

INCH-POUNDS

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## MILITARY SPECIFICATION

### PLASTIC MATERIALS, GLASS FIBER-EPOXY RESIN, LOW PRESSURE LAMINATED

**This document is inactive for new design.**

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 glass fiber base, epoxy resin low pressure laminated plastic materials. The materials may be furnished as sheets or formed parts, as specified.

1.2 Classification. The glass fiber base, epoxy resin low pressure laminated plastic materials should be of the following types and classes, as specified (6.2):

Type I – General Purpose  
Type II – Heat Resistant

Class 1 – Nonelectrical  
Class 2 – Radio Frequency  
Class 3 – Radar Requency

1.2.1 Glass base identification. The laminated materials should be further identified by cloth number or mat description of the component glass fiber base as shown in Tables I and II; e.g. "Type I, Class 1 laminate, cloth base number 112."

Comments, suggestions, or questions on this document should be addressed to: Commander, U.S. Army Research, Development and Engineering Center, ATTN: AMSRD-AMR-SE-TD, Redstone Arsenal, AL 35898-5000. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at [HTTP://assist.daps.dla.mil](http://assist.daps.dla.mil).

AMSC N/A

FSC 9330

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## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 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 cited in the solicitation or contract.

## DEPARTMENT OF DEFENSE SPECIFICATIONS

PPP-B-585	Boxes, Wood, Wirebound
MIL-R-9300	Resin, Epoxy, Low Pressure Laminating
MIL-P-9400	Plastic Laminate and Sandwich Construction Parts and Assembly, Aircraft Structural, Process Specification Requirements
MIL-M-43248	Mats, Reinforcing, Glass Fiber

## DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-2073-1	Standard Practice for Military Packaging
MIL-STD-1916	Department of Defense Preferred Methods for Acceptance of Product

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/>.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

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ANSI/ASQ Z1.4

Sampling Procedures and Tables for Inspection by Attributes

(Copies of this document can be obtained from ASQ Distribution Center, 5131 S. Third Street, Milwaukee, Wisconsin, 53207-6028 or [www.asq.org](http://www.asq.org).)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM), International

ASTM D1974

Standard Practice for Methods of Closing, Sealing, and Reinforcing Fiberboard Boxes

ASTM D2240

Standard Test Method for Rubber Property – Durometer Hardness

ASTM D6251

Standard Specification for Wood-Cleated Panelboard Shipping Boxes

ASTM D6880

Standard Specification for Wood Boxes

(Copies of these documents can be obtained from the American Society for Testing Material, 100 Bar Harbor Drive, West Conshohocken, PA 19428-2959, or [www.astm.org](http://www.astm.org).)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE), International

SAE-AMS-C-9084

Cloth, Glass, Finished, for Resin Laminates

(Copies of this document can be obtained from 400 Commonwealth Drive, Warren, PA 15096-0001, or <http://www.sae.org/>.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), 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 Precedence of requirements. The products furnished under this specification shall be as specified herein and in accordance with the drawings, specification, or contract requirements for the specific sheet or part. In the event of discrepancy between this specification and the requirements of the applicable drawings, specifications, or contract for the specific sheet or part, the requirements of the latter shall govern.

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3.2 First article approval. Unless otherwise specified in the contract or order (6.2), the laminated plastic materials furnished under this specification shall be products which have been approved under the first article inspection prescribed herein (4.3).

3.3 Materials. Materials used in the laminates shall be as follows:

3.3.1 Glass fiber base.

3.3.1.1 Cloth. The cloth shall be continuous filament glass cloth in accordance with Tables I and II and the requirements of SAE AMS-C-9084.

3.3.1.2 Mat, short fibers. The short fiber mat shall conform to the requirements of MIL-M-43248, Grade A.

3.3.1.3 Mat, nonwoven continuous filament. The nonwoven continuous filament mat shall be as described in Tables I and II.

3.3.2 Resin. The laminating resin shall conform to the requirements of MIL-R-9300. Types I and II resin of MIL-R-9300 shall be used for Types I and II, laminated material, respectively, of MIL-P-25421. Any electrical or nonelectrical grade of resin under MIL-R-9300 may be used for any class of laminated material of MIL-P-25421, provided the finished laminate product conforms to the requirements for the applicable class and type under MIL-P-25421 and the requirements for the specific part or end item.

3.3.3 Fillers. Finely divided, inert, inorganic fillers may be used in mat laminates only, provided other applicable requirements of this specification are met by the laminates.

3.4 Finished product. The finished laminated product shall conform to the following requirements:

3.4.1 Physical properties. The minimum Barcol hardness value and the minimum and maximum values for specific gravity and for resin content of the laminated materials shall be as specified in the process specification or data sheet.

3.4.2 Mechanical properties. The mechanical properties of the laminated materials shall conform to the requirements of Tables I and II when tested in accordance with Table VI.

3.4.3 Electrical properties. Except as may be specified otherwise for Class 3 in contract or order (6.2, 6.3), the electrical properties of Class 2 and Class 3 laminated materials shall conform to Table III when tested in accordance with Table VI. There shall be no electrical requirements for Class 1 material.

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TABLE I. Longitudinal <sup>1/</sup> Mechanical Properties of Epoxy Laminates (Types I and II) at Standard Temperature (23°C)

Glass Fiber Base		Tensile Strength Thousands of psi (Minimum Average)		Compression Strength Thousands of psi (Minimum Average)		Flexural Strength (Ultimate) Thousands of psi (Minimum Average)		Flexural Modulus of Elasticity (Initial) Millions of psi (Minimum Average)	
Cloth number <sup>2/</sup>									
(Parallel Laminated)		Standard Conditions	<sup>3/</sup> Wet Conditions	Standard Conditions	<sup>3/</sup> Wet Conditions	Standard Conditions	<sup>3/</sup> Wet Conditions	Standard Conditions	<sup>3/</sup> Wet Conditions
(I)	112	47	45	47	42	70	65	3.3	3.2
(IA)	112-150	47	45	47	42	70	65	3.3	3.2
(II)	116	47	45	43	39	63	58	3.3	3.2
(IIA)	116-150	47	45	43	39	63	58	3.3	3.2
(III)	120	47	45	47	42	70	65	3.3	3.2
(IV)	128	47	45	33	30	63	58	3.3	3.2
(IVA)	128-150	47	45	33	30	63	58	3.3	3.2
(IVB)	128-750	47	45	33	30	63	58	3.3	3.2
(V)	143	90	85	68	60	115	110	5.2	5.0
(VA)	143-150	90	85	68	60	115	110	5.2	5.0
(VI)	162	47	45	23	20	49	45	2.8	2.6
(VII)	164	39	35	31	28	49	45	2.8	2.6
(VIIA)	164-150	39	35	31	28	49	45	2.8	2.6
(VIII)	181	48	45	50	45	75	65	3.2	3.2
(VIII A)	181-150	48	45	50	45	75	65	3.2	3.2
(VIII B)	181-750	48	45	50	45	75	65	3.2	3.2
(IX)	182	50	47	46	41	70	65	3.3	3.2
(IX A)	182-150	50	47	46	41	70	65	3.3	3.2
(X)	183	50	47	43	39	63	58	3.3	3.2
(XI)	184	50	47	37	33	63	58	3.3	3.2
(XI A)	184-150	50	47	37	33	63	58	3.3	3.2
Mat, short fibers (Random laminated)		25	23	30	25	35	30	1.7	1.5
Mat, nonwoven continuous filament <u>Laminated as specified</u>									
Crossplied		60	55	55	50	100	85	3.3	3.2
Isotropic		40	35	45	40	65	58	2.5	2.5
Unidirectional		100	90	70	62	125	110	5.0	5.0

- <sup>1/</sup> Except that volume for random laminated and isotropic laminated materials are for random oriented specimens and values for crossplied laminates are for specimens cut in the stronger principal direction. By "longitudinal" is meant the warp directions of the parallel laminated cloth base or filament direction of the unidirectional mat base.
- <sup>2/</sup> Arabic numerals show the base cloth identification numbers under this specification. Parenthetical Roman numerals show, for information only, the cloth type designations under SAE AMS-C-9084.
- <sup>3/</sup> Dimensional measurements for the determination of mechanical properties under wet conditions are taken before immersion.

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TABLE II. Longitudinal <sup>1/</sup> Mechanical Properties of Epoxy Laminates at Elevated Temperatures

Glass Fiber Base		Types I and II At 70°C after ½ hour at 70°C		TYPE II At 260°C after ½ hour at 260° C				TYPE II At 260°C after 192 hours at 260° C	
Cloth number <sup>2/</sup>		Flexural Strength (Ultimate) (Thousands of psi) (Minimum Average)	Flexural modulus of elasticity (Initial) (Millions of psi) (Minimum Average)	Tensile Strength (Thousands of psi) (Minimum Average)	Compressive Strength (Thousands of psi) (Minimum Average)	Flexural Strength (Ultimate) (Thousands of psi) (Minimum Average)	Flexural modulus of elasticity (Initial) (Millions of psi) (Minimum Average)	Flexural Strength (Ultimate) (Thousands of psi) (Minimum Average)	Flexural modulus of elasticity (Initial) (Millions of psi) (Minimum Average)
(Parallel	Laminated)								
(I)	112	65.0	3.2	20.0	10.0	22.0	2.0	18.0	1.8
(IA)	112-150	65.0	3.2	20.0	10.0	22.0	2.0	18.0	1.8
(II)	116	58.0	3.2	20.0	8.0	20.0	2.0	15.0	1.8
(IIA)	116-150	58.0	3.2	20.0	8.0	20.0	2.0	15.0	1.8
(III)	120	65.0	3.2	20.0	10.0	22.0	2.0	18.0	1.8
(IV)	128	58.0	3.2	20.0	8.0	20.0	2.0	15.0	1.8
(IVA)	128-150	58.0	3.2	20.0	8.0	20.0	2.0	15.0	1.8
(IVB)	128-750	58.0	3.2	20.0	8.0	20.0	2.0	15.0	1.8
(V)	143	105.0	5.0	42.0	16.0	40.0	3.3	29.0	2.8
(VA)	143-150	105.0	5.0	42.0	16.0	40.0	3.3	29.0	2.8
(VI)	162	45.0	2.8	20.0	6.0	15.0	2.0	11.0	1.4
(VII)	164	45.0	2.8	20.0	6.0	15.0	2.0	11.0	1.4
(VIIA)	164-150	45.0	2.8	20.0	6.0	15.0	2.0	11.0	1.4
(VIII)	181	65.0	3.2	45.0	10.0	25.0	2.3	20.0	1.9
(VIII A)	181-150	65.0	3.2	45.0	10.0	25.0	2.3	20.0	1.9
(VIII B)	181-750	65.0	3.2	45.0	10.0	25.0	2.3	20.0	1.9
(IX)	182	65.0	3.2	21.0	10.0	22.0	2.0	18.0	1.8
(IX A)	182-150	65.0	3.2	21.0	10.0	22.0	2.0	18.0	1.8
(X)	183	58.0	3.2	21.0	8.0	20.0	2.0	15.0	1.8
(XI)	184	58.0	3.2	21.0	8.0	20.0	2.0	15.0	1.8
(XI A)	184-150	58.0	3.2	21.0	8.0	20.0	2.0	15.0	1.8
Mat, short fibers (Random laminated)		32.0	1.6	12.0	8.0	11.0	1.0	8.5	0.85
Mat, nonwoven continuous filament <u>Laminated as specified</u>									
Crossplied		80.0	3.0	28.0	11.0	31.0	2.0	25.5	1.8
Isotropic		60.0	2.2	17.0	9.0	20.0	1.5	16.0	1.4
Unidirectional		100.0	4.5	42.5	15.0	39.0	3.0	32.0	2.6

<sup>1/</sup> Except that volume for random laminated and isotropic laminated materials are for random oriented specimens and values for crossplied laminates are for specimens cut in the stronger principal direction. By "longitudinal" is meant the warp directions of the parallel laminated cloth base or filament direction of the unidirectional mat base.

<sup>2/</sup> Arabic numerals show the base cloth identification numbers under this specification. Parenthetical Roman numerals show, for information only, the cloth type designations under SAE AMS-C-9084.

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TABLE III. Electrical Requirements for Classes 2 and 3 Laminated Materials  
(see also 6.3)

Characteristic	Standard Conditions	Immersion Conditions
Class 2 (At 1 megacycle) Dielectric constant (max) Loss tangent (max)	4.4 0.045	4.6 0.055
Class 3 (At 8,500 to 10,000 megacycles) <u>1/</u> Dielectric constant (max) Loss tangent (max)	4.6 0.020	4.6 0.025

1/ "X-band" frequency range. The recommended test frequency for this band is 9,375 megacycles per second (6.3).

3.4.4 Shape, dimensions, and make-up of laminate. The shape, thickness, and surface dimensions of the laminate, the number of component plies of glass cloth or mat in the laminate, the position and direction of the plies, and other specific details of the laminate parts or end items shall be as specified herein and in the drawings or specifications for the part or end item (3.1). Dimensional tolerances shall be as shown in Table V.

3.4.4.1 Gaps or laps in fabric plies. There shall be no gaps between pieces of glass fabric in any lamination. When laps are necessary, they shall be laid up with a lap width of at least ½ inch. No two laps shall be superimposed upon each other in the plastic.

3.4.4.2 Resin overlays. The laminated plastic materials shall not be made with a gel resin overlay, integrally molded or otherwise, or with any other such thick-resin surface or surfacing material.

3.4.5 Foreign materials. No metal staples, paper tape, fillers (except in mat laminates (3.3.3)), or other foreign materials shall remain in the finished plastic laminate, unless permitted by the applicable drawings or specifications. Parts to which rain-erosion resistant coatings or other coatings are subsequently to be applied, shall be cleaned free of surface contamination, such as parting agents, which might adversely affect the adhesion of the coating.

3.4.6 Workmanship. The plastic material shall be uniform, smooth, and free from uncured or unbounded areas, gaps, cracks, holes, blisters, resin pockets, areas lacking resin, tackiness, excess surface resin, incorrect laps, wrinkles, delamination,

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air or gas pockets, patches, porosity, and other similar defects as defined in MIL-P-9400. The material shall be essentially void free.

3.4.6.1 Allowable defects. Allowable defects in the plastic laminate, including repairable defects, shall be limited to those described in the applicable drawing or specification.

#### 4. VERIFICATION

4.1 Classification of inspections. The inspections performed under this specification shall be one of the following classifications:

- (a) First article inspection (4.2).
- (b) Quality conformance inspection (4.3)

4.2 First article inspection. First Article inspection shall include all the examinations and tests of this specification (4.4) except the examination of preparation of delivery (4.4.4). Unless otherwise specified (6.2), no material shall be submitted for acceptance until the first article samples prescribed in 4.2.1 have been subjected to first article inspection, and determined to be satisfactory, or equivalent certification and data (4.2.2) have been approved. However, approval of the first article samples or of equivalent certification and data shall not eliminate the need for verification for conformance to the requirements of this specification.

4.2.1 Sampling for first article inspection. For first article inspection, the following samples, certified as representative of the materials to be used and the products to be furnished.

Finished glass cloth – 1 linear yard, full width

Fibrous glass mat – 4 linear yards, full width

Laminating resin – 1 gallon

Inorganic filler – 1 pound

Sheets or formed parts – 1 finished sheet or part, minimum

Laminate – 1 or 2 sheets, as applicable of dimensions and description specified for sample sheets in 4.4.3.1, where it is impractical to derive laminate test specimens from the items to be furnished. Where practical, this may be substituted by additional part or end item specimens sufficient to yield an equivalent quantity of laminate suitable for testing. The provisions of 4.4.3 and



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4.4.3.1 concerning preparation of laminate test specimens when required shall be applicable to the first article sample, also.

4.2.2 First article inspection in repeat orders. In repeat orders or orders for different parts, the requirement for first article inspection in this specification may be met by analysis of applicable test data from previous first article testing, provided the materials and processes have not been changed. However, the performance of any first article test or examination may be required to assure the conformance of the material to the specification requirements.

4.3 Quality conformance inspection. Quality conformance inspection shall include the examination of sheets or parts for visual and dimensional defects (4.4.2, tests of the sheets or parts for conformity to physical, mechanical, and electrical requirements (4.4.3), and examination of preparation for delivery (4.4.4).

4.3.1 Sampling for quality conformance inspection. Sampling for quality conformance inspection shall be performed in accordance with MIL-STD-1916 or ANSI/ASQ Z1.4 for the inspection level and acceptability quality level (AQL) prescribed under the applicable examination or test. The following definitions shall apply:

4.3.1.1 Lot. For purposes of quality conformance sampling, a lot shall consist of all laminated materials of the same type, class, glass fiber base, and part number subjected to inspection at one time.

4.3.1.2 Unit of product. The unit of product for determining lot size for quality conformance sampling shall be as specified in the respective examination or test paragraphs. The sample units shall also be as specified in these paragraphs.

4.3.3 Rejection criteria. The acceptability quality levels (AQLs) in this specification are expressed in effects per 100 units in accordance with MIL-STD-1916 or ANSI/ASQ Z1.4. If, in any of the specified quality conformance examinations and tests, the number of defects in the sample units exceeds the MIL-STD-1916 or ANSI/ASQ Z1.4 acceptance number for the applicable AQL, the lot represented by the samples shall be rejected. The disposition of rejected lots shall be in accordance with MIL-STD-1916 or ANSI/ASQ Z1.4.

#### 4.4 Examinations and tests.

4.4.1 Examination and tests of component materials (first article inspection only). The cloth, mat, resin or filler components which are to be used in the laminated plastic materials shall be inspected for conformity to 3.3 and the applicable referenced specifications.

4.4.2 Examination of sheets or parts. As examination of the sheets or parts for visual defects and for dimensional defects shall be made in accordance with 4.4.2.1

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and 4.4.2.2 respectively, and at the inspection levels and acceptable quality levels (AQLs) specified therein. The unit of product for determining lot size for these examinations shall be one plastic sheet or part, as applicable, and the sample unit shall also be one sheet or part.

4.4.2.1 Examination of sheets or parts for visual defects. This examination shall be in accordance with Table IV. The inspection level shall be Level I and the AQL shall be 1.5 defects per 100 units.

TABLE IV. Examination of Sheets or Parts for Visual Defects

Characteristic	Defect
Shape	Not shape specified.
Appearance	Not uniform in translucence or color. Finish not as specified, not uniform.
Make-up	Not laminated as specified. Laminations gap. Overlaps less than ½ inch. Made with resin overlay or thick resin surface.
Foreign Material	Embedded foreign material, surface dirt, parting material, or other contaminants.
Workmanship	Cracks, scratches holes, blisters, wrinkles, tacky surface, resin-starved or porous areas, resin pockets, chipped or broken parts. Rough surfaces, rough edges. Sheets not flat when required (curvature exceeds 1/8 inch per foot of length or width). Reverse curvature, warped or distorted. Sheets delaminated, unbonded, or containing air pockets. Patches, except when specifically permitted as allowable defect.

4.4.2.2 Examination of sheets or parts for dimensional defects. The sample units shall be examined in accordance with Table V. The inspection level shall be S-3, and the AQL shall be 2.5 defects for 100 units.

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TABLE V. Examination of Sheets or Parts for Dimensional Defects

Characteristic	Defect								
Length or Width	Varies by more than 1/8 inch or by more than the tolerances indicated in drawings or requirements, as applicable.								
Thickness	<p>Varies by more than the tolerances indicated in drawings, specifications, or other requirements. Unless otherwise specified, the following thickness-tolerance relationships shall apply:</p> <table> <tr> <th><u>Specified thickness (inches)</u></th><th><u>Tolerance (percent)</u></th></tr> <tr> <td>0.25 or less</td><td>± 10</td></tr> <tr> <td>Over 0.25 through 0.50</td><td>± 7</td></tr> <tr> <td>Over 0.50</td><td>± 5</td></tr> </table>	<u>Specified thickness (inches)</u>	<u>Tolerance (percent)</u>	0.25 or less	± 10	Over 0.25 through 0.50	± 7	Over 0.50	± 5
<u>Specified thickness (inches)</u>	<u>Tolerance (percent)</u>								
0.25 or less	± 10								
Over 0.25 through 0.50	± 7								
Over 0.50	± 5								

4.4.3 Tests of sheets or parts. The sheets or parts shall be subjected to physical, mechanical, and electrical tests in accordance with Table VI. The unit of product for determining lot size for these tests shall be one sheet or part. The sample unit shall be a sufficient area of flat laminate,  $0.125 \pm 0.010$  inch in thickness, to perform all the applicable tests for Class 1 or Class 2 laminated material, or all the physical and mechanical tests for Class 3 laminated material. For Class 3 only, the sample unit shall also include additional flat laminate of sufficient area and suitable thickness to perform the required electrical tests at 8,500 to 10,000 megacycles. Unless otherwise specified (6.2), the additional laminate for the Class 3 electrical tests shall be at least 0.75 inch thick. When required, all sample units shall be cut into specimens of the number and description specified for the tests of Table VI, machined to size and suitable for testing. The inspection level for the tests of Table VI shall be S-1 and the AQL shall be 6.5 defects per 100 units, except that the minimum sample size shall be three units with an acceptance number of zero for a sample of that size.

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TABLE VI. Laminate Test of Sheets or Parts

Property	Requirement	Method <u>1</u> /	Number of determinations per sample unit
Specific gravity	3.5.1	5011 or 5012	1
Resin content	3.5.1	7061	3
Barcol hardness	3.5.1	4.7.1	10
Tensile strength:			
Standard conditions	Table I	1011 <u>2</u> /	5
Wet conditions	Table I	1011 <u>2</u> /	5
260°C, ½ hour (Type II only)	Table II	1011 <u>2</u> /	5
Compressive strength:			
Standard conditions	Table I	1021 <u>3</u> /	5
Wet conditions	Table I	1021 <u>3</u> /	5
260°C, ½ hour (Type II only)	Table II	1021 <u>3</u> /	5
Flexural strength, Ultimate			
Standard conditions	Table I	1031 <u>4</u> /	5
Wet conditions	Table I	1031 <u>4</u> /	5
70° C, ½ hour	Table II	1031 <u>4</u> /	5
260°C, ½ hour (Type II only)	Table II	1031 <u>4</u> /	5
260°C, 192 hours (Type II only)	Table II	1031 <u>4</u> /	5
Flexural modulus of elasticity, initial			
Standard conditions	Table I	1031 <u>4</u> /	5
Wet conditions	Table I	1031 <u>4</u> /	5
70° C, ½ hour	Table II	1031 <u>4</u> /	5
260°C, ½ hour (Type II only)	Table II	1031 <u>4</u> /	5
260°C, 192 hours (Type II only)	Table II	1031 <u>4</u> /	5
Dielectric constant at 1 megacycle (Class 2 Only):			
Standard conditions	Table III	4021	4
After immersion	Table III	4021	4
Loss tangent at 1 megacycle (Class 2 only):			
Standard conditions	Table III	4021	4
After immersion	Table III	4021	4
Dielectric constant at 8,500 to 10,000 megacycles (Class 3 only):			
Standard conditions	Table III	4.7.2	4
After immersion	Table III	4.7.2	4
Loss tangent at 8,500 to 10,000 megacycles (Class 3 only):			
Standard conditions	Table III	4.7.2	4
After immersion	Table III	4.7.2	4

1/ Method references other than paragraph numbers refer to methods of ASTM D2240.

2/ Tensile specimens to be Type II of Method 1011.

3/ Compression specimens to be tested edgewise by thin-sheet procedure.

4/ Flexural specimens to be tested flatwise.

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4.4.3.1 Substitute sample sheets. If the items in the procurement lot are impractical for providing test specimens, the substitute sample shall be one laminate sheet,  $0.125 \pm 0.010$  inch thick, with a linear measurement of at least 12 inches in any dimension, and a minimum area of four square feet. For the Class 3 electrical test, the unit shall also include a 4 inch by 8 inch laminate sheet with a minimum thickness of 0.75 inch, unless otherwise specified (6.2). When required, the sample sheets shall be cut into specimens of the proper number and description for test as provided in 4.4.3.

4.4.4 Examination of preparation for delivery. An examination shall be made in accordance with Table VII to determine that packaging, packing, and markings comply with the requirements of Section 5 of this specification. The sample unit for this examination and also the unit to determine lot size for sampling shall be one shipping container, fully packed, selected just prior to the closing operation. Shipping containers full prepared for delivery shall be examined for closure defects. The inspection level for this examination shall be S-2 and the Acceptable Quality Level (AQL) shall be 2.5 defects per 100 units.

TABLE VII. Examination of Preparation for Delivery

Characteristic	Defect
Packaging	Not level specified in requirements. Not individually wrapped or interleaved, when specified. Packaging material not as specified.
Packing	Not level specified in contract requirements. Arrangement not as specified. Specified pads or liners missing or not as specified. Any nonconforming packing component, component missing, damaged or otherwise defective affecting serviceability. Closure not as specified.
Count	Less than specified or indicated quantity.
Weight	Gross weight exceeds specified requirements.
Markings	Interior or exterior markings (as applicable) omitted, illegible, incorrect, incomplete, or not in accordance with requirements.

4.5 Test conditions.

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4.5.1 Standard conditions. Standard conditions shall be  $23^{\circ} \pm 1.1^{\circ} \text{ C}$  ( $73.4^{\circ} \pm 2^{\circ} \text{ F}$ ) and  $50 \pm 4$  percent relative humidity. Specimens shall be tested at standard conditions after being conditioned for 96 hours at this temperature and humidity.

4.5.2 Wet conditions (for mechanical tests). Wet conditioning shall be a two-hour immersion of the specimen in boiling distilled water. The specimens shall be cooled in distilled water to  $23^{\circ} \pm 1.1^{\circ} \text{ C}$  ( $73.4^{\circ} \pm 2^{\circ} \text{ F}$ ) and shall be tested wet at that temperature immediately after removal from the water. In case of any questions as to the validity of the test results, wet conditioning shall be 30 days soaking in distilled water at room temperature, and the specimens shall be tested wet immediately after removal from the water. Results obtained under the latter conditions shall be final. Surface moisture may be wiped from all wet specimens before testing.

4.5.3 Immersion conditions (for electrical tests). The specimens shall be immersed in distilled water at  $23^{\circ} \pm 1.1^{\circ} \text{ C}$  ( $73.4^{\circ} \pm 2^{\circ} \text{ F}$ ) for 24 hours. The specimen shall then be removed from the water, the surface moisture shall be wiped off, and the tests shall be conducted immediately at  $23^{\circ} \pm 1.1^{\circ} \text{ C}$  ( $73.4^{\circ} \pm 2^{\circ} \text{ F}$ ).

4.5.4 Elevated temperature conditions,  $70^{\circ} \text{ C}$ . The specimens shall be exposed for  $30 \pm 5$  minutes at a temperature of  $70^{\circ} \pm 1.1^{\circ} \text{ C}$  ( $158^{\circ} \pm 2^{\circ} \text{ F}$ ) in a test chamber previously heated to that temperature and shall be tested immediately at the same temperature.

4.5.5 Elevated temperature conditions  $260^{\circ} \text{ C}$ , (Type II only). In the  $\frac{1}{2}$  hour exposure, the specimens shall be exposed for  $30 \pm 5$  minutes at a temperature of  $260^{\circ} \pm 2.8^{\circ} \text{ C}$  ( $500^{\circ} \pm 5^{\circ} \text{ F}$ ) in a test chamber previously heated to that temperature and shall be tested immediately at the same temperature. In the 192 hour exposure, the specimens shall be exposed for  $30 \pm 5$  minutes at a temperature of  $260^{\circ} \pm 2.8^{\circ} \text{ C}$  ( $500^{\circ} \pm 5^{\circ} \text{ F}$ ) for 192 hours in a circulating air oven. The specimens shall then be transferred to a previously heated  $260^{\circ} \pm 2.8^{\circ} \text{ C}$  ( $500^{\circ} \pm 5^{\circ} \text{ F}$ ) test chamber for an additional half hour, and shall be tested at that temperature.

4.6 Test methods. Tests shall be conducted by the methods of ASTM D2240 prescribed in Table VI, except as follows.

4.6.1 Barcol hardness. Barcol hardness shall be determined by direct reading on a Barcol tester. Barcol tester model GYZJ 934-1 shall be used (6.4).

4.6.2 Electrical properties of Class 3 laminate. Electrical properties tests at 8,500 to 10,000 megacycles per second (Class 3 laminate only) shall be performed by the shunted line wave-guide method or resonant cavity technique (6.3.2), using the sample specified for that purpose in 4.4.3 and 4.4.3.1. If calculations (6.3) establish that specimens thinner than the samples furnished would be preferable, the testing activity is permitted to abrade or otherwise mill the specimens to the optimum thickness.

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## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

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

6.1 Intended use. The laminated plastic materials covered by this specification are intended for use in aircraft and non-aircraft structural parts, such as radio and radar antenna housings and fairings and for use in other applications. All exterior aircraft plastic parts are considered structural parts.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, Number, and date of this specification.
- (b) Packaging requirements (5.1).

6.3 Special electrical requirements. In addition to the test frequency and values for electrical properties specified for Class 3 material in Table III, other electrical frequencies and specific values for the electrical properties may be of importance in particular applications and may be specified in the contract or order in lieu of the frequency and values given in Table III. Typical frequencies are as follows, including the X-band.

<u>Band</u>	<u>Test frequency (mega cycles per second)</u>
S	2,880
C	5,400
X	9,375
K <sub>u</sub>	16,500
K	24,500
K <sub>a</sub>	35,000

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For tests above the  $K_a$  band, a possible test frequency is 58,500 megacycles per second, based on available oscillator tubes.

6.3.1 Specimen thickness. The thickness of specimens required for electrical tests at the frequencies of 6.3 may be calculated by the following formula:

$$d = \frac{3\lambda_0}{4\sqrt{\epsilon - (\lambda_0/\lambda_c)^2}}$$

Where:

- d = specimen thickness
- $\lambda_0$  = free space wavelength
- $\lambda_c$  = cut-off wavelength of wave guide
- $\epsilon$  = Approximate dielectric constant of sample

6.3.2 Source document. Further information on test of Class 3 material is available in ARTC Report, "ARTC-4 Electrical Test Procedures for Radomes and Radome Materials (Revised July 1960)," prepared by Aerospace Industries Association of America, Inc., 1725 DeSales Street, Washington, D.C. 20036.

6.4 Barcol tester. Information concerning Barcol tester, model GYZJ 934-1, is available from the Barber-Colman Company, Rockford, Illinois.

#### 6.5 Keyword listing.

Barcol hardness  
End item specimen  
Laminate materials  
Properties  
Repairable defects

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.



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### Custodians:

Army – AV  
Navy – AS  
Air Force – 99

### Preparing activity:

Army - AV  
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### Review Activities:

Army – MI  
Air Force – 85

### Industry Associations:

ASTM, ANSI, SAE

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil>.