

MIL-R-9300B

15 January 1968

SUPERSEDING

MIL-R-9300A

14 December 1955

(see 6.5)

MILITARY SPECIFICATION

RESIN, EPOXY, LOW-PRESSURE LAMINATING

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 low-pressure laminating epoxy resins used in fabricating glass fabric-based plastic laminates for various applications (see 6.1 and 6.6).

* 1.2 Classification - The resin shall be furnished in the following types, grades, and forms, as specified (6.2):

Type I - General Purpose

Type II - Heat Resistant

Grade 0 - Nonelectrical.

Grade A - Dielectric constant (laminate) of 3.6 up to 4.0.

Grade B - Dielectric constant (laminate) of 4.0 up to 4.2.

Grade C - Dielectric constant (laminate) of 4.2 up to 4.4.

Grade D - Dielectric constant (laminate) of 4.4 up to 4.6.

Form A - Liquid or solid resin (3.3).

Form B - Pre-impregnated resin (3.3).

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2. APPLICABLE DOCUMENTS

- * 2.1 Government-furnished documents - 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:

SPECIFICATIONS

Federal

| | |
|-----------|---|
| TT-I-735 | Isopropyl Alcohol |
| TT-S-735 | Standard Test Fluids; Hydrocarbon |
| PPP-B-576 | Boxes, Wood, Cleated, Veneer, Paper Overlaid |
| PPP-B-585 | Boxes, Wood, Wirebound |
| PPP-B-591 | Boxes, Fiberboard, Wood-cleated |
| PPP-B-601 | Boxes, Wood, Cleated-Plywood |
| PPP-B-621 | Boxes, Wood, Nailed and Lock-Corner |
| PPP-B-636 | Box, Fiberboard |
| PPP-C-96 | Cans, Metal, 28 Gage and Lighter |
| PPP-D-705 | Drum, Metal Shipping, Steel (Over 12 and Under 55 Gallon) |
| PPP-D-729 | Drums: Metal, 55-Gallon (For Shipment of Noncorrosive Material) |
| PPP-P-704 | Pails, Metal. (Shipping, Steel, 1 through 12 Gallon) |
| PPP-T-60 | Tape, Pressure-Sensitive Adhesive, Water-proof, for Packaging |

Military

| | |
|------------|--|
| MIL-H-5806 | Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance |
|------------|--|

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Military (Continued)

| | |
|-------------|---|
| MIL-C-9084 | Cloth, Glass, Finished, for Polyester Resin Laminates |
| MIL-L-10547 | Liners, Case, and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible |

STANDARDS

Federal

| | |
|----------------------------------|------------------------------|
| Fed. Test Method Std. No. 406 | Plastics; Methods of Testing |
|----------------------------------|------------------------------|

Military

| | |
|-------------|---|
| MIL-STD-105 | Sampling Procedures and Tables for Inspection by Attributes |
| MIL-STD-129 | Marking for Shipment and Storage |
| MIL-STD-147 | Palletized and Containerized Unit Loads - 40" X 48", 4-Way (Partial) Pallet Skids, Runners, or Pallet-Type Base |

(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.)

2.2 Other publications - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply:

Uniform Classification Committee

Uniform Freight Classification Rules

(Application for copies of the above publication should be addressed to the Uniform Classification Committee, 202 Chicago Union Station, Chicago, Illinois 60606.)

Interstate Commerce Commission

| | |
|----------------|--|
| 49 CFR 71 - 90 | Interstate Commerce Commission Rules and Regulations for the Transportation of Explosives and Other Dangerous Articles |
|----------------|--|

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(The Interstate Commerce Commission Regulations are now a part of the Code of Federal Regulations (latest cumulative pocket supplement) available from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402. Orders for the above publication should cite "Code of Federal Regulations, 49 CFR 71 - 90 (Revised 1963)").

Manufacturing Chemists Association, Inc.

Manual L-1

Guide to Precautionary Labeling of Hazardous Chemicals (Sixth Edition-1961)

(Application for copies should be addressed to the Manufacturing Chemists Association, Universal Building, 1825 Connecticut Avenue, Washington, D. C. 20009.)

3. REQUIREMENTS

- * 3.1 Preproduction - The resin furnished under this specification shall be a product which has been subjected to and has passed the preproduction inspection specified herein.
- * 3.1.1 One-year weathering data - As part of the preproduction requirement, the supplier shall submit certified data showing that a glass cloth base plastic laminate, fabricated as specified in 4.3.1.1 from the resin to be furnished under this specification, has been exposed to outdoor weathering in accordance with 4.5.6 for a period of one year and has subsequently met the applicable requirements of Table I. The data shall identify the geographical location in which the outdoor weathering was accomplished.
- 3.2 Materials - The materials used in the manufacture of the resin shall be of high quality and as specified herein. The resin shall be an epoxy, thermosetting, low pressure laminating type. The component materials of the resin shall be such that the cured resin shall not be corrosive to metals.
- 3.3 Form - The resin shall be in a form (liquid or solid) suitable for impregnating or may be furnished already impregnated on glass fabric (pre-impregnated). It shall be free from foreign materials.
- 3.4 Code number - The supplier shall designate each resin composition by a code number that shall be used to identify the resin. The code number may include trade name if desired. Any changes in the components or manufacturing procedures shall necessitate use of a different code number. For pre-impregnated materials, those materials using the same resin but having different properties due to different impregnating conditions shall have different designations. The designation shall consist of the resin code number with a suffix indicating impregnating conditions.

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3.5 Physical and reactive properties - For liquid or solid resin, the supplier shall furnish limiting values for specific gravity, viscosity, and melting point of the unactivated resin; gel time and peak exotherm of the activated resin; and the Barcol hardness and specific gravity of the cured unfilled resin. For pre-impregnated material, limiting values shall be furnished for the volatile content, dry resin content, and flow. These values and the methods of determination, when not specified herein, shall be included by the supplier in the instruction sheet (3.8) and shall be considered requirements of this specification for resin of the code number or designation concerned. The supplier shall also furnish nominal values (adequate for design calculation) for the dielectric constant and loss tangent of the cured unfilled resin (Grades A through D only) at the frequency applicable to the electrical tests of Table II.

3.6 Mechanical and physical properties of the laminate - For both Type I and Type II resins, the mechanical and physical properties of a glass cloth base plastic laminate, fabricated as specified in 4.3.1.1 shall conform to the values listed in Table I.

3.7 Electrical properties of the laminate (Grades A through D only) - The electrical properties of a glass cloth base plastic laminate, fabricated as specified in 4.3.1.2, shall conform to the values listed in Table II. (See also 6.2 (d) and 6.3.)

3.8 Instruction sheet -

3.8.1 For liquid or solid resin - Unless otherwise specified, the supplier shall provide for each unit package of resin an approved instruction sheet, preferably adherent to the container, with the following information:

- (a) Type and grade of the resin and the number of this specification.
- (b) Resin code number (3.4).
- (c) The form of the resin (3.3).
- (d) Limiting values required in 3.5 for the unactivated resin, the activated resin, and the cured unfilled resin; also the test procedures when not specified herein.
- (e) Dielectric constant (nominal) and loss tangent (nominal) of the cured unfilled resin, Grades A through D only (3.5).
- (f) Maximum usable storage life of the resin (unactivated and activated) and recommended storage conditions.

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TABLE 1

• **EDGWISE MECHANICAL AND PHYSICAL PROPERTIES
OF GLASS CLOTH BASE PLASTIC LAMINATE 1/**

(Unless otherwise specified, all values are minimum for the average of five specimens)

| Property | Test Method (FED-STD-406 Method Nos. except as noted) | Requirements 2/ |
|---|---|-----------------------------|
| TESTED UNDER STANDARD CONDITIONS (see 4.5.1) | | |
| • Flexural properties, flatwise - psi Ultimate strength Initial modulus of elasticity | 1031 (Specimen size 1 by 4 inches) | 75,000 3.2×10^6 |
| • Ultimate tensile strength, psi | 1011 (Type 2 specimens) | 48,000 |
| Ultimate compressive strength, edgewise, psi | 1021 (Specimen size 3-1/8 by 1/2 inches) | 50,000 |
| Flammability, inches per minute | 2021 | 0.5 (max) |
| Water absorption, 24 hours immersion, percent change in weight | 7031 | 0.5 (max) |
| Rockwell M hardness | 1061 | 100 |
| • Barcol hardness | (see 4.6.4) | 70 |
| Specific gravity | 5011 or 5012 | <u>3</u> / |
| Resin content, percent | 7061 | <u>3</u> / |
| TESTED WET (see 4.5.2) | | |
| Flexural properties, flatwise, psi Ultimate strength Initial modulus of elasticity | 1031 (Specimen size 1 by 4 inches) | 65,000 3.2×10^6 |
| Ultimate tensile strength, psi | 1011 (Type 2 specimens) | 45,000 |
| Ultimate compressive strength, edgewise, psi | 1021 (Specimen size 3-1/8 by 1/2 inches) | 45,000 |
| TESTED AT 70° C AFTER EXPOSURE TO 70° C FOR 1/2 HOUR (see 4.5.3) | | |
| Flexural properties, flatwise, psi Ultimate strength Initial modulus of elasticity | 1031 (Specimen size 1 by 4 inches) | 65,000 3.2×10^6 |

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TABLE I (Continued)

| Property | Test Method (FED-STD-406 Method Nos. except as noted) | Requirements <u>2/</u> |
|--|---|------------------------|
| TESTED AT 260° C AFTER EXPOSURE TO 260° C for 1/2 HOUR (see 4.5.4) (Type II only) | | |
| Flexural properties, flatwise, psi | 1031 | |
| • Ultimate strength | (Specimen size 1 by 4 inches) | 25,000 |
| • Initial modulus of elasticity | | 2.3×10^6 |
| • Ultimate tensile strength, psi | 1011 (Type 2 specimens) | 45,000 |
| Ultimate compressive strength, edgewise, psi | 1021 (Specimen size 3-1/8 by 1/2 inches) | 10,000 |
| TESTED AT 260° C AFTER EXPOSURE TO 260° C FOR 192 HOURS (see 4.5.4) (Type II only) | | |
| Flexural properties, flatwise, psi | 1031 | |
| • Ultimate strength | (Specimen size 1 by 4 inches) | 20,000 |
| • Initial modulus of elasticity | | 1.9×10^6 |
| TESTED AFTER IMMERSION IN CHEMICAL FLUIDS (see 4.5.5) | | |
| MIL-H-5606, Hydraulic Fluid, Petroleum Base Aircraft, Missile and Ordnance | (Specimen size 1 by 4 inches) | |
| • Percent change in weight (increase or decrease) | 7011 | 0.2 (max) |
| • Percent change in thickness (increase or decrease) | 7011 | 0.2 (max) |
| • Ultimate flexural strength, psi <u>4/</u> | 1031 | 70,000 |
| TT-I-735 Isopropyl Alcohol | (Specimen size 1 by 4 inches) | |
| • Percent change in weight (increase or decrease) | 7011 | 0.2 (max) |
| • Percent change in thickness (increase or decrease) | 7011 | 0.1 (max) |
| • Ultimate flexural strength, psi <u>4/</u> | 1031 | 70,000 |
| TT-S-735 Standard Test Fluids, Hydrocarbon, Type III | (Specimen size 1 by 4 inches) | |
| • Percent change in weight (increase or decrease) | 7011 | 0.2 (max) |
| • Percent change in thickness (increase or decrease) | 7011 | 0.2 (max) |
| • Ultimate flexural strength, psi <u>4/</u> | 1031 | 65,000 |
| TESTED AFTER 1 YEAR OF OUTDOOR WEATHERING (see 4.5.6) | | |
| Flexural properties, flatwise, psi | 1031 | |
| • Ultimate strength | (Specimen size 1 by 4 inches) | 65,000 |
| • Initial modulus of elasticity | | 3.2×10^6 |

NOTES: 1/ Lengthwise direction of test specimens is parallel to warp direction of glass fabric.2/ The specimens shall show no cracking, crazing, softening, delamination, nor any other visible deterioration after conditioning exposures or immersions.3/ There are no requirements for these properties. However, the values should be determined and reported.4/ Calculations for ultimate flexural strength after immersion in chemical fluids shall be based on the dimensions of the specimens before immersion.

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TABLE II

- * **ELECTRICAL REQUIREMENTS FOR GLASS CLOTH BASE PLASTIC (GRADES A-D ONLY) LAMINATES AT 8,500 - 10,000 MEGACYCLES ^{1/}**
 (Values reported shall be the average of the determinations made on a minimum of 3 specimens.)

| | Dielectric constant | Loss tangent |
|---|---|--------------|
| Standard conditions (4.5.1) | As specified for the applicable grade (1.2) | 0.020 (max) |
| Immersion conditions (4.5.7) | Not greater than 5 percent increase over the value at standard conditions | 0.025 (max) |
| * High temperature range (4.5.4) (Type II only) | ±3.0 percent (max) change from value at standard conditions | 0.045 (max) |

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

- (g) Recommended mixing and impregnating procedures, including recommended types, percentages and manner of utilization of curing agents (hardeners, accelerators, etc.)
- (h) Recommended finishes to be used on glass fabric.
- (i) Maximum allowable shelf life at various temperatures of impregnated fabric before curing.
- (j) Range of time, temperature and pressure cycles recommended to affect the cure for laminates.
- (k) Any other pertinent information, at the supplier's option, on storage and handling.

3.8.2 For pre-impregnated material - An instruction sheet for the pre-impregnated form shall be prepared as specified in 3.8.1 except that the following information, with description of the method of determining the properties shall be substituted for items (a) through (h) of 3.8.1.

- (a) Type and grade of the resin and the number of this specification.

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- (b) Material designation (3.4).
- (c) Form of the resin (3.3).
- (d) Type of glass fabric.
- (e) Dielectric constant (nominal) and loss tangent (nominal) of the cured unfilled resin component, Grades A through D only (3.5).
- (f) Volatile content (average and tolerance) (3.5).
- (g) Dry resin content (average and tolerance) (3.5).
- (h) Flow (average and tolerance) (3.5).

3.9 Workmanship - The material specified herein shall be processed as required in accordance with the best practice for a high quality resin.

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 the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 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) Preproduction inspection (4.3).
- (b) Quality conformance inspection (4.4).

4.3 Preproduction inspection - Preproduction inspection shall include all the examinations and tests of this specification except the one year outdoor weathering test (4.5.6), for which certified test data shall be submitted by the supplier (3.1.1), and the examination of preparation for delivery (4.6.11). Unless otherwise specified (4.3.2), no material shall be offered for acceptance under any contract or order until the preproduction samples prescribed in 4.3.1 have been subjected to preproduction inspection and pronounced satisfactory by the procuring activity. However, approval of the preproduction samples or of acceptable test data (4.3.2) in lieu thereof shall not relieve the supplier of his obligation to meet the quality conformance inspection.

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4.3.1 Sampling for preproduction test - The following samples and materials shall be submitted by the supplier for preproduction test:

- (a) Two copies of the certified weather resistance data specified in 3.1.1.
- (b) Two copies of the instruction sheet specified in 3.8.
- (c) One gallon of liquid resin or 10 pounds of dry resin; or eight square feet, full fabric width, of pre-impregnated resin fabric as applicable, dependent on the form of resin supplied; also, a sufficient quantity of any curing agents (hardeners, accelerators, etc.) needed for the preproduction tests of the resin under this specification.
- (d) A 2 foot by 2 foot glass cloth base laminate sheet 0.125 \pm 0.010 inch thick (see 4.3.1.1) or five sheets, each one foot square, of that thickness for determining mechanical and physical properties in the laminate. Unless otherwise specified in the contract or order, this sheet shall be processed by the supplier into the required number of test specimens for all mechanical and physical tests, machined to size and suitable for testing.
- (e) A 4 inch by 8 inch glass cloth base laminate sheet at least 0.75 inch thick (see 4.3.1.2) for tests of electrical properties (Grades A through D only).

* 4.3.1.1 Laminate sheet for mechanical and physical properties - The laminate sample for mechanical and physical tests shall be fabricated in the form of a sheet or sheets 0.125 \pm 0.010 inch in thickness, using the resin which is under test and 12 plies, laid up parallel, of 181 glass cloth conforming to MIL-C-9084 with a finish compatible with the resin being tested. The sample shall be laminated at a pressure not exceeding 30 pounds per square inch and shall be fully cured in accordance with the resin supplier's instruction sheet. The sample shall be essentially void free and representative of the best quality workmanship and shall have a resin content by weight that will produce a laminate with optimum properties. Specimens from this laminate shall be tested to determine conformance to the mechanical and physical requirements of 3.6.

* 4.3.1.1.1 Base fabric for pre-impregnated laminate samples - Unless otherwise specified, the laminate prepared for preproduction tests of pre-impregnated materials shall be fabricated with 181 glass cloth, regardless of the base cloth to be used in the actual delivery of pre-impregnated resin. This substitution shall apply to the laminate samples only, not to the pre-impregnated samples of 4.3.1 (c) or 4.4.1.2.

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- * 4.3.1.2 Laminate sheet for electrical property tests - The glass fabric base, resin content, specific gravity, finish, and other physical characteristics of the laminate sample for electrical test (4.3.1 (e)) shall be the same as those of the laminate fabricated in accordance with 4.3.1.1. The laminating procedure shall follow, as closely as practical, the procedure used in 4.3.1.1.
- * 4.3.2 Preproduction inspection in repeat orders - In repeat orders or orders for different parts, the requirement for preproduction inspection in this specification may be met, at the discretion of the procuring activity, by submittal of applicable test data, including one-year weathering data (3.1.1), from previous preproduction 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 preproduction test deemed necessary to assure the conformance of the material to the specification requirements.
- * 4.4 Quality conformance inspection - Quality conformance inspection shall include the material conformance inspection of Table III and the inspection of preparation for delivery specified in 4.6.11.

TABLE III

MATERIAL CONFORMANCE INSPECTION

| Test | Requirement Paragraph | Method Paragraph |
|-----------------------|-----------------------|------------------|
| Unactivated resin | | |
| Specific gravity | 3.5 | 4.6.1 |
| Viscosity | 3.5 | 4.6.2 |
| Melting point | 3.5 | 4.6.3 |
| Activated resin | | |
| Gel time | 3.5 | 4.6.5 |
| Peak exotherm | 3.5 | 4.6.5 |
| Cured unfilled resin | | |
| Specific gravity | 3.5 | 4.6.1 |
| Barcol hardness | 3.5 | 4.6.4 |
| Pre-impregnated resin | | |
| Volatile content | 3.5 | 4.6.6 |
| Dry resin content | 3.5 | 4.6.7 |
| Flow | 3.5 | 4.6.8 |

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4.4.1 Sampling for quality conformance inspection -

- * 4.4.1.1 Lot - For sampling purposes, a lot shall consist of all the resin of one code number or designation subjected to inspection at one time.

- * 4.4.1.2 Sample for material conformance - One gallon of liquid resin, 10 pounds of dry resin, or eight square feet, full fabric width, of pre-impregnated fabric, dependent on the form of resin supplied, shall be selected at random from each lot. Two copies of the instruction sheet specified in 3.8 shall be submitted with each sample; also a sufficient quantity of any curing agents needed for the material conformance tests under this specification.

4.4.1.3 Sample for conformance to preparation for delivery - A sample of filled exterior containers shall be selected from each lot in accordance with the provisions of MIL-STD-105 for Inspection Level I and an Acceptable Quality Level (AQL) of 2.5 percent defective.

- * 4.4.2 Rejection criteria - If any sample of liquid or solid resin or of pre-impregnated fabric, fails to conform completely with the requirements of this specification, or if the preparation-for-delivery sample contains more defective units than permitted by AQL 2.5, the lot of resin represented by the sample shall be rejected. Disposition of rejected lots shall be in accordance with MIL-STD-105.

4.5 Test conditions -

4.5.1 Standard conditions - Specimens shall be conditioned and tested at an air temperature of $23 \pm 1.1^\circ \text{C}$ ($73.4 \pm 2^\circ \text{F}$) and relative humidity of 50 ± 4 percent. The conditioning period prior to test shall be 96 hours.

- * 4.5.2 Wet conditions (for mechanical and physical tests) - Specimens shall be immersed for 2 hours in boiling distilled water by Procedure E of Method No. 7031, Fed. Test Method Std No. 406. Specimens shall then be cooled in water at $23 \pm 1.1^\circ \text{C}$ ($73.4 \pm 2^\circ \text{F}$) and tested wet at that temperature immediately after removal from the water. In case of any question as to validity of the test results, specimens shall be soaked for 30 days in distilled water at $23 \pm 1.1^\circ \text{C}$ and tested wet at that temperature immediately after removal from the water. Results obtained under the latter conditioning shall be final.

4.5.3 Exposure to 70°C - Specimens shall be exposed for 1/2 hour to a temperature of $70 \pm 1.1^\circ \text{C}$ ($158 \pm 2^\circ \text{F}$) in a previously heated test chamber and shall then be tested immediately at the same temperature.

4.5.4 High temperature conditions (260° max.) (Type II only) -

4.5.4.1 For mechanical and physical tests - Specimens shall be

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exposed for 1/2 hour to a temperature of $260 \pm 3^\circ \text{C}$ ($500 \pm 5^\circ \text{F}$) in a previously heated test chamber and shall then be tested immediately at the same temperature. Specimens for the long term high temperature test shall be exposed in a circulating air oven at $260 \pm 3^\circ \text{C}$ for 192 hours. The specimens shall then be transferred to the 260°C test chamber for an additional half hour and shall be tested at that temperature.

4.5.4.2 For electrical tests - Specimens shall be exposed to the electrical test (4.6.10) for a minimum of 10 minutes at each of a series of measurement temperatures. Measurement temperatures shall range from $60 \pm 3^\circ \text{C}$ ($140 \pm 5^\circ \text{F}$) to $260 \pm 3^\circ \text{C}$ ($500 \pm 5^\circ \text{F}$), inclusive, in 50° (Centigrade) increments.

4.5.5 Immersion in chemical fluids - Specimens shall be immersed in the chemical fluids specified in Table I. A separate set of specimens shall be used for each fluid. The immersion procedure shall be in accordance with Method 7011 of Fed. Test Method Std. No. 406, except that the immersion time shall be 24 hours at $23 \pm 1.1^\circ \text{C}$ ($73.4 \pm 2^\circ \text{F}$). The specimens shall be removed from the fluids at the close of the exposure period and tested immediately.

4.5.6 One year outdoor weathering (for supplier's certified test data (3.1.1)) - The laminate shall be exposed to outdoor weathering for one year in the North Temperate or South Temperate Zone on a land rack inclined 45 degrees to the horizontal, facing the equator. The laminate shall be turned over every 14 to 15 days. At the end of the weathering period, specimens shall be cut from the laminate, subjected to standard conditions (4.5.1) for 96 hours, and tested at standard conditions.

4.5.7 Water immersion (for tests of electrical properties) - Specimens shall be immersed for 24 hours in distilled water at $23 \pm 1.1^\circ \text{C}$ ($73.4 \pm 2^\circ \text{F}$). Specimens shall then be removed from the bath, wiped free of surface water, and tested immediately.

4.6 Test methods -

4.6.1 Specific gravity - Specific gravity of the unactivated and of the cured unfilled resin shall be determined by weighing a specific volume of the resin in grams and dividing by the volume in cubic centimeters.

4.6.2 Viscosity - The viscosity of the liquid unactivated resin shall be determined by a calibrated MacMichael viscosimeter or equivalent. The test procedure shall be submitted by the supplier in the instruction sheet (3.8).

4.6.3 Melting point - The melting point of the unactivated resin shall be determined by the procedure specified in the instruction sheet (3.9).

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4.6.4 Barcol hardness - The Barcol hardness of the cured unfilled resin specimens and laminate specimens shall be obtained by direct reading on a Barcol Impressor. Barcol instrument, Model GYZJ 934-1, shall be used (6.4). The laminate specimens shall be at least 1 inch square.

* 4.6.5 Gel time and peak exotherm - The gel time and peak exotherm shall be determined by the procedure specified in the instruction sheet (3.8).

* 4.6.6 Volatile content (pre-impregnated form) - The specimen shall be a four inch square, the full thickness of the material, taken at least an inch from the edge of the fabric and bias cut to minimize raveling. The specimen shall be weighed at standard conditions (4.5.1), dried by suspending for 15 ± 1 minutes in a circulating air oven at 163 ± 3° C (325 ± 5° F), cooled in a desiccator, and reweighed.

$$\text{Volatile content \%} = \frac{\text{Initial wt.} - \text{dry wt.}}{\text{Initial wt.}} \times 100$$

Result shall be the average of three specimens taken from representative areas of the material.

* 4.6.7 Dry resin content (pre-impregnated form) - The dry specimen from 4.6.6 shall be placed in a dish in a muffle furnace at 565.5 ± 14° C (1050 ± 25° F) for 30 minutes or to constant weight. The ignition residue shall be cooled in a desiccator and weighed.

$$\text{Dry resin content (\%)} = \frac{\text{Dry wt.} - \text{Ignited wt.}}{\text{Dry wt.}} \times 100$$

Result shall be the average of three specimens.

4.6.8 Flow of pre-impregnated material - The flow of the pre-impregnated material shall be determined in the following manner: Four 4-inch squares shall be cut from the impregnated fabric material. These specimens shall be weighed. Specimens of 4 plies each shall be wrapped in cellophane, placed between platens, and pressed into a laminate at the temperature specified in the instruction sheet (3.8) and 30 psi pressure for 5 minutes. After taking the specimen from the press, the cellophane and the release agent, if used, as well as all the flash resin that has flowed from the four edges of the laminate, shall be removed. The specimen shall then be reweighed.

$$\text{Flow (\%)} = \frac{\text{Initial wt.} - \text{final wt.}}{\text{Initial wt.}} \times 100$$

Result shall be the average of three tests.

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4.6.9 Mechanical and physical properties of the laminate - The mechanical and physical properties of the laminate shall be determined in accordance with the methods of Table I, using specimens prepared from the 0.125 inch thick laminate sample (4.3.1.1).

- * 4.6.10 Electrical properties of the laminate - The electrical tests shall be performed by the shunted line waveguide method or the resonant cavity technique using the laminate sample of 0.75 inch thickness (4.3.1.2). If calculations (6.3) establish that thinner specimens would be preferable, the testing activity is permitted to abrade or otherwise mill the 0.75 inch specimens to the optimum thickness.
- * 4.6.11 Inspection of preparation for delivery - The sample selected in accordance with 4.4.1.3 shall be inspected before closing the exterior containers. Each interior container of the sample shall be weighed to determine the amount of contents and shall be examined for presence of the required instruction sheet. Interior and exterior containers shall be checked for nonconformities of materials, workmanship, and marking. Defects of closure of exterior containers shall be checked in containers ready for shipment. Any exterior container having one or more non-conformities in the exterior container itself or its contents shall be rejected.

5. PREPARATION FOR DELIVERY

5.1 Packaging - Packaging shall be Level A or C as specified (see 6.2).

5.1.1 Level A -

5.1.1.1 Liquid or solid form - The resin shall be packaged, as specified (see 6.2), in 1-gallon or smaller cans conforming to Type V, Class 2, round of PPP-C-96, 5-gallon pails conforming to Type II, Class 3 of PPP-P-704, 16-gallon drums conforming to Type III of PPP-D-705, or 55-gallon drums conforming to Type III or Type IV of PPP-D-729. Cans in accordance with PPP-C-96 shall be rust-resistant coated on the exterior in accordance with Plan B of that specification and the side seam shall be striped with a suitable corrosion-resistant coating.

5.1.1.2 Pre-impregnated form - Pre-impregnated glass fabric shall be furnished in approximately 60-pound rolls wound on cylindrical cores with polyethylene interleaf between the layers of impregnated fabric. The rolls shall be paper-wrapped and individually packaged in Weather-Resistant Class PPP-B-636 fiberboard boxes in such fashion that the roll is suspended by the ends of the core.

5.1.2 Level C - Packaging shall be such as to afford adequate protection against corrosion, deterioration, and damage during shipment from the

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supply source to the first receiving activity for immediate use. Providing this requirement is met, packaging in accordance with the supplier's commercial practice shall be acceptable.

5.2 Packing - Packing shall be Level A, B, or C as specified
(see 6.2).

5.2.1 Level A -

5.2.1.1 Liquid or solid form - Resin packaged in containers conforming to PPP-C-96 shall be packed in accordance with the overseas requirements of the appendix thereto. Resins packaged in containers conforming to PPP-P-704, PPP-D-705 or PPP-D-729 require no overpacking. When specified (see 6.2), 5-gallon pails and 16-gallon drums shall be palletized in accordance with MIL-STD-147.

5.2.1.2 Pre-impregnated form - Pre-impregnated glass fabric, packaged as specified in 5.1.1.2 shall be packed in export type shipping containers conforming to PPP-B-576, PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-621, or PPP-B-636. As far as practicable, exterior containers shall be of uniform shape and size, shall be of minimum cube and tare consistent with the protection required, and shall contain identical quantities. The gross weight of each pack shall be limited to approximately 200 pounds. Containers shall be closed and strapped in accordance with the applicable container specification or appendix thereto. Containers, except those meeting PPP-B-636, shall be provided with a case liner conforming to MIL-L-10547 and shall be sealed in accordance with the appendix thereto. As an alternate, PPP-B-636 containers may be sealed at all joints and seams with tape conforming to PPP-T-60.

5.2.2 Level B -

5.2.2.1 Liquid or solid form - Resin packaged in containers conforming to PPP-C-96 shall be packed in accordance with the domestic requirements of the appendix thereto. Resins packaged in containers conforming to PPP-P-704, PPP-D-705, or PPP-D-729 require no overpacking. When specified (see 6.2), 5-gallon pails and 16-gallon drums shall be palletized in accordance with MIL-STD-147.

5.2.2.2 Pre-impregnated form - Pre-impregnated glass fabric, packaged as specified in 5.1.1.2 shall be packed in domestic type shipping containers conforming to PPP-B-576, PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-621, or PPP-B-636. Exterior containers shall be of minimum cube and tare consistent with the protection required. As far as practicable, exterior containers shall be of uniform shape and size and shall contain identical quantities. The gross weight of each pack shall be limited to approximately 200 pounds. Containers shall be closed and strapped in accordance with the applicable container specification or appendix thereto.

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5.2.3 Level C - Low pressure laminating resin and pre-impregnated glass fabric packaged as specified in 5.1.2 shall be packed to afford protection against corrosion, deterioration, and damage during direct shipment from the supply source to the first receiving activity for immediate use. Containers shall comply with Uniform Freight Classification Rules and Regulations or other common carrier regulations applicable to the mode of transportation.

- * 5.3 Marking for shipment - In addition to any special marking required by the contract or order (6.2) or herein, interior packages, exterior shipping containers, and palletized unit loads shall be marked in accordance with MIL-STD-129. The nomenclature shall include:

RESIN, EPOXY, LOW-PRESSURE LAMINATING
MIL-R-9300B
Resin type and grade
Form (liquid, solid-granular, pre-impregnated)
Type of glass fabric reinforcement (pre-impregnated form only)
Code number (see 3.4)
Date of manufacture

- * 5.3.1 Hazardous chemicals - All packaged units of hazardous chemicals shall have affixed thereto such warning labels and markings as may be required by the Interstate Commerce Commission CFR, Title 49, Part 71-90, and the Manufacturing Chemists Association Manual L-1.

- * 5.3.2 Warning markings - When applicable, packaged units shall be marked essentially as follows:

WARNING: USE WITH ADEQUATE VENTILATION -
FLAMMABLE - The solvents contained in this compound may have flash points well below prevailing room temperatures. Do not heat by, or use near, an open flame. Heat preferably by means of a steam coil or other nonflame-producing heat source.

WARNING: Curing agents, accelerators, and solvents to be used with this compound should be stored in original tight containers isolated from one another in cool locations. Never permit a catalyst to come in contact with any component except the base compound.

5.4 Instruction sheet - Unless otherwise specified, a copy of the latest approved issue of the supplier's instruction sheet shall be included with each interior package (see 3.8).

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5.5 Air transport - When specified in the procurement documents (6.2), preparation for delivery shall be modified to meet any special requirements of air transport.

6. NOTES

6.1 Intended use - Low pressure epoxy resin covered by this specification is intended for use in fabricating laminates for general structural parts, aircraft radio and radar antenna housing, and other applications.

6.2 Ordering data - Procurement documents should specify:

- (a) Title, number, and date of this specification.
- (b) Type, grade, and form of resin (1.2 and 3.3).
- (c) Glass fabric base required (pre-impregnated resin only).
- (d) Required sampling and testing for frequencies other than x-band (8,500 to 10,000 mcs), if applicable (6.3).
- (e) Quantity of resin:
 - 1. Liquid or solid: pounds or gallons (6.2.1).
 - 2. Pre-impregnated: weight, width of fabric, and length of rolls.
- (f) Curing agents to be furnished, if applicable (6.6).
- (g) Where the preproduction samples should be sent and the agency designated to perform tests (4.3 and 4.3.1).
- (h) Levels of packaging and packing required (5.1 and 5.2).
- (i) Size and type of containers required (5.1 and 5.2).
- (j) Whether palletizing is required (5.2.1.1 and 5.2.2.1).
- (k) Special marking, if required (5.3).
- (l) Special preparation for delivery requirements for air transport, if applicable (5.5).

6.2.1 Purchase unit - The unit of purchase for both liquid and solid resin is the pound.

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- * 6.3 Additional test frequencies - In addition to the specified test frequency range for electrical properties (Table II), other frequencies may be of importance in particular applications and may be specified in contract or order in addition to or in lieu of the 8,500-10,000 megacycle (x-band) range. Typical frequencies are as follows, including the x-band.

| <u>Band</u> | <u>Test Frequency (mcs)</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 mcs, 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

Further information 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 De Sales 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 Supersedure - In issues of this specification prior to Revision B, the classification of resins was as follows:

Class 1 - General purpose
 Class 2 - Radio frequency
 Class 3 - Radar Frequency

Where drawings or specifications prescribe Classes 1, 2, or 3 of MIL-R-9300, the following are proper substitutions:

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In lieu of
Class 1
Classes 2 or 3

Substitute (Type I or II)
Grade O, A, B, C, or D
Grade A, B, C, or D

6.6 Resin systems - The epoxy resins described in this specification are used in resin systems comprising the resin itself and a curing agent or agents (hardener, accelerator, etc.), which may constitute a large percentage, by weight, of the cured epoxy product. The resins furnished under this specification may be furnished as pre-mixed systems in a partially reacted condition in a single container or pre-impregnated fabric, or the curing agents may be packaged separately to be mixed with the resin at time of use. In the latter case, the packaged curing agents may be procured with the resin or may be procured separately. It should be understood that the optimum properties of a given brand of resin may not be developed in the cured product if the curing agents and procedures are not in accordance with the supplier's instruction sheet (3.8).

6.7 Marginal indicia - The margins of this specification have been marked "*" to indicate where changes (additions, modifications, corrections, deletions) from the previous issue have been made. This has been 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 on the basis of the entire content, irrespective of the marginal notations and relationship to the last previous issue.

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Preparing activity:

Navy - AS
 (Project No. 9330-0193)

Review activities:

Army - EL, MI, MR, MU
 Navy - OS, SH
 Air Force - 11, 69

User activity:

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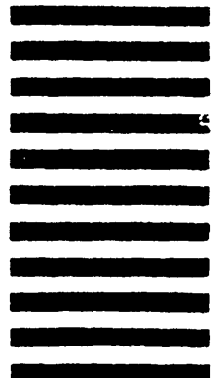
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