

MIL-P-25421B

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SUPERSEDING

MIL-P-25421A

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MILITARY SPECIFICATION

**PLASTIC MATERIALS, GLASS FIBER BASE - EPOXY
RESIN, LOW PRESSURE LAMINATED**

This specification is mandatory 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 shall 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 Frequency

1.2.1 **Glass base identification.** The laminated materials shall be further identified by the 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".

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

MIL-P-25421 B**SPECIFICATIONS****Federal**

PPP-B-585	Boxes, Wood, Wirebound
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-621	Boxes, Wood, Nailed and Lock-Corner
PPP-B-636	Box, Fiberboard

Military

MIL-P-116	Preservation, Methods of
MIL-C-9084	Cloth, Glass, Finished, for Resin Laminates
MIL-R-9300	Resin, Epoxy, Low-Pressure Laminating
MIL-P-9400	Plastic Laminate Materials and Sandwich Construction, Glass Fiber Base, Low-Pressure Aircraft Structural, Process Specification Requirements
MIL-M-43248	Mats, Reinforcing, Glass Fiber

STANDARDS**Federal**

FED-STD-406	Plastics: Methods of Testing
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Military

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

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

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3. REQUIREMENTS

3.1 Precedence of requirements. The products furnished under this specification shall be as specified herein and in accordance with the drawings, specifications, 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.

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 MIL-C-9084, Class 2.

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 Process specification. When required by the drawing, specification, or contract applicable to the specific part or end item, the supplier shall furnish to the Government, prior to commencement of production, a detailed description of the manufacturing and fabricating process in the form of a titled, numbered, and dated process specification. The process specification shall conform, in content and format, to MIL-P-9400 with regard to identification of materials and processing

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equipment and in describing the raw material preparation, lay-up, and fabrication procedures. It shall also state the minimum Barcol hardness of the product and limiting values for specific gravity and resin content. When a process specification is not so required, the supplier shall provide a data sheet or label containing the following information:

- (a) Number of this specification.
- (b) Type and class of laminated material being furnished (1. 2).
- (c) Cloth number or mat identification of glass fiber base (1. 2. 1).
- (d) The supplier's designation for the laminate product.
- (e) Certified minimum Barcol hardness of the product (3. 5. 1).
- (f) Certified minimum and maximum values for specific gravity of the product (3. 5. 1).
- (g) Certified minimum and maximum values for resin content of the product (3. 5. 1).
- (h) Identification (supplier's designation) of glass finish and resin.

3. 5 Finished product. The finished laminated product shall conform to the following requirements:

3. 5. 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 supplier's process specification or data sheet.

3. 5. 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. 5. 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.

3. 5. 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 laminated parts or end items shall be as specified herein and in the

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TABLE II
LONGITUDINAL λ MECHANICAL PROPERTIES OF EPOXY LAMINATES (TYPES I AND II) AT STANDARD TEMPERATURES (23°C)

Glass fiber base	Tensile strength (Thousands of psi) (Minimum Average)		Compressive strength (Thousands of psi) (Minimum Average)		Flexural strength (Thousands of psi) (Minimum Average)		Flexural modulus of elasticity (Initial) (Millions of psi) (Minimum Average)	
	Standard conditions	Wet conditions λ /	Standard conditions	Wet conditions λ /	Standard conditions	Wet conditions λ /	Standard conditions	Wet conditions λ /
Cloth number 2/ (Parallel Laminated)								
(I)	47	45	47	42	70	65	3.3	3.2
(IA)	47	45	47	42	70	65	3.3	3.2
(II)	47	45	43	39	63	58	3.3	3.2
(IIA)	47	45	43	39	63	58	3.3	3.2
(IIB)	47	45	47	42	70	65	3.3	3.2
(IIC)	47	45	33	30	63	58	3.3	3.2
(IIV)	47	45	33	30	63	58	3.3	3.2
(IVA)	47	45	33	30	63	58	3.3	3.2
(IVB)	47	45	33	30	63	58	3.3	3.2
(V)	90	85	66	60	115	110	5.2	5.0
(VA)	90	85	66	60	115	110	5.2	5.0
(VI)	47	45	33	20	49	45	2.6	2.6
(VIA)	39	35	31	28	49	45	2.6	2.6
(VII)	39	35	31	28	49	45	2.6	2.6
(VIIA)	39	35	31	28	49	45	2.6	2.6
(VIIIA)	48	45	50	45	75	65	3.2	3.2
(IIIB)	48	45	50	45	75	65	3.2	3.2
(IIC)	50	47	46	41	70	65	3.3	3.2
(IIC)	50	47	46	41	70	65	3.3	3.2
(IIC)	50	47	43	39	63	58	3.3	3.2
(IIC)	50	47	37	33	63	58	3.3	3.2
(IIC)	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 (Laminated as specified)								
Crossplied isotropic	60	55	55	50	100	85	3.3	3.2
Unidirectional	40	35	45	40	65	58	2.5	2.5
	100	90	70	62	125	110	5.0	5.0

λ / Except that values 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 direction of the parallel laminated cloth base or filament direction of the unidirectional mat base.

λ / Arabic numerals show the base cloth identification numbers under this specification. Parenthetical Roman numerals show, for information only, the cloth type designations under MIL-C-9084.

λ / Dimensional measurements for the determination of mechanical properties under wet conditions are taken before immersion.

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TABLE II
LONGITUDINAL 1/ MECHANICAL PROPERTIES OF EPOXY LAMINATES AT ELEVATED TEMPERATURES

Glass fiber base	TYPES I and II At 70°C after 1/2 hour at 70°C		TYPE II At 260°C after 1/2 hour at 260°C				TYPE II At 260°C after 192 hours at 260°C	
	Flexural strength (Ultimate) (Thousands of psi) (Min average)	Flexural modulus of elasticity (Initial) (Millions of psi) (Min average)	Tensile strength (Thousands of psi) (Min average)	Compressive strength (Thousands of psi) (Min average)	Flexural strength (Ultimate) (Thousands of psi) (Min average)	Flexural modulus of elasticity (Initial) (Millions of psi) (Min average)	Flexural strength (Ultimate) (Thousands of psi) (Min average)	Flexural modulus of elasticity (Initial) (Millions of psi) (Min average)
Cloth number 2/ (Parallel laminated)								
(I)	65.0	3.2	20.0	10.0	21.0	2.0	16.0	1.8
(IA)	65.0	3.2	20.0	10.0	21.0	2.0	16.0	1.8
(II)	58.0	3.2	20.0	8.0	20.0	2.0	15.0	1.8
(IIA)	58.0	3.2	20.0	8.0	20.0	2.0	15.0	1.8
(IIB)	65.0	3.2	20.0	10.0	21.0	2.0	15.0	1.8
(IV)	58.0	3.2	20.0	8.0	20.0	2.0	15.0	1.8
(IVA)	58.0	3.2	20.0	8.0	20.0	2.0	15.0	1.8
(IVB)	58.0	3.2	20.0	8.0	20.0	2.0	15.0	1.8
(V)	105.0	5.0	42.0	16.0	40.0	3.3	29.0	2.6
(VA)	105.0	5.0	42.0	16.0	40.0	3.3	29.0	2.6
(VI)	45.0	2.8	20.0	6.0	15.0	2.0	11.0	1.4
(VIA)	45.0	2.8	20.0	6.0	15.0	2.0	11.0	1.4
(VII)	45.0	2.8	20.0	6.0	15.0	2.0	11.0	1.4
(VIIA)	45.0	2.8	20.0	6.0	15.0	2.0	11.0	1.4
(VIII)	65.0	3.2	45.0	10.0	25.0	2.3	20.0	1.9
(VIII A)	65.0	3.2	45.0	10.0	25.0	2.3	20.0	1.9
(VIII B)	65.0	3.2	45.0	10.0	25.0	2.3	20.0	1.9
(IX)	65.0	3.2	21.0	10.0	22.0	2.0	18.0	1.6
(IXA)	65.0	3.2	21.0	10.0	22.0	2.0	18.0	1.6
(I)	58.0	3.2	21.0	8.0	20.0	2.0	15.0	1.6
(IA)	58.0	3.2	21.0	8.0	20.0	2.0	15.0	1.6
(IIA)	58.0	3.2	21.0	8.0	20.0	2.0	15.0	1.6
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 (Laminated as specified)	80.0	3.0	26.0	11.0	31.0	2.0	25.5	1.8
Crossplied 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

1/ Except that values 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. "Longitudinal" is meant the warp direction of the parallel laminated cloth base of filament direction of the unidirectional mat base.

2/ Arabic numerals show the base cloth identification numbers under this specification. Parenthetical Roman numerals show, for information only, the cloth type designations under MIL-C-9004.

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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)	4.4	4.6
Loss tangent (max)	0.045	0.055
Class 3 (At 8,500 to 10,000 megacycles) ^{1/}		
Dielectric constant (max)	4.6	4.6
Loss tangent (max)	0.020	0.025

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

drawings, specifications, or contracts for the part or end item (3.1). Dimensional tolerances shall be as shown in Table V.

3.5.4.1 Gaps or laps in fabric plies. Unless otherwise approved by the procuring activity, 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 1/2 inch. No two laps shall be superimposed upon each other in the plastic material.

3.5.4.2 Resin overlays. Unless specifically approved by the procuring activity, 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.

3.5.5 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, specifications, or contract. 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.

3.5.6 Workmanship. Except as otherwise specifically approved (3.5.6.1), the plastic material shall be uniform, smooth, and free from uncured or unbonded areas, gaps, cracks, holes, blisters, resin pockets, areas lacking resin, tackiness,

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excess surface resin, incorrect laps, wrinkles, delamination, air or gas pockets, patches, porosity, and other similar defects as defined in MIL-P-9400. The material shall be essentially void free.

3.5.6.1 Allowable defects. Allowable defects in the plastic laminate, including repairable defects corrected by the supplier, shall be limited to those described in the applicable drawing, specification, or contract. All allowable defects shall be fully described, in such procurement documents, as to type, size, number, extent, and spacing. Defects other than those so described shall be counted as workmanship defects.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 assure that supplies and services conform to prescribed requirements.

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

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

4.3 First article inspection. First article inspection shall include all the examinations and tests of this specification (4.5) except the examination of preparation for delivery (4.5.4). Unless otherwise specified (6.2), no material shall be submitted for acceptance under any contract or order until the first article samples prescribed in 4.3.1 have been subjected to first article inspection and pronounced satisfactory by the procuring activity or until equivalent certification and data (4.3.2) have been approved by the procuring activity. However, approval of the first article samples or of equivalent certification and data shall not relieve the supplier of his obligation to meet the quality conformance inspection.

4.3.1 Sampling for first article inspection. For first article inspection, the supplier shall submit at least two copies of the process specification or data sheet (3.4) together with the following samples, as applicable, certified as representative of the materials to be used and the products to be furnished under the contract or order.

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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 4.5.3.1, where it is impractical to derive laminate test specimens from the items to be furnished under the contract. 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 4.5.3 and 4.5.3.1 concerning preparation of laminate test specimens by the supplier when required shall be applicable to the first article sample also.

4.3.2 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, at the discretion of the procuring activity, by submittal of applicable test data from previous first article testing, provided the materials and processes have not been changed and provided the supplier submits a certified statement to that effect. However, the procuring activity may, at any time, require the performance of any first article test or examination deemed necessary to assure the conformance of the material to the specification requirements.

4.4 Quality conformance inspection. Quality conformance inspection shall include the examination of sheets or parts for visual and dimensional defects (4.5.2), tests of the sheets or parts for conformity to physical, mechanical, and electrical requirements (4.5.3), and examination of preparation for delivery (4.5.4).

4.4.1 Sampling for quality conformance inspection. Sampling for quality conformance inspection shall be performed in accordance with MIL-STD-105 for the inspection level and acceptable quality level (AQL) prescribed under the applicable examination or test. The following definitions shall apply:

4.4.1.1 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.

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4.4.1.2 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.

4.4.2 Rejection criteria. The acceptable quality levels (AQL's) in this specification are expressed in defects per 100 units in accordance with MIL-STD-105. If, in any of the specified quality conformance examinations and tests, the number of defects in the sample units exceeds the MIL-STD-105 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-105.

4.5 Examinations and tests.

4.5.1 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 reference specifications.

4.5.2 Examination of sheets or parts. An examination of the sheets or parts for visual defects and for dimensional defects shall be made in accordance with 4.5.2.1 and 4.5.2.2 respectively at the inspection levels and acceptable quality levels (AQL's) 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.

4.5.2.1 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 1/2 inch. Made with resin overlay or thick resin surface.

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TABLE IV (Continued)

Characteristic	Defect
Foreign material	Embedded foreign material. Surface dirt, parting material, or other contaminants. Sur-
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 defects.

4.5.2.2 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 per 100 units.

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 contract requirements, as applicable.								
Thickness	Varies by more than the tolerances indicated in drawings, specifications, or contract requirements. Unless otherwise specified, the following thickness-tolerance relationships shall apply: <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th><u>Specified thickness (inches)</u></th> <th><u>Tolerance (percent)</u></th> </tr> </thead> <tbody> <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> </tbody> </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								

4.5.3 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 ± .010 inch in thickness, to perform all the applicable tests for Class 1 or Class 2 laminated material or all

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the physical and mechanical tests for Class 3 laminated material. For Class 3 only, the sample unit shall include also 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 by the procuring activity (6.2), all sample units shall be cut by the supplier 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.

TABLE VI

LAMINATE TESTS OF SHEETS OR PARTS

Property	Requirement	Method <u>1/</u>	Number of determinations per sample unit <u>2/</u>
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>3/</u>	5
Wet conditions	Table I	1011 <u>3/</u>	5
260°C, 1/2 hr (Type II only)	Table II	1011 <u>3/</u>	5
Compressive strength:			
Standard conditions	Table I	1021 <u>4/</u>	5
Wet conditions	Table I	1021 <u>4/</u>	5
260°C, 1/2 hr (Type II only)	Table II	1021 <u>4/</u>	5
Flexural strength, ultimate:			
Standard conditions	Table I	1031 <u>5/</u>	5
Wet conditions	Table I	1031 <u>5/</u>	5
70°C, 1/2 hr	Table II	1031 <u>5/</u>	5
260°C, 1/2 hr (Type II only)	Table II	1031 <u>5/</u>	5
260°C, 192 hrs (Type II only)	Table II	1031 <u>5/</u>	5
Flexural modulus of elasticity, initial:			
Standard conditions	Table I	1031 <u>5/</u>	5
Wet conditions	Table I	1031 <u>5/</u>	5
70°C, 1/2 hr	Table II	1031 <u>5/</u>	5
260°C, 1/2 hr (Type II only)	Table II	1031 <u>5/</u>	5
260°C, 192 hrs (Type II only)	Table II	1031 <u>5/</u>	5

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TABLE VI (Continued)

Property	Requirement	Method <u>1</u> /	Number of determinations per sample unit <u>2</u> /
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 Fed. Test Method Std. No. 406.

2/ Test reports should include results of the individual determinations.

3/ Tensile specimens to be type II of Method 1011.

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

5/ Flexural specimens to be tested flatwise.

4.5.3.1 Substitute sample sheets. If the items in the procurement lot are impractical for providing test specimens, the substitute sample unit shall be one laminate sheet, 0.125 ± 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 tests, the unit shall include also a 4 inch by 8 inch laminate sheet with a thickness of 0.75 inch minimum unless otherwise specified (6.2). When required by the procuring activity, the sample sheets shall be cut by the supplier into specimens of the proper number and description for test as provided in 4.5.3.

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4.5.4 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 fully 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 contract 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 contract requirements.

4.6 Test conditions.

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

4.6.2 Wet conditions (for mechanical tests). Wet conditioning shall be a 2-hour immersion of the specimen in boiling distilled water. The specimens shall be cooled in distilled water to $23 \pm 1.1^{\circ} \text{C}$ ($73.4 \pm 2^{\circ} \text{F}$) and shall be tested wet at that temperature immediately after removal from the water. In case of any question 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

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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.

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

4.6.4 Elevated temperature conditions, 70°C . The specimens shall be exposed for 1/2 hour ± 5 minutes at a temperature of $70 \pm 1.1^\circ \text{C}$ ($158 \pm 2^\circ \text{F}$) in a test chamber previously heated to that temperature and shall then be tested immediately at the same temperature.

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

4.7 Test methods. Tests shall be conducted by the methods of FED-STD-406 prescribed in Table VI, except as follows:

4.7.1 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).

4.7.2 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 4.5.3 and 4.5.3.1. If calculations (6.3.1) 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.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging.

5.1.1 Level A. Sheets shall be packaged in quantities specified, in accordance with Method III of MIL-P-116. The exterior container shall be the unit container. The preservation and packaging for parts shall be as specified in the specifications, drawings, or contracts for the parts fabricated from the plastic material.

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5.1.2 Level C. Unit and intermediate packaging shall be in accordance with the supplier's best commercial practice.

5.2 Packing.

5.2.1 Level A. Sheets shall be packed in quantities specified in wirebound wood boxes conforming to PPP-B-585, Class 3; wood cleated plywood boxes conforming to PPP-B-601, overseas type; nailed wood boxes conforming to PPP-B-621, Class 2; or fiber boxes conforming to PPP-B-636, weather-resistant class. The gross weight of the fiber boxes shall be as specified in PPP-B-636 and gross weight for the other boxes shall not exceed 200 pounds. Containers shall be closed and strapped in accordance with the applicable container specification or appendix thereto. The packing for parts shall be as specified in the specifications, drawings, or contracts for the parts fabricated from the plastic material.

5.2.2 Level B. Sheets shall be packed in quantities specified in domestic type shipping containers conforming to the requirements of PPP-B-585, PPP-B-601, PPP-B-621, or PPP-B-636. As far as practical, containers shall be of uniform shape and size, of minimum cube and tare consistent with the protection required, and contain identical quantities. The gross weight of a pack conforming to PPP-B-636 shall be as specified in PPP-B-636 and gross weight for packs conforming to the other specifications shall not exceed 200 pounds. Containers shall be closed and strapped in accordance with applicable container specifications or appendix thereto. The packing for parts shall be as specified in the specifications, drawings, or contracts for the parts fabricated from the plastic material.

5.2.3 Level C. Packing shall be in accordance with commercial practice adequate to ensure acceptance and safe delivery by the carrier for the mode of transportation employed.

5.3 Marking. In addition to any special marking which may be required in the contract or order (6.2), the marking of interior and exterior containers shall be in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The laminated plastic materials covered by this specification are intended for use in aircraft and nonaircraft 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.

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6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type, class, and glass base identification of the laminated material (1.2, 1.2.1).
- (c) Drawings, specifications, et cetera, applicable to the sheet or part (3.1).
- (d) Shape, dimensions, and make-up of sheet or part, unless covered under (c) above (3.5.4).
- (e) Where the first article samples should be sent, the activity responsible for testing, and instructions concerning the submittal of the test reports (4.3).
- (f) Level of packaging and packing requirements for sheets; or packaging and packing requirements for parts, unless covered under (c) above (5.1, 5.2).
- (g) Exceptions, if any, to the optional provisions of this specification including:
 - (1) Waiver, if applicable, of first article inspection (3.2, 4.3); or, if applicable, acceptability of certification supported by previous data, for repeat orders or different parts (4.3, 4.3.2).
 - (2) Requirement, if applicable, for process specification in lieu of data sheet, unless covered under (c) above (3.4).
 - (3) Special electrical requirements for Class 3 material, if applicable (3.5.3, 6.3).
 - (4) Allowable defects, if applicable (3.5.6.1).
 - (5) Required thickness for Class 3 laminate sample for electrical tests, if other than 0.75 inch (4.5.3, 4.5.3.1).
 - (6) Requirement, if applicable, that the samples be processed into test specimens by the supplier (4.5.3, 4.5.3.1).
 - (7) Special marking requirements, if applicable (5.3).

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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 (megacycles per second)</u>
S	2,880
C	5,400
X	9,375
K _u	16,500
K	24,500
K _a	35,000

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
- λ_0 = free space wavelength
- λ_c = cut-off wavelength of wave guide
- ϵ = approximate dielectric constant of sample

6.3.2 Source document. Further information on tests 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 Marginal indicia. Because of the extensive degree of revision in this issue of the specification, no attempt has been made to indicate by marginal indicia where changes (additions, modifications, corrections, deletions) from the previous issue were made. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of relationship to the last previous issue.

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Air Force - 84
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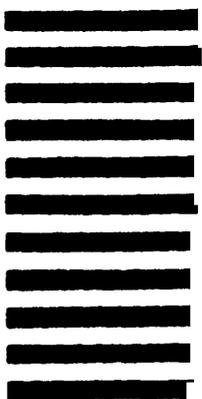
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