MIL-C-8087C(ASG)
24 APRIL 1968
Superseding
MIL-C-8087B(ASG)
9 March 1961

MILITARY SPECIFICATION

CORE MATERIAL, FOAMED-IN-PLACE, URETHANE TYPE

* This specification has been approved by the Department of the Air Force and by the Naval Air Systems Command.

1. SCOPE

* 1.1 Scope. - This specification covers foamed-in-place urethane type core material having a density ranging from 2 to 20 pounds per cubic foot (pcf). It is for use in relatively thin core sandwich structures having glass fabric base plastic laminate faces for structural applications up to 350° F, including all aircraft external plastic parts, and other weapons applications.

1.2 Classification.- Foamed-in-place urethane type core material shall be of the following types and classes, as specified (see 6.2):

* Type I - General purpose - for exposure to 165° F
Type II - Heat resistant - for exposure to 350° F

Class 1 - Radar purpose (electrical)
Class 2 - General purpose (nonelectrical)

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:

SPECIFICATIONS

Federal

L-P-383	Plastic Material, Polyester Resin, Glass Fiber Base, Low Pressure Laminated
PPP-C-96	Cans, Metal, 28 Gage and Lighter
PPP-C-186	Containers, Packaging and Packing for Drugs, Chemicals, and Pharmaceuticals

Military

MIL-P-116	Preservation, Methods of
MIL-R-7575	Resin, Polyester, Low Pressure Laminating

MIL-C-9084	Cloth, Glass, Finished, for Polyester Resin Laminates
MIL-R-25042	Resin, Polyester, High Temperature Resistant, Low Pressure Laminating

STANDARDS

Federal

FED. TEST METHOD STD. NO. 406	Plastics: Methods of Testing

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-401	Sandwich Constructions and Core Materials; General Test Methods
MIL-STD-1186	Cushioning, Anchoring, Bracing, Blocking, and Waterproofing; with Appropriate Test Methods

(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 document forms 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, Ill. 60606.)

3. REQUIREMENTS

3.1 Preproduction.- This specification provides for preproduction inspection (see 4.3).

* 3.2 Materials.- Materials shall be as specified herein. When materials which are not specifically designated herein are used, such materials shall be subject to the approval of the procuring activity. The core material shall be a foamed-in-place resin system formed by reacting a polyol (polyester resin or polyether) with an isocyanate foaming agent.

3.2.1 Cured foam core.- Unless otherwise specified in the contract or order, cured foam core material shall be in sandwich form.

3.3 Code number.- The manufacturer or supplier shall designate each system of foam core material components by a code number which shall be used to identify the material. The code number shall include the range of density in pounds per cubic foot and may include the trade name if desired. When any changes are made in the manufacturer's procedures which will affect the properties of the core material, a sample of the core material made by the new system shall be identified with a new code number and submitted for preproduction testing.

3.4 Limiting values of components.-

3.4.1 Resin.- The manufacturer or supplier of the foam core system shall submit limiting values within which the specific gravity, viscosity, moisture content, and acid number of the liquid uncatalyzed polyol can be controlled. These values and the methods used to determine them, if the methods are other than those specified in 4.7.1.1, shall be included in the manufacturer's instruction sheet (see 3.11). When approved, these values and methods shall form a part of this specification.

* 3.4.2 Isocyanate component.- The manufacturer or supplier of the system shall submit applicable limiting values within which the purity, amine equivalent, hydrolyzable chloride, boiling point, and crystallization point of the isocyanate component can be controlled. If the foaming agent is combined with any other materials, the above values may be replaced by submitting only the limiting values for the amine equivalent. These values and the methods used to determine them shall be included in the manufacturer's instruction sheet (see 3.11). When approved, these values and the methods used to determine them shall form a part of this specification.

3.5 Bonding.- The foamed-in-place core material shall be capable of bonding or being bonded to premolded plastic resin glass fabric base low pressure laminated skins.

3.6 Mechanical properties.- When tested in accordance with 4.7.2.1, mechanical properties shall be as follows.

3.6.1 At room temperature.- When tested in sandwich form at room temperature, the mechanical strength properties for type I and type II cured core materials shall conform to figures 1 and 2, respectively.

3.6.2 At 165° F for type I materials.- When tested in sandwich form under the temperature conditions specified in 4.5.2, the mechanical strength properties of the cured foam core material shall be not less than 70 percent of the requirements at room temperature as shown on figure 1.

3.6.3 At 350° F for type II materials.- When tested in sandwich form under the temperature conditions specified in 4.5.3, the mechanical strength properties of the cured foam core material shall be not less than 70 percent of the requirements at room temperature as shown on figure 2.

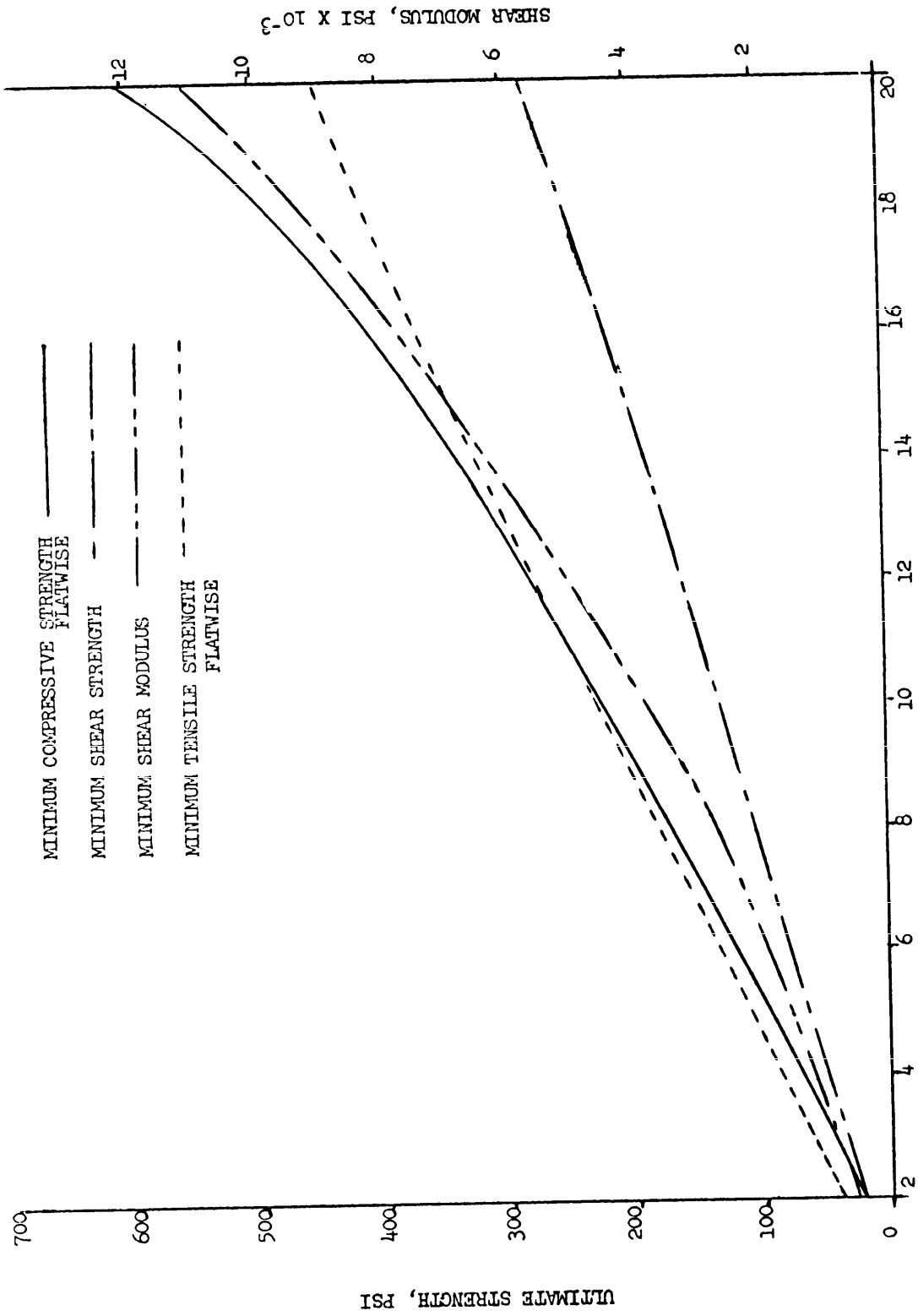

FIGURE 1. Mechanical strength properties for type 1 material

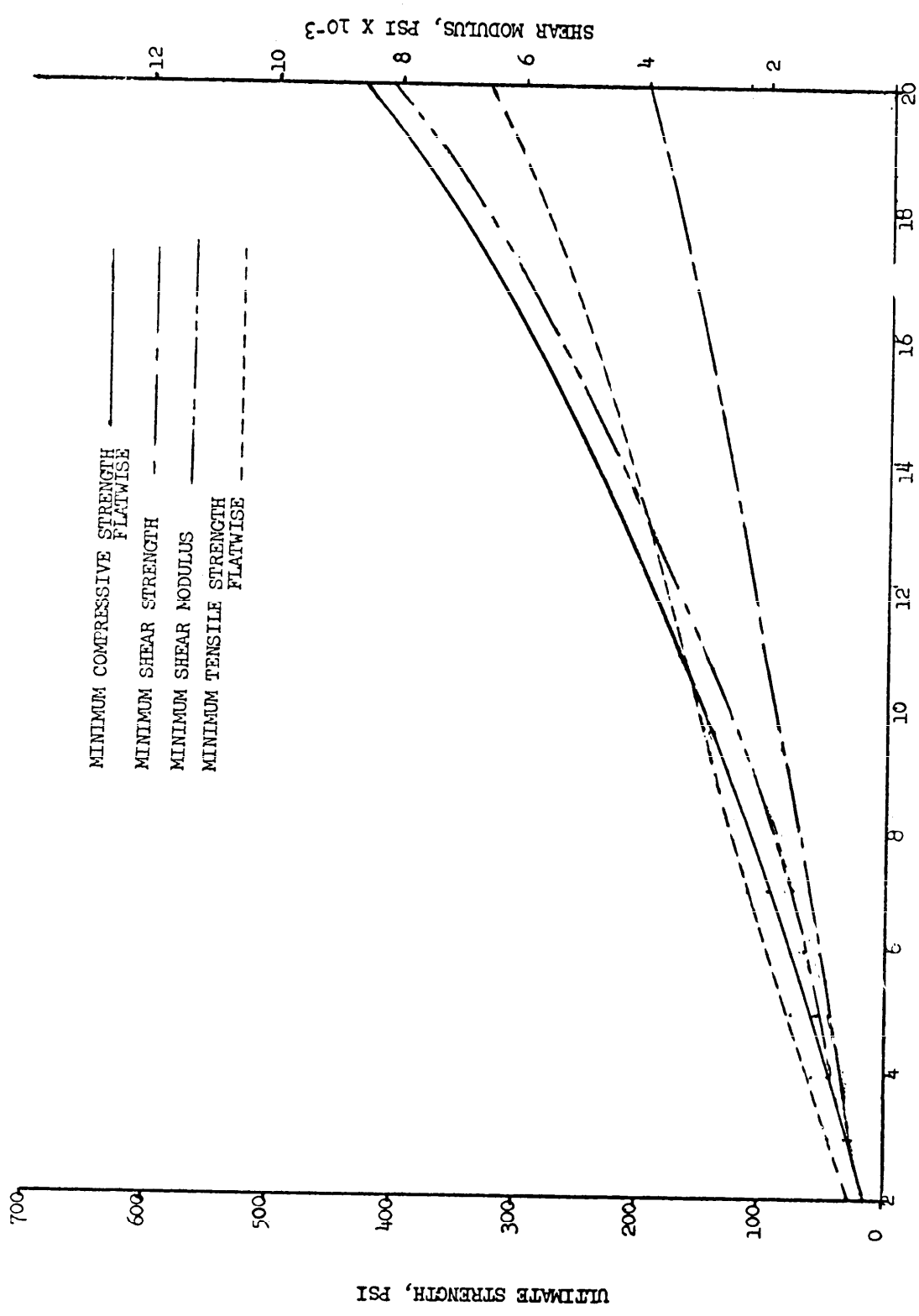

FIGURE 2. Mechanical strength properties for type II materials

3.7 Water absorption properties.- The water absorption properties of all types and classes of material shall conform to figure 3.

3.8 Electrical properties.- When tested in accordance with 4.7.2.2, the electrical properties of the cured foam material shall conform to figure 4. There are no electrical property requirements for class 2 materials, types I and II.

3.9 Blowholes.- When the core components are foamed in sandwich form, blowholes shall not exceed 3 percent of the total volume of the foam, shall not be larger than 3/8 inch in diameter, and shall not occur more than once in any projected area comprising 4 square inches.

3.10 Identification of product.- Each system of foam constituents and each component of the foam system shall be suitably tagged, using oilproof tags, with the following information:

(a) Manufacturer's or supplier's name and address
(b) Code name and number of the foam system
(c) Identification of the foam components (by code if desired)
(d) Weight and volume of component
(e) Specification MIL-C-8087C
(f) Density range
(g) Date of manufacture
(h) Date when usable storage life expires

3.11 Manufacturer's instruction sheet.- For each formulation, the manufacturer or supplier of the core materials resin system shall submit to the procuring activity, for approval, two copies of an instruction sheet for foaming-in-place between plastic skins. Type I materials shall be compatible with plastic skins conforming to L-P-383, and type II materials shall be compatible with plastic skins laminated with a resin conforming to MIL-R-25042. The approved instruction sheet shall be made available by the manufacturer or supplier to all fabricators and manufacturers and to the authorized Government inspectors for use at contractor's plants. The instruction sheet shall contain the following information:

(a) Manufacturer's code number for the components system
(b) All information required in 3.2 through 3.4.2
(c) Maximum usable storage life of the polyol and other components
(d) Fabrication of foamed-in-place core material

    (1) Type of equipment for mixing
    (2) Recommended mixing procedure including precautions to be taken
    (3) Weight percent and chemical nomenclature of solvent(s) used (if any) to facilitate pouring
    (4) Whether mold is preheated, and, if so, the temperature

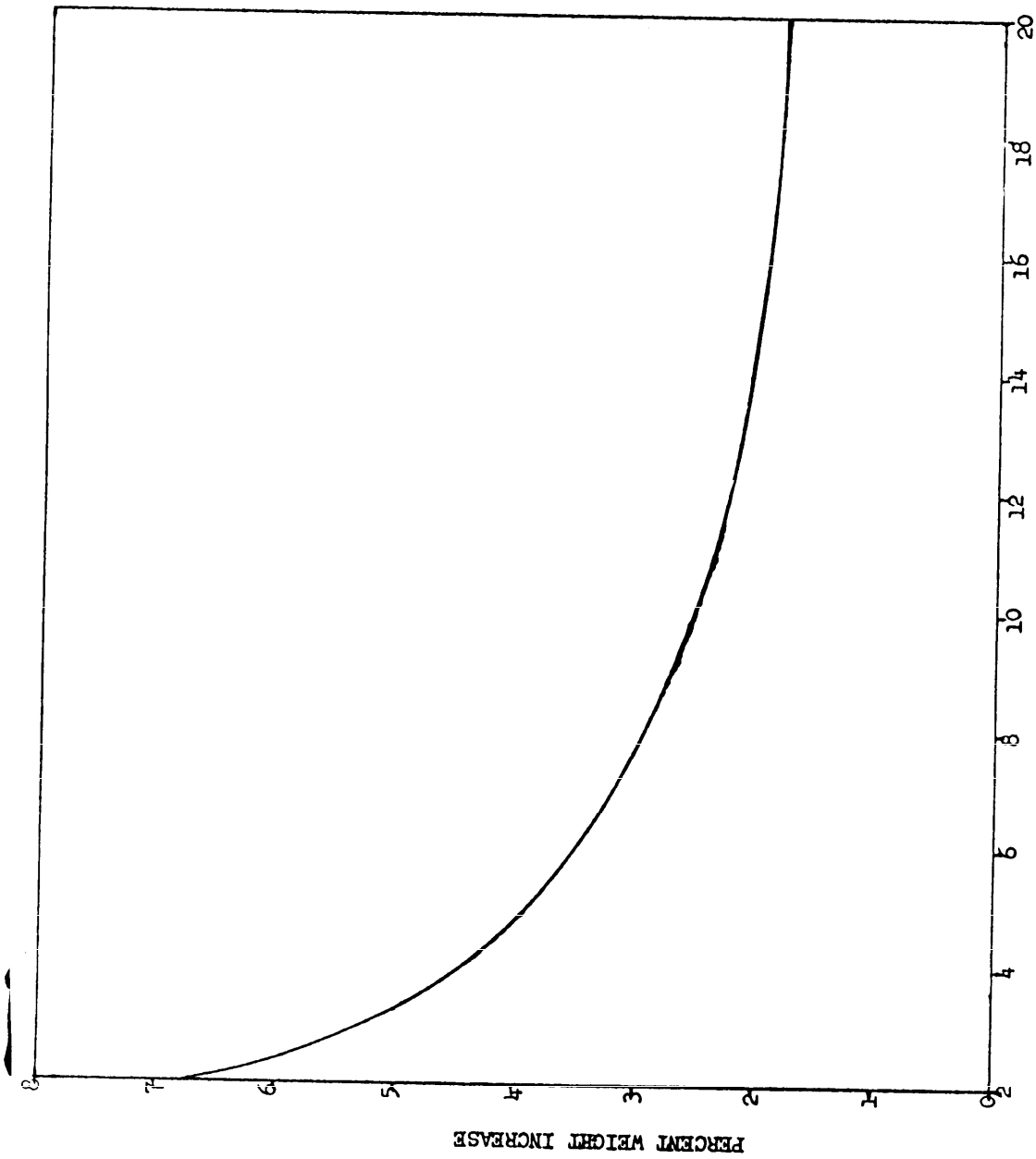

FIGURE 3. Average water absorption for all types and classes - 10 days' exposure to 100 percent rh and 100° F (maximum requirement)

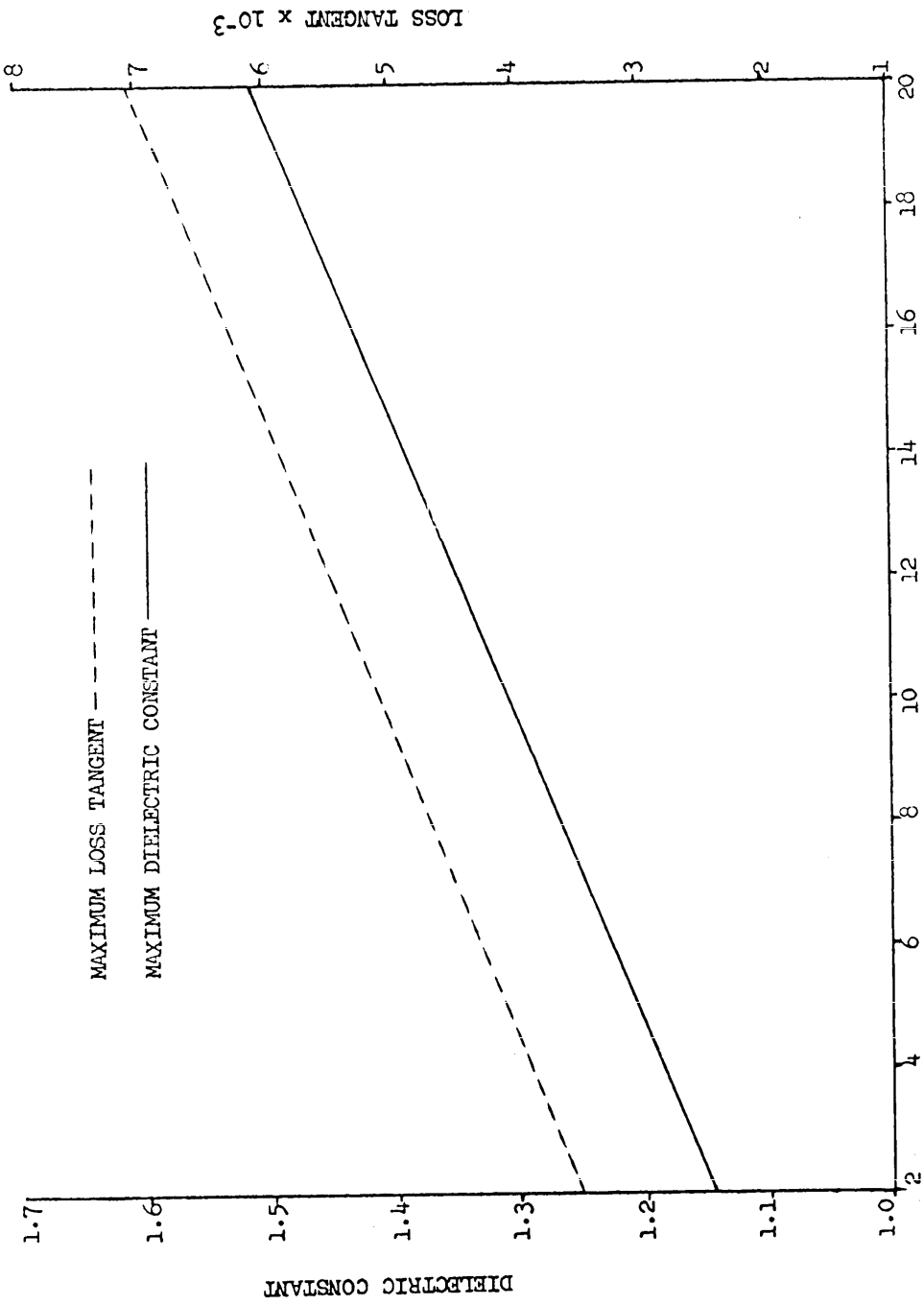

FIGURE 4. Electrical properties of class 1, types I and II materials (frequency 8.5 to 10 KMC)

(5) Whether mold is restrained, partially restrained, or unrestrained
(6) Direction of foaming (i.e., vertical or horizontal)
(7) Method of varying density and weight percentage of excess material used
(8) Commercial designation of primer used, if any, to obtain a good bond between core and skins, and method of mixing and applying the primer to plastic skins
(9) The amount of linear shrinkage (percent) occurring in the thickness and edge dimensions of a panel fabricated as described in 4.3.1.1. (The metal mold dimensions in the cold- or room-temperature condition shall be used as the basis for determining shrinkage after the core is completely cured.)

(e) Curing cycle for fabrication of foamed-in-place core materials

(1) Standard cure
(a) Temperature
(b) Time
(c) Restrained
(2) Post cure, if any
(a) Temperature
(b) Time
(c) Restrained

(f) The method of applying heat to cure the core, such as steam coils, electric heaters, or infrared lamps shall be described. Room-temperature and ultraviolet-light curing systems will not be permitted.

3.12 Workmanship.- The core material shall be free from excess resin accumulations, tackiness, foreign materials, and other defects, except as specifically permitted herein.

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 supplies and services conform to prescribed requirements.

4.2 Classification of inspections.- The examination and testing of the cured foam and foam core material components shall be classified as:

(a) Preproduction inspection (4.3)
(b) Quality conformance inspection (4.4)

4.3 Preproduction inspection.- Preproduction inspection of the foam plastic materials and components shall consist of all the examinations and tests specified in 4.6 and 4.7.

4.3.1 Preproduction inspection samples.- Samples shall consist of three 24- by 24-inch panels, 1/2-inch total thickness (with skins) for both the minimum and maximum density core materials (a total of 6 panels), a 2-quart sample of the uncatalyzed polyol and the required amounts of foaming agent and additives (if any).

4.3.1.1 Fabrication of flat test panels.- Flat panels shall be foamed in a vertical direction between MIL-C-9084, type VIII glass fabric base plastic laminated skins having a nominal thickness of 0.030 inch and conforming to the workmanship requirements of L-P-383. For type I core materials, the skins shall be fabricated using a resin conforming to MIL-R-7575. For type II core materials, the skins shall be fabricated using a resin conforming to MIL-R-25042. The test panel shall be marked to show the direction of foaming. The method used for mixing the components, pouring, and curing shall be in accordance with the manufacturer's instruction sheet.

4.3.1.2 Accompanying documents and materials.- When specified by the procuring activity, each sample shall be accompanied by the following (see 6.2):

(a) Manufacturer's identifying nomenclature and code number for the core material components system.
(b) Two copies of the instruction sheet as specified in 3.11.
(c) Two copies of a test report containing the following data:

(1) All results (individual and average) for all preproduction tests required by this specification, except the electrical properties test, for both the minimum and maximum densities available, signed by an authorized representative of the manufacturer.
(2) Curves, typical of those in figures 1 through 4, showing that cores conform to the requirements within the minimum and maximum limits.
(3) A sketch identifying the location of test specimens.

4.4 Quality conformance inspection.- Quality conformance inspection shall consist of sampling tests only.

4.4.1 Sampling tests.- Samples in sufficient quantities shall be selected at random from each batch of foam components and subjected to the tests specified in 4.7.1.

4.4.1.1 Batch.- For the purpose of sampling, a batch shall consist of an integral quantity of foam components produced in one manufacturing cycle.

4.5 Test conditions.-

4.5.1 Room-temperature conditions.- Tests shall be performed in an atmosphere where the temperature ranges from 65° to 80° F and the relative humidity ranges from 30 to 70 percent. When the validity of test results is questionable, tests shall be performed at a temperature of 73° ±2° F and relative humidity of 50 ±4 percent. Specimens shall be tested immediately after being exposed for 4 days to the room-temperature conditions.

4.5.2 Type I - exposure to 165° F.- Specimens shall be exposed for 1/2 hour to a temperature of 165° ±4° F in a circulating-air test chamber previously heated to the temperature of test. Immediately after the 1/2-hour exposure, the compression and tensile specimens shall be tested at the same temperature. The shear strength specimens shall be tested at room temperature immediately after the 1/2-hour exposure to 165° ±4° F.

4.5.3 Type II - exposure to 350° F.- Specimens shall be exposed for 1/2 hour to a temperature of 350° ±5° F in a circulating air test chamber previously heated to the temperature of test. Immediately after the 1/2-hour exposure, the compression and tensile specimens shall be tested at the same temperature. The shear strength specimens shall be tested at room temperature immediately after the 1/2-hour exposure to 350° ±5° F.

4.6 Examinations.-

4.6.1 Examination of product.- Each sample of core material selected in accordance with 4.4.1 shall be examined to verify conformance with 3.2 and 3.11 and all other requirements which do not involve destructive tests.

4.6.2 Packaging, packing, and marking.- Preparation for delivery shall be examined for conformance to section 5.

4.7 Test methods.-

4.7.1 Foam core components (polyol system).-

4.7.1.1 Liquid uncatalyzed polyol component.- The polyol component shall be subjected to the following tests to determine conformance to the approved values (see 3.4.1).

4.7.1.1.1 Specific gravity.- Specific gravity of the liquid uncatalyzed polyol shall be determined by weighing a specific volume of the liquid to the nearest 0.001 gram and dividing by the volume in cubic centimeters.

4.7.1.1.2 Viscosity.- Viscosity of the liquid uncatalyzed polyol shall be determined by a calibrated Brookfield viscosimeter, or equivalent. The test procedure shall be in accordance with the manufacturer's approved procedure (see 3.4.1).

4.7.1.1.3 Moisture content.- The moisture content of the liquid uncatalyzed polyol shall be determined by titration of a methanol solution of the liquid polyol with Karl Fischer reagent.

4.7.1.1.4 Acid number.- The acid number of a polyol is defined as the milligrams of potassium hydroxide required to neutralize 1 gram of polyol. Unless otherwise specified in the contract or order, the acid number of the liquid uncatalyzed polyol shall be determined by titrating a suitable sample of the material as a solution in neutral acetone with 0.1 normal potassium hydroxide, using phenolphthalein as an indicator. Other methods may be used but shall be in accordance with the manufacturer's approved procedure (see 3.4.1).

4.7.1.2 Isocyanate component.- The purity, amine equivalent, hydrolyzable chloride, boiling point, and crystallization point determinations of the component shall be accomplished by the methods used to determine the limits specified in 3.4.2. If the component is combined with any other materials, then only the amine equivalent shall be determined.

4.7.2 Cured foam core material.-

4.7.2.1 Mechanical and physical properties.- The mechanical and physical properties of the core material shall be determined for the maximum and minimum density to which the material may be foamed-in-place. Specimens shall be taken at random so that the average properties of the panel are obtained. A sketch shall be made to identify the location of specimens on the panel. Methods for performing tests are as follows.

4.7.2.1.1 Density.- Density shall be determined on five specimens, each at least 4 inches square, which have been subjected to the conditions specified in 4.5.1. The skins may be removed by any applicable method. The test procedure and calculations for core density shall be in accordance with MIL-STD-401.

4.7.2.1.2 Compression flatwise tests.- Flatwise compressive strength shall be determined on sandwich specimens of foamed-in-place core material 2 inches by 2 inches by the panel thickness (approximately 1/2 inch), carefully machined from the test panel with the 2- by 2-inch surface perpendicular to the direction of loading in accordance with Method 1021 of Federal Test Method Standard No. 406. The dimensions of the specimens shall be measured to an accuracy of at least 0.5 percent. Ten specimens shall be tested as machined and the results averaged. The specimens shall be loaded between flat plates at a uniform rate of head travel so adjusted that the maximum load or failure occurs between 3 and 6 minutes after the beginning of the test. The load shall be applied through a spherical loading block, preferably of the suspended self-aligning type. The compressive strength shall be reported as the value in pounds per square inch at 10 percent total compression or ultimate (maximum) strength, whichever is less. The amount of compression in inches shall be determined by measuring the movement of the loading head with a dial gage or equivalent.

4.7.2.1.2.1 Definition of terms.- Specifying strength to be reported as the value at a particular percent of total compression shall not be interpreted to mean the same as conventional offset methods, such as are used for determining yield stress in a ductile metal. For purposes of this specification, the interpretation shall be that the strengths reported on a percent total compression basis shall be the value which would be fixed at the intersection of the stress-strain curve and a line perpendicular to the horizontal axis at the specified strain value (10 percent for head travel).

4.7.2.1.3 Shear strength and shear modulus tests.- Shear tests and modulus of rigidity (shear modulus) shall be determined in accordance with MIL-STD-401. Ten sandwich specimens, five perpendicular to foam rise and five parallel to foam rise, shall be tested and the results averaged. Tensile loading shall be employed. The modulus of rigidity shall be obtained by computing the slope of the initial straight line portion of the stress-strain curve.

4.7.2.1.4 Flatwise tensile test.- Flatwise tensile strength shall be determined in accordance with MIL-STD-401. Ten sandwich specimens shall be tested and the results averaged.

4.7.2.1.5 Water absorption test.- Water absorption shall be determined on five specimens selected at random from each density submitted for testing. Each specimen shall be 1 by 3 inches by 0.4-inch thick after the sandwich facings have been removed. Light sanding of the surfaces to meet the thickness requirement is permissible. The specimens shall be taken so that the 3-inch dimension is parallel to the direction of foaming. After conditioning as specified in 4.5.1, the specimens shall be immediately exposed for 10 days to 100 percent relative humidity at 100° F. The specimens shall be weighed to the nearest 0.001 gram before exposure and at 1-day intervals during exposure. When weighing the specimens, only a few specimens shall be removed from the humidity chamber at a time, and these shall be carried to the balance in a closed container to prevent excessive drying.

4.7.2.2 Electrical properties.- Electrical tests shall be performed at a frequency between 8,500 and 10,000 megacycles by the shorted-line waveguide method on specimens exposed to standard conditions. The test specimens shall be machined from the sandwich panel as specified in 4.3.1.1 and the skins shall be removed.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging.-

5.1.1 Level A.- Core material shall be packaged in metal cans conforming to PPP-C-96 or in glass jars conforming to PPP-C-186. The type and size of the containers shall be as specified by the procuring activity (see 6.2(e)).

5.1.2 Level C.- Core material shall be preserved and packaged in accordance with the manufacturer's commercial practice.

5.2 Packing.-

5.2.1 Level A.- Core material packaged as specified in 5.1.1 shall be packed in accordance with the appendix to PPP-C-96 for metal cans and in accordance with PPP-C-186 for glass bottles.

5.2.2 Level C.- Packages which require overpacking for acceptance by the carrier shall be packed in exterior-type shipping containers in a manner that will ensure safe transportation at the lowest rate to the point of delivery. Containers shall conform to the Uniform Freight Classification Rules or regulations of other common carriers as applicable to the mode of transportation.

5.3 Physical protection.- Cushioning, blocking, bracing, and bolting, as required, shall be in accordance with MIL-STD-1186, except that for domestic shipments, waterproofing requirements for cushioning materials and containers shall be waived. Drop tests of MIL-STD-1186 shall be waived when preservation, packaging, and packing of the item is for immediate use or when drop tests of MIL-P-116 are applicable.

5.4 Marking for shipment and storage.- Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use.- The core material may be used for aircraft structural-electrical applications, including exterior aircraft parts, such as radio and radar antenna housings, other structural, nonelectrical parts, and in weapons items.

6.2 Ordering data.- Procurement documents should specify:

(a) Title, number, and date of this specification.
(b) Type and class (see 1.2).
(c) (1) Quantity by weight or volume of the foaming system or foam components, or
(2) The volume of cured foam material of a particular density that is desired (whereby the manufacturer will determine the quantity of the components that must be furnished).
(d) Data requirements (see 4.3.1.2).
(e) Applicable level of packaging and packing (see 5.1 and 5.2)
(f) Type and size of container (see 5.1.1).

* 6.3 Marginal indicia.- The margins of this specification are marked with an asterisk to indicate where changes, deletions, or additions to the previous issue have been made. This is done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Figures are not so marked. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content as written, irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Navy - AS
Air Force - 11

Reviewer activities:
Navy - AS
Air Force - 11, 84

Preparing activity:
Navy - AS

Project No. 9330-N351

SPECIFICATION ANALYSIS SHEET

Form Approved Budget
Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity.

SPECIFICATION

MIL-C-8087C(ASG) Core Material, Foamed-in-Place, Urethane Type

ORGANIZATION | CITY AND STATE

CONTRACT NO. | QUANTITY OF ITEMS PROCURED | DOLLAR AMOUNT $

MATERIAL PROCURED UNDER A

( ) Direct Government Contract ( ) Subcontract

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID.

3. IS THE SPECIFICATION RESTRICTIVE?

( ) YES ( ) NO IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.)

SUBMITTED BY (Printed or typed name and activity) DATE

DD Form 1426

FOLD

POSTAGE AND FEES PAID
DEFENSE SUPPLY AGENCY

OFFICIAL BUSINESS

Aeronautical Standards Group (ASG)

8719 Colesville Rd.

Silver Spring, Md. 20910

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303-227 (Z1149)