Item 3. Safety Glazing Material for Use Anywhere in Motor Vehicle Except Windshields and Certain Specified Locations. Safety glazing materials that comply with the tests listed in (a), (b), (c), or (d) below may be used anywhere in a motor vehicle except in windshields and in the following locations at levels requisite for driving visibility.

- (1) Buses, Trucks, and Truck Tractors. Glazing of windows to the immediate right and left of the driver and in rearmost window if the latter is used for driving visibility.
- (2) Passenger Cars and Taxicabs. Glazing of all windows, including rear window, all interior partitions, and all apertures created for window purposes.
 - (a) Tests 1, 3, 4, 9, and 12; or
 - (b) Tests 6, 7, and 8; or
 - (c) Multiple glazed units, Class 1¹², the individual component units of which comply with one or

¹⁰ Glazing materials that in a single sheet have some areas with a light transmittance of less than 70 % and are intended for use at levels requisite for driving visibility are to be permanently marked at the edge of the sheet to show what portion of the material may be used at levels requisite for driving visibility. The portion of the glazing materials intended for use at levels requisite for driving visibility must comply with Test 2.

¹¹ Multiple glazed units are classified only for convenience in designating test procedures. See 1.11 for multiple glazed unit classification.