

1 INCH-POUND  
MIL-G-5485D  
22 February 1993  
SUPERSEDING  
MIL-G-5485C  
23 April 1971

MILITARY SPECIFICATION

GLASS, LAMINATED, FLAT, BULLET-RESISTANT

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for bullet resistant glass in aircraft windscreen and other similar applications.

\* 1.2 Classification. The bullet resistant glass is classified by type as follows:

Type I - Regular ground (see 3.9.1.1).

Type II - Precision ground (see 3.9.1.2).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

\* 2.1.1 Specifications, standards and handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2d).

SPECIFICATIONS

FEDERAL

A-A-55057 - Panels, Wood/Wood Based, Construction and Decorative

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Warfare Center Aircraft Division Lakehurst, Code SR3, Lakehurst, NJ 08733-5100, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC/NA

FSC 9340

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

## MIL-G-5485D

DD-G-451	-	Glass, Float or Plate, Sheet, Figured (Flat, For Glazing, Mirrors and Other Uses)
TT-W-572	-	Wood-Preservative, Water-Repellent
PPP-B-585	-	Box, Wood, Wirebound
PPP-B-591	-	Boxes, Shipping, Fiberboard, Wood-Cleated
PPP-B-601	-	Boxes, Wood, Cleated Plywood
PPP-B-621	-	Box, Wood, Nailed and Lock Corner
PPP-T-60	-	Tape, Packaging, Waterproof

## MILITARY

MIL-P-116	-	Preservation, Methods of
MIL-L-10547	-	Liner, Case and Sheet, Overwrap, Water Vaporproof or Waterproof, Flexible

## STANDARDS

## MILITARY

MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	-	Marking for Shipment and Storage

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the DODSSP - Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

\* 2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of the documents not listed in the DoDISS are the issues of the documents cited in the solicitation (See 6.2c).

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036-90	-	Standard Specification for Flat Glass.
ASTM D 1003	-	Haze and Luminous Transmittance of Transparent Plastics

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

## MIL-G-5485D

## UNIFORM CLASSIFICATION COMMITTEE, AGENT

## Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents may be available in or through libraries or other informational services.)

\* 2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 First article. When specified by the acquisition activity (see 6.2m), the bullet resistant glass shall be subjected to the first article inspection (see 6.3) in accordance with 4.3.

3.1.1 Ballistic requirement. When specified by the acquisition activity, a ballistic requirement shall be included. The acquisition activity shall include all pertinent instructions for test and evaluation of the glass (see 6.2j). A ballistic requirement and test procedure are included for information and use in 6.6.

3.2 Materials.

\* 3.2.1 Glass plies. The glass plies used in the lamination shall be specially selected polished plate or float glass conforming to Type I, Class 1, quality - q3 of DD-G-451 or Type I, class 1, quality - q3 of ASTM C 1036. The plies shall be annealed, semi-tempered or tempered as specified (see 6.2g).

\* 3.2.2 Interlayer. Unless otherwise specified by the acquisition activity (see 6.2k), the transparent interlayer plastic shall be polyvinyl butyral plasticized with either  $21.0 \pm 2$  parts by weight triethylene glycol 2-di-ethyl butyrate or  $19.0 \pm 1$  part by weight di-n-hexyl adipate per 100 parts of the resin. The manufacturer shall identify and provide traceability for the plasticizer used in the laminate interlayer (see 4.3.1). The material used shall be stable without edge sealing and shall have the necessary binding characteristics as evidenced by conformance to the requirements of this specification.

3.3 Construction. The bullet resistant glass shall consist of two or more plies held together by the transparent plastic interlayer.

3.3.1 Ballistic resistance characteristics. Figure 1 shall be used for design in determining the ballistic resistance characteristics required of the laminated glass. Laminated glass constructed to the weight ratio (pounds per square foot/inch of thickness) specified in Figure 1 should be an acceptable ballistic resistant product.

MIL-G-5485D

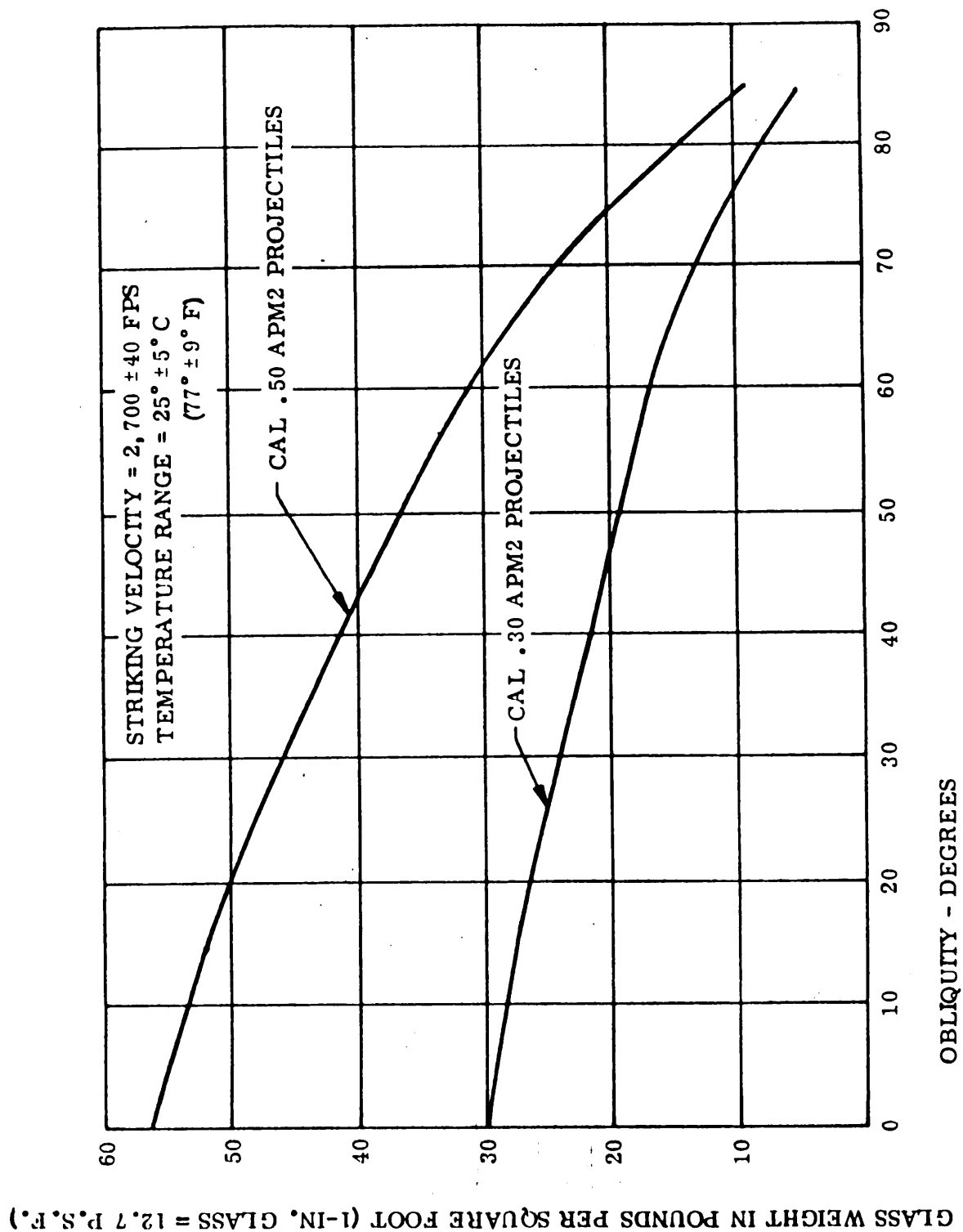


Figure 1. Projectiles, obliquities, and velocities for ballistic tests

## MIL-G-5485D

3.3.2 Plastic edges. When specified by the acquisition activity, the laminated glass shall be furnished with extended plastic edges with or without reinforcement (see 6.21).

3.3.2.1 Parting medium. A parting medium shall be used during fabrication to reduce or prevent bonding of the glass plies to the extended plastic edge only, to a specific portion of the interlayer only, or to both the plastic edge and interlayer when so specified on the applicable drawing (see 6.2c).

3.4 Dimensions. Laminated glass shall be furnished in lengths and widths as specified. Unless otherwise specified in the contract or order, thickness shall be in accordance with Table II (See 6.2g).

3.5 Tolerances.

3.5.1 Thickness. The tolerance on the thickness of the final assembly shall be as specified on the contract or order (see 6.2g). The tolerance shall be plus from the basic dimension and shall be held to a minimum consistent with sound manufacturing practices.

3.5.2 Length and width. Unless otherwise specified by the acquisition activity (see 6.2f), a length or width tolerance of 0.063 inch (1.6 mm) shall be permitted.

3.6 Finish. Unless otherwise specified, all edges of the laminated glass shall be ground, with no plate underlapping another more than 0.078 inch (2 mm). All edges shall have a ground satin finish. Unless otherwise specified in the acquisition drawing (see 6.2c), all sharp edges, including corners, shall be chamfered from 0.032 to 0.063 inch (0.8 to 1.6 mm).

3.7 Glass quality. Defects, including blow-ins up to 0.25 inch deep by 1 inch (6.4 by 25.4 mm) long, or flake chips along the edge which do not impair the strength of the glass and do not cause objectionable reflections or scattering of light shall be permissible over the area of the glass covered by the mounting frame and extending 0.25 inch (6.4 mm) inboard. Defects over the remaining area of the glass shall be permissible as shown in Table I.

3.7.1 Critical sighting area. The critical sighting area of Type II laminates (see 3.9.1.2) shall contain no defects which may impair the utility of this area for use in conjunction with the gunsight (see 6.4).

3.8 Marking. Individual glass laminates shall be marked as specified by the acquisition activity (see 6.2i).

3.9 Performance.

3.9.1 Optical deviation.

3.9.1.1 Type I. Unless otherwise specified by the acquisition activity, the optical deviation of parallel light at normal incidence to the glass shall not exceed 3 minutes of arc over the area of the glass, except for a 1 inch (25.4 mm) margin at the edge when tested in 4.5.2.1.

## MIL-G-5485D

TABLE I. Glass defects.

Defect <u>1/</u>	Size	Remarks
Small cullets Slight inclusions Dirt spots	less than 0.063 inch (1.6 mm) diameter	Permissible - provided the defects are not so clustered as to obstruct vision and they occur only occasionally in critical areas. Larger defects of the same type shall be cause for rejection if they reduce visibility, cause noticeable distortion or are grouped to form an objectionable pattern.
Light fingerprints Light scratches Traces of crayon	less than 0.25 inch (6.4 mm) long	
Fine lint or hair	less than 0.5 inch (12.7 mm) long	
Light plastic rubs or streaks Light scratches Light surface sleeks	less than 3 inches (76 mm) long	Permissible - Provided the defects do not impair visibility and do not occur in a critical area.
Vents Vee edge chips Stones	Any size	Not permitted - any foreign material not specified above is also not permitted.

1/ Defects are defined in DD-G-451, ASTM C1036 and 6.5 of this specification.

3.9.1.2 Type II. The optical deviation of parallel light at normal incidence in the critical sighting area, as specified in the acquisition drawing (see 6.2c), shall not exceed 31.5 seconds of arc (60 second wedge angle). The optical deviation outside the critical sighting area shall conform to the requirements for Type I laminates. The critical sighting area shall be that area of the glass laminate over which the gunsight optical reflection occurs, or if a gunsight equipped with a separate reflector is used, that area which lies in the projection of the reflector along the line of sight.

3.9.2 Optical distortion. The optical distortion requirements for the bullet resistant laminates shall be as specified by the acquisition activity (see 6.2h), when tested in accordance with 4.5.3.

3.9.3 Flatness. When determined as specified in 4.5.4, the surfaces of the critical area of Type II laminates shall be optically flat with a minimum radius of curvature of 500 feet (152.4 meters).

3.9.4 Thermal stability. The bullet resistant glass shall not crack, cloud, delaminate or show other visual evidence of deterioration after testing as specified in 4.5.5.

## MIL-G-5485D

\* 3.9.5 Luminous transmittance. The parallel luminous transmittance of the bullet resistant glass, as furnished and after being subjected to the exposure test (4.5.6), shall be not less than the values given in Table II. When nominal or actual thicknesses exceed those designated in Table II, values for the next highest thickness shall be used. Surface coating to increase the luminous transmittance shall not be used unless specifically authorized by the acquisition activity.

\* TABLE II. Luminous transmittance at normal incidence.

Nominal thickness		Percent minimum
Inch	mm	
0.50	12.7	81
0.75	19.0	78
1.00	25.4	76
1.25	31.8	73
1.50	38.1	70
1.75	44.5	68
2.00	50.8	66
2.25	57.2	63
2.50	63.5	60
2.75	69.9	58
3.00	76.2	56

3.9.6 Ball impact. The laminate, after testing in 4.5.7, shall show no delamination along any crack or fracture line which extends over 0.125 inch (3.2 mm) normal to the crack or fracture line. The spalling off of a cone shaped mass opposite the point of impact shall be disregarded. Delamination shall be any visible parting of the glass from the interlayer plastic observable by reflected light.

3.9.7 Workmanship. Workmanship shall be in accordance with high grade aircraft glass manufacturing practice required by this specification.

#### 4. QUALITY ASSURANCE PROVISIONS

\* 4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

## MIL-G-5485D

\* 4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

\* 4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.3).
- b. Quality conformance inspection (see 4.4).

4.3 First article inspection. When specified (see 6.2n), a first article sample shall be subjected to all the tests and visual examinations in this specification.

4.3.1 First article sample. The first article sample shall consist of ten specimens of the same thickness and construction specified by the acquisition activity. The first article sample shall be forwarded to the test facility specified in the contract or order (see 6.3).

4.3.2 Manufacturer's data. The manufacturer shall submit, with the first article sample, two copies of the test report which show the laminated glass to conform to the requirements of this specification. The test report shall reference the specific requirement and test paragraphs in the specification.

4.4 Quality conformance inspection.

4.4.1 Lot formation. A lot shall consist of 100 glass laminate assemblies or portion thereof of the same type, nominal thickness, and construction which have been laminated within a thirty day period and submitted for inspection at one time.

4.4.2 Sampling.

4.4.2.1 Destructive inspection. Unless otherwise specified, sampling for destructive inspections shall be in accordance with MIL-STD-105, Inspection Level S-1 (see 6.2p). Requirements, number of specimens from each sample and acceptance criteria shall be as specified in Table III.

4.4.2.2 Nondestructive inspection. Each completed assembly shall be nondestructively inspected to the requirements in Table IV. There shall be no defects.



## MIL-G-5485D

TABLE III. Destructive inspection.

Property	Requirement paragraph	Test paragraph	Specimens each sample <u>1/</u>	Acceptance criteria
Thermal stability <u>2/</u>	3.9.4	4.5.5	1	No defects
Luminous transmittance Before exposure	3.9.5	4.5.6	1	No defects
After exposure			1	No defects
Ball impact <u>2/</u>	3.9.6	4.5.7	2	No defects

1/ Results reported as pass or fail.

2/ For purposes of this inspection the lot size shall be 500 completed assemblies.

TABLE IV. Nondestructive inspection.

Property	Requirement paragraph	Test paragraph
Examination of product	3.3 through 3.8	4.5.1
Optical deviation	3.9.1	4.5.2
Optical distortion	3.9.2	4.5.3
Flatness - Type II	3.9.3	4.5.4

4.4.2.3 Preparation for delivery. A quantity of shipping containers prepared for delivery, just prior to closure, shall be selected in accordance with Inspection Level I of MIL-STD-105. The lot size for purposes of this inspection shall be the number of shipping containers. In addition, shipping containers fully prepared for delivery shall be examined for closure defects. The shipping containers selected shall be examined for conformance to the requirements of Section 5 of this specification and to Table V. There shall be no defects.

#### 4.5 Test procedures.

4.5.1 Examination of product. Each assembly shall be visually examined to determine conformance to 3.3 through 3.8.

## MIL-G-5485D

TABLE V. Examination of preparation for delivery.

Examine	Defect
Packaging	Not level specified. Glass not cleaned and dried prior to wrapping. Sheets of paper missing or not as specified. Overwrap omitted, damaged or missing.
Packing	Not level specified; container not in accordance with contract requirements. Any nonconforming component; components missing, damaged. Incomplete closure of case liner, container flaps, loose strappings. Bulged or distorted containers.
Weight	Gross weight exceeds requirement.
Count	Less than specified or indicated quantity of assemblies per container.
Markings	Interior or exterior markings omitted, illegible, incorrect, incomplete or not in accordance with contract requirements.  Special markings omitted or incorrect.

4.5.2 Optical deviation.

4.5.2.1 Type I. Optical deviation shall be determined by examining the image of a line projected on a screen through the specimen. A lantern slide projector shall be used to project the image of a narrow black line focused on a smooth screen. The screen shall be located in a fixed position at a distance of 25 feet (9.2 m) from the specimen. An opaque shield having a vertical aperture 1 by 10 inches (2.54 by 25.4 cm) shall be mounted 3 feet (0.9 m) in front of the projector lens. The screen shall contain a faint vertical line and two parallel black lines, one on either side corresponding to an angular deviation of 3 minutes (0.262 inch (6.66 mm)) from the centerline. The screen shall be aligned with the projector to provide superposition of the central line and the projected line. The specimen shall be passed horizontally through the light beam in a plane normal to the light beam until each portion of the glass, except for the area within 1 inch (25.4 mm) from the edge, has been tested. The specimen shall then be rotated through 90 degrees in its own plane and the test repeated. In both positions, the deviation of the projected vertical line from the centerline on the screen shall be noted. Observations may be made by means of a second observer at the screen or by means of a low power telescope. Conformance to 3.9.1.1 shall be noted.

## MIL-G-5485D

4.5.2.2 Type II. The optical deviation outside the critical area shall be determined by the method described in 4.5.2.1. The optical deviation in the critical area shall be determined by examining the reflection of a specially constructed and illuminated screen on the two surfaces of the specimen. The screen shall have 0.50 inch (12.7 mm) diameter holes drilled 1.50 inches (38.1 mm) between centers and shall have the aft face suitably illuminated in order that the holes will appear as illuminated dots on the surfaces of the specimen. The perforated area of the screen shall be large enough to embrace the entire critical area. The specimen shall be placed 47 feet (14.3m) from the screen as shown on Figure 2. A low power telescope shall be placed not more than 6 inches (15.2 cm) from the center of the screen for observing the reflections on the surfaces of the specimen. Separation of the illuminated dots indicates that the optical deviation of the specimen exceeds 31.5 seconds of arc (60 seconds wedge angle). Conformance to 3.9.1.2 shall be noted.

4.5.3 Optical distortion. The optical distortion of each assembly shall be determined by a test based on the principle of viewing a grid through the laminate sample and measuring the optical distortion by direct measurement, measurement of photograph, or by split-line determination.

4.5.4 Flatness. Each assembly of Type II glass shall be tested to determine the radius of curvature of each surface of the critical area. One method shall be make use of the interference fringes produced as shown in Figure 3.

4.5.4.1 Determination of radius of curvature. A straight edge shall be placed over that portion of the critical area which reveals the most highly curved fringes. The straight edge shall be placed tangent to the most highly curved fringe at its peak, and a count shall be made of the number of fringes that it crossed from the point of tangency to a point on the tangent line which is a distance H from the point off tangency. N shall equal the number of fringes crossed. The value  $NL/2$  shall be computed where L is the wave length of the light used. In order that the radius of curvature of the surface shall be greater than 500 feet (152.4 m), the value of  $NL/2$  shall not exceed a value of  $H^2/12,000$  inches. When sodium light of wave length 5,898.9 angstroms ( $1\text{A} = 3.937 \times 10^{-9}$  inches) is used, the maximum allowable value of N shall be computed as follows for a distance of 1 inch (2.54 cm) from the point of tangency, i.e.,  $H = 1$  inch (2.54 cm).

$$\begin{aligned} H^2/12,000 &= 1/12,000 \text{ inch} = 0.000083 \text{ inch (0.00211 mm)} \\ NL/2 &= 0.0000116 N \text{ inch} \end{aligned}$$

In order that  $NL/2$  does not exceed  $H^2/12,000$ , N may be not greater than 7. Therefore, when sodium light is used, and the straight edge crosses more than 7 fringes per inch, the radius of curvature is less than 500 feet (152.4 m).

4.5.5 Thermal stability. The glass specimen shall be placed in air at a temperature of  $-65^\circ \pm 10^\circ\text{F}$  ( $-54^\circ \pm 5^\circ\text{C}$ ) for a period of six hours, then placed in still air at  $73.5^\circ \pm 2^\circ\text{F}$  ( $23^\circ \pm 1.1^\circ\text{C}$ ) for 1 hour or until temperature equilibrium has been attained in the specimen. The laminate shall then be placed in circulating air at  $161.4^\circ \pm 4^\circ\text{F}$  ( $72^\circ \pm 2.2^\circ\text{C}$ ) for 3 hours. After removal to still air at  $70^\circ$  to  $80^\circ\text{F}$  ( $21^\circ$  to  $27^\circ\text{C}$ ) and cooling to this temperature, the specimen shall be examined for conformance to the requirements of 3.9.4.

MIL-G-5485D

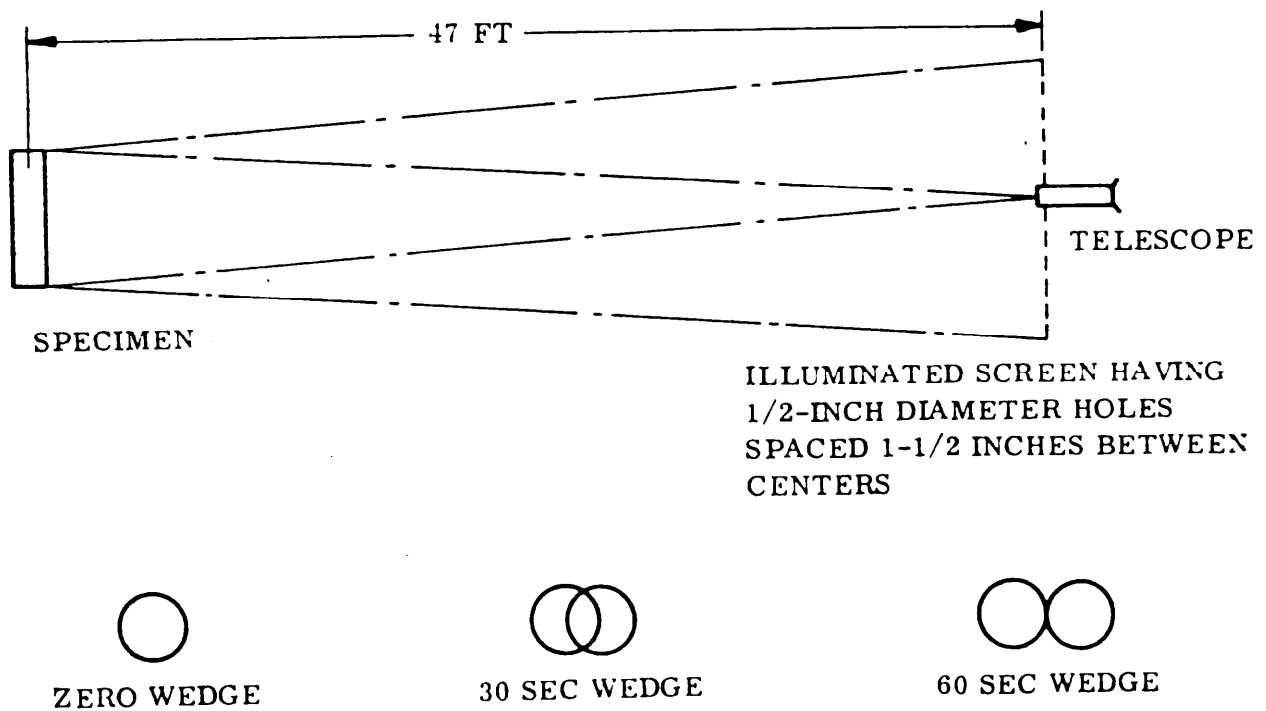
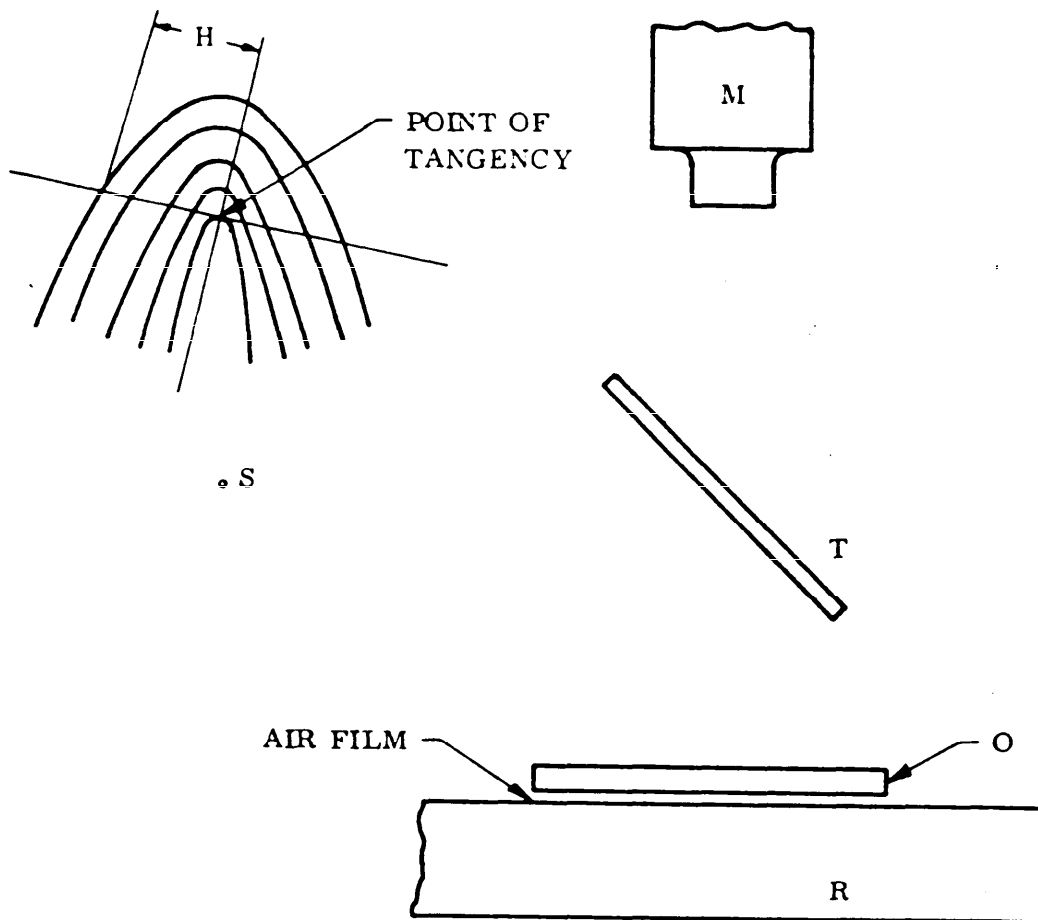


FIGURE 2. Setup for determining optical deviation.

MIL-G-5485D



- S - is a monochromatic source of light.  
 T - is a thin transparent plate of glass.  
 O - is an optical flat.  
 R - is the specimen under test.  
 M - is a microscope of low magnifying power used with a calibrated mechanical stage.

Light from S shall be reflected downward by T to ensure that it falls on R and O. The observer looking through M will then see the interference fringes formed by the air film between R and O. When the upper surface of R is plane, straight parallel fringes equally spaced will result. When this surface is cylindrical, straight parallel fringes not equally spaced or curved fringes will result. When unequally spaced straight fringes are seen, the plate shall be moved until curved fringes are visible. When the surface R is curved in any other manner, curved fringes will be visible.

FIGURE 3. Setup for determining flatness.

## MIL-G-5485D

\* 4.5.6 Luminous transmittance.

4.5.6.1 Before exposure. Luminous transmittance of glass specimens shall be determined in accordance with ASTM D1003, Procedure A. Transmittance shall be determined before and after the exposure of 4.5.6.2 and shall be in conformance with 3.9.5.

4.5.6.2 Exposure. The light source used in exposure of the specimen shall be a flaming carbon arc of the Fade-O-Meter type enclosed in a clear Corex D globe or equivalent, using the equivalent of Atlas No. 70 and No. 20 Carbons, with a current rate of 13 amperes, or an equivalent apparatus. As an alternate to the flaming arc, a quartz mercury arc, enclosed in a clear Corex D globe and possessing controls to provide an intensity equivalent to the flaming carbon arc, may be used. The specimens shall be suspended in unobstructed light with the plane of the glass normal to the light source at a distance of 15 inches (38.1 cm) from the arc. The exposure time shall be 100 hours. The specimen temperature shall not exceed 165°F (74°C) at any time during the exposure period.

4.5.7 Ball impact test. The laminated glass shall conform to 3.9.6, after the ball impact test described in 4.5.7.1.

4.5.7.1 Procedure. Each specimen shall be conditioned at  $0^{\circ} \pm 2^{\circ}\text{F}$  ( $-18^{\circ} \pm 1^{\circ}\text{C}$ ) until stabilized at that temperature, then placed in an impact frame that supports the edges and maintains the specimen in a horizontal position. A 0.5 (1.1 Kilograms) pound smooth steel sphere shall be dropped from a suitable height onto the approximate center of the specimen causing the glass plies to break. If all the glass plies are not broken, the specimen shall be reversed and the impacts repeated until all glass plies are broken. The impacts shall be conducted as rapidly as possible. The specimen shall remain at  $-18^{\circ} \pm 5^{\circ}\text{C}$  ( $0^{\circ} \pm 10^{\circ}\text{F}$ ) throughout the test. Impacts which occur in areas other than the center of the specimen shall not be evaluated. The specimen shall be discarded and another tested.

4.5.8 Ballistic test. The acquisition activity shall designate the procedure and specimen pass/fail criteria (see 6.2j). The acquisition activity may use the suggested procedure specified in 6.6.

## 5. PACKAGING

5.1 Preservation. Preservation shall be levels A or C, as specified (see 6.2m).

## 5.1.1 Level A

5.1.1.1 Cleaning. The glass shall be cleaned in accordance with Method C-1 of MIL-P-116.

5.1.1.2 Individual protection. Individual glass laminates shall be protected with an adhering paper, that can be readily removed without scratching or otherwise injuring the surfaces, or wrapped with heavy tissue paper. An overwrap consisting of a double layer of single-faced corrugated fiberboard and Kraft paper (30 pound, 13.6 kg) shall be applied and taped with a moisture-resistant tape conforming to PPP-T-60.

## MIL-G-5485D

5.1.1.3 Unit package. Unit quantities shall be as specified by the acquisition activity (see 6.2e). Glass protected as specified in 5.1.1.2 shall be packaged in accordance with Method III of MIL-P-116. The unit containers shall be cushioned to prevent shifting of the glass within the unit container.

5.1.2 Level C. Glass laminates shall be cleaned and packaged in accordance with the manufacturer's commercial practice.

5.2 Packing. Packing shall be Level A, B or C as specified (see 6.2m). Each exterior container, as far as practicable, shall contain the same size and quantity of product, and shall be of uniform size with tare and cube consistent with the protection required of that level.

5.2.1 Level A. Glass laminates prepared as specified in 5.1.1 for level A, shall be packed in exterior overseas type shipping containers conforming to PPP-B-585, Class 3; PPP-B-591 Class II, Style A or B; PPP-B-601 overseas or PPP-B-621, Class 2, Style 2. Plywood used shall conform to Type A of A-A 55057 and be treated in accordance with TT-W-572. Containers shall be provided with a case liner, fabricated and sealed in accordance with MIL-L-10547. The containers shall be closed and strapped in accordance with the applicable container specification and appendix thereto. The gross weight of each pack shall not exceed 200 pounds (91 kg), unless the weight of an individual item exceeds this limitation.

5.2.2 Level B. Glass laminates shall be packed as specified in 5.2.1, except that containers shall be of the domestic type.

5.2.3 Level C. Glass shall be packed in such a manner as to ensure carrier acceptance and safe delivery at destination, in accordance with carrier regulations and rules for the applicable method of transportation.

5.3 Marking of shipments. Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. The identification shall contain the following information:

Stock number or other identification number as specified in  
the purchase document.\*

GLASS, LAMINATED, FLAT, BULLET-RESISTANT

MIL-G-5485D

Type

Quantity

Order number

Manufacturer's name or trademark

\*NOTE: The contractor shall enter the National Stock Number specified in the purchase document or as furnished by the acquisition activity. When a National Stock Number is not provided or available from the acquisition activity, leave space therefore and enter the Number or other identification when provided by the acquisition activity.

## MIL-G-5485D

5.3.1 In addition, each package shall also be plainly marked:

GLASS - HANDLE WITH CARE

6. NOTES.

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Laminated bullet resistant glass laminates covered by this specification are intended for use in aircraft windscreens, windows and similar applications, as follows:

6.1.1 Type I. Type I laminates are intended for use where armor protection is the primary concern.

6.1.2 Type II. Type II laminates are intended for applications where, in addition to armor protection, precision-ground surfaces are required for use of the laminate in conjunction with a gunsight. They may be used as a reflector for the sight or to provide minimum sight line deviation when gun sights equipped with separate reflectors are used.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. Type. (see 1.2)
- c. Title, number and date of the applicable acquisition drawing.
- d. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of documents referenced (see 2.1).
- e. Quantity.
- f. Unit quantity per package.
- g. Dimensions and tolerances (see 3.4).
- h. Heat treatment, distortion criteria, and critical areas if not defined in applicable drawings (see 3.2.1, 3.7.1 and 3.9.2, respectively).
- i. Marking requirement (see 3.8).
- j. Ballistic requirement, test, and evaluation criteria, when required (see 3.1.1, 4.5.8 and 6.6).
- k. Interlayer material, if other than specified in 3.2.2).
- l. Plastic edge requirement (see 3.3.2).
- m. Levels of preservation/packaging (see Section 5).



## MIL-G-5485D

- n. First article, when required (see 3.1 and 6.3).
- o. Quality conformance destructive inspection sampling, if other than 4.4.2.1.

6.3 Instructions for first article. When first article inspection is required, the acquisition activity shall designate the testing facility to which the samples shall be forwarded.

6.4 Critical sighting area. Design of type II windscreen glass laminates should provide for a clearance of at least one (1) inch (2.54 cm) between the perimeter of the critical sighting area and the edge of the laminate.

6.5 Definitions. The following is a list of defects not defined in DD-G-451 or ASTM C1036:

- a. Blow-ins: Oil stains caused by penetration of oily substance along the edge.
- b. Bristles: Small particles of cleaning brush bristles entrapped with the laminations.
- c. Crayon marks: The remains of crayon markings which are not entirely removed in glass cleaning operations.
- d. Culletts: Small, transparent glass chips which adhere to interior plastic or glass surfaces.
- e. Fingerprints: Handling imprints which are not entirely removed in glass cleaning operations.
- f. Lint: Small bits of fabric embedded in the plastic layers or entrapped within the laminations.
- g. Plastic streaks: Surface irregularities in the plastic filler which appear as faint streaks in the laminated product.
- h. Vents: Cracks in glass plates which do not so open as to make a rough surface or cause glass to fall away.

6.6 Suggested ballistic requirement. When the acquisition activity specifies a ballistic requirement, the following procedure may be considered for use:

6.6.1 Ballistics procedure. Use the velocity (feet per second), size of projectile, angles of obliquity, and test temperature specified on Figure 1. Securely mount three, 16 by 30 inch by as supplied thickness glass assemblies in a wood or metal frame. Mount a 0.020 inch thick sheet of cellulose acetate 6 inches behind and parallel to the assembly undergoing test. Fire one round of ammunition (size as specified in the acquisition document or by the test official) at each assembly. Any impact away from the approximate center of the test specimen may be discarded and another specimen tested. The test official will determine the location of the impact.

## MIL-G-5485D

6.6.1 Test evaluation. The assembly fails when any of the following occur:

- a. The bullet core or core fragments completely penetrate the assembly tested.
- b. The cellulose acetate sheet is cut or opened (penetrated) by the bullet core, core fragments or any piece of glass.

6.7 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

<u>Reference Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
4.3.2	DI-NDTI-80809A	Test/Inspection Report	

The above DID's were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.8 Subject term (key word) listing.

Ballistic requirements  
Impact resistance  
Laminate construction

6.9 Marginal notations. The margins of this specification are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:  
Army - MR  
Navy - AS  
Air Force - 99

Preparing activity:  
Navy - AS  
Project No. 9340-1003

Review activities:  
Army - AV  
Air Force - 84  
DLA - GS

User activities:  
Navy - OS

Commanding Officer  
Naval Air Warfare Center Aircraft Division Lakehurst  
Systems Requirements Department (Code SR3)  
Lakehurst, NJ 08733-5100

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

**NOTE:** This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

<b>I RECOMMEND A CHANGE:</b>	1. DOCUMENT NUMBER MIL-G-5485D	2. DOCUMENT DATE (YYMMDD) 93/02/22
3. DOCUMENT TITLE GLASS, LAMINATED, FLAT, BULLET RESISTANT		
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)		
5. REASON FOR RECOMMENDATION		
6. SUBMITTER		
a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	e. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY		
a. NAME COMMANDING OFFICER, NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION LAKEHURST SYSTEMS REQUIREMENTS DEPARTMENT	b. TELEPHONE (Include Area Code) (1) Commercial (908) 323-7488	(2) AUTOVON 624-7488
c. ADDRESS (Include Zip Code) CODE SR3 LAKEHURST, NJ 08733-5100	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	