MIL-I-22023A
2 May 1961
SUPERSEDING
(See section 6)

MILITARY SPECIFICATION

INSULATION FELT, THERMAL AND SOUND ABSORBING

FELT, FIBROUS GLASS, FLEXIBLE

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 Scope. - This specification covers lightweight, flexible fibrous glass felt for thermal and acoustical control.

1.2 Types and classes. - Fibrous glass felt shall be of the following types and classes, as specified (see 6.1):

Type I - Thermal insulation felt.
Type II - Sound absorbing felt.
Class 1 - Nominal density 0.5 pound per cubic foot.
Class 2 - Nominal density 0.75 pound per cubic foot.
Class 3 - Nominal density 1.0 pound per cubic foot.
Class 4 - Nominal density 1.5 pound per cubic foot.
Class 5 - Nominal density 2.0 pound per cubic foot.
Class 6 - Nominal density 3.0 pound per cubic foot.

2. APPLICABLE DOCUMENTS

2.1 The following specifications, and standards, of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

SPECIFICATIONS

FEDERAL
UU-P-268 - Paper, Kraft, Wrapping.
UU-P-271 - Paper, Wrapping, Waterproof Kraft.
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 - Boxes, Fiberboard.
PPP-T-76 - Tape, Pressure-Sensitive Adhesive, Paper, Water Resistant.
PPP-T-97 - Tape, Pressure-Sensitive Adhesive, Filament Reinforced.

MILITARY
MIL-P-116 - Preservation, Methods of.
MIL-A-140 - Adhesive, Water-Resistant, Waterproof Barrier-Material.
MIL-B-10377 - Boxes: Wood-cleated, Veneer, Paper Overlaid.
MIL-L-10547 - Liners, Case, Waterproof.
MIL-I-16688 - Insulation Felt, Thermal, Fibrous Mineral (Semi-Rigid) (Lightweight).

STANDARDS

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 contractors 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 shall apply.

OFFICIAL CLASSIFICATION COMMITTEE
Uniform Freight Classification Rules.

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd Street, New York 16, N. Y.)

3. REQUIREMENTS

3.1 Material. - The basic material shall be glass, processed from a molten state into fibrous form, free from nonfibrous material (shot), bonded with a binder to form flexible felts. (See 4.4.1.)

3.1.1 Fiber diameter. - The average fiber diameter shall not exceed 0.00025 inch. (See 4.4.2.)

3.2 Dimensions and densities. -

3.2.1 Dimensions. -

3.2.1.1 Length. - The felt shall be furnished in rolls, 50 feet, 100 feet, or 200 feet in length, as specified (see 6.1). Rolls may contain more than one piece, but no piece shall be less than 25 feet in length.

3.2.1.2 Width. - The width of the rolls shall be 36, 48, 54 or 72 inches, as specified (see 6.1).

3.2.1.3 Thickness. - The felt shall be furnished in thicknesses of 1/2 inch to 4 inches by 1/4 inch increments, as specified (see 6.1).

3.2.1.4 Tolerances. - A minus tolerance of 1/8 inch in width and thickness and an excess in all dimensions will be permitted.

3.2.2 Density. -A plus or minus tolerance of 10 percent in the densities shown in 1.2 will be permitted.

3.3 Binder content. - The binder content of the felt shall not exceed 30 percent (see 4.4.4).

3.4 Alkalinity. - The alkalinity of the felt expressed as equivalent sodium oxide (Na_2O) shall not exceed 0.60 percent (see 4.4.5).

3.5 Flexibility. - The felt shall show no visible rupture on its outside surface and shall spring back to its original shape and dimensions when tested as specified in 4.4.6.

3.6 Resistance to smoldering. - Material shall not be smoldering at the expiration of the test specified in 4.4.7.

3.7 Fire resistance. - The felt shall be rated as incombustible or fire-retardant when tested as specified in 4.4.8.

3.8 Type I. -

3.8.1 Thermal conductivity. - The thermal conductivity (k) of the felt expressed in B.t.u. - inch percent hour square feet degree fahrenheit shall not exceed the values shown in table I (see 4.4.9).

Table I - Maximum thermal conductivities.

Class	Maximum thermal conductivity (k) at mean temperatures (°F.)		
	25°	50°	75°
1	0.27	0.29	0.31
2	.27	.29	.31
3	.25	.26	.28
4	.24	.25	.26
5	.22	.23	.24
6	.21	.22	.23

3.9 Type II. -

3.9.1 Vibration resistance. - There shall be no material passing through the screen when tested as specified in 4.4.10.

3.9.2 Acoustic performance. - Blankets shall have a performance rating of not less than 1.00, when tested as specified in 4.4.11.

3.10 Workmanship. - The workmanship shall be first class in every respect.

4. QUALITY ASSURANCE PROVISIONS

4.1 The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. 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 Sampling. -

4.2.1 Lot. - For purposes of sampling, a lot shall consist of all felt of the same type, thickness and width produced in one plant under essentially the same conditions and offered for delivery at one time.

4.2.2 Sampling for visual and dimensional examination. - A random sample of rolls shall be selected from each lot offered for inspection in accordance with Standard MIL-STD-105 at Inspection Level II. The Acceptable Quality Level shall be 2.5 percent defective.

4.2.3 Sampling for lot acceptance tests.- From each lot, samples of the proper size shall be selected at random for the tests specified in 4.3.2. The total quantity of felt in square feet shall be the lot size, and the number of test specimens to be in accordance with Standard MIL-STD-105 at Inspection Level L-2.

4.3 Lot acceptance examination and tests.-

4.3.1 Lot acceptance examination.-

4.3.1.1 Examination.- Each roll selected for visual and dimensional examination in accordance with 4.2.2 shall be surface examined and measured to determine conformance with the requirements of this specification which do not require tests.

4.3.1.2 Density.- Each roll selected in accordance with 4.2.2 shall be weighed to verify the amount of content and density of material.

4.3.1.3 Thickness.- The thickness of each roll selected in accordance with 4.2.2 shall be determined by the method specified in 4.4.3. It will not be necessary to cut samples from the rolls in order to determine the thickness of the rolls. A 36- by 36-inch section of each roll can be ruled off and used as the test specimen.

4.3.1.4 Rejection of lot.- Any roll containing one or more visual, dimensional or density defects shall be rejected, and if the number of defective rolls in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

4.3.2 Lot acceptance tests.- The samples selected in accordance with 4.2.3 shall be subjected to the tests specified in 4.4.1 through 4.4.10. Tests of performance as specified in 4.4.11 may also be conducted as deemed necessary by the Government. If any one of the samples tested is found not to be in conformance with this specification, the lot which it represents shall be rejected.

4.4 Test procedures.-

4.4.1 Nonfibrous material (shot) content.- The nonfibrous material (shot) content shall be determined for each sample by separating by hand 10 grams of fiber as fine as possible over a U. S. Standard No. 30 sieve having a U.S. Standard No. 50 sieve and a pan underneath. Breaking up the material facilitates its separation so that the fiber can be picked up readily. The material remaining after the fiber is picked out shall be screened by hand and all the fiber remaining on the No. 30 and No. 50 sieves shall be picked off. The fine splinters and dust shall be aspirated and the remainder on the No. 30 and No. 50 sieves shall be combined and weighed as the nonfibrous material (shot) content.

4.4.2 Diameter of fiber.- Diameter of fibers shall be determined microscopically on the basis of measuring seven fibers on each of the samples selected in accordance with 4.2.3. The average diameter for purposes of determining conformance with 1.2 shall be the average of all measurements on all samples.

4.4.3 Thickness.- The test specimen shall be ruled off into ten approximately square and equal areas, and the thickness measurement taken at the center of each area. In determining the thickness, the test specimen shall be placed on a hard, flat surface, and the penetrating pin of the depth gage shall be forced downward through the specimen, perpendicular to the flat surface as shown on figure 1. If necessary to prevent compression of the specimen by the depth gage pin, the specimen shall first be pierced. When the point of the pin touches the flat surface, the sliding disk shall be lowered to the point of contact with the top surface of the specimen. The gage shall be withdrawn, and the distance from the point of the pin to the sliding disk shall be measured to the nearest 1/32 inch. The average of the ten thickness measurements shall be taken as the thickness of the test specimen.

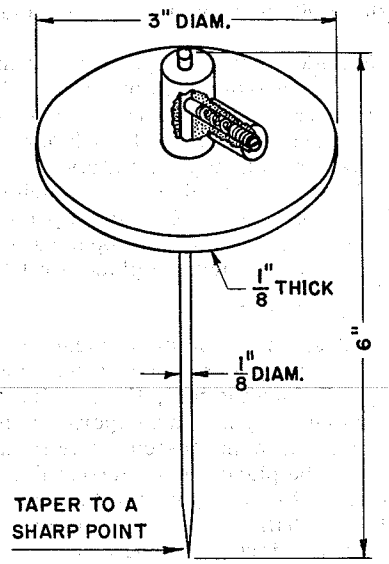

Figure 1.-Depth gage for thickness measurements.

4.4.4 Binder content.- The binder content of each sample tested shall be determined by heating not less than 1/2 square foot of material to approximately 800°F. for 3 hours in an oven adequately vented in such a manner as to insure complete circulation of the atmosphere of the entire oven

chamber, preferably by fan or other forced circulation methods. The weight before and after heating shall be taken under atmospheric conditions of the same relative humidity.

4.4.5 Alkalinity.- The alkalinity test shall be performed as follows: Weigh a 5-gram (±0.01 gram) representative sample[1/] of the felt, and introduce into a 500-milliliter (mℓ.), pyrex Erlenmeyer flask. Wet with 5 mℓ. of 95 percent ethyl alcohol and add 400 mℓ. of distilled water. Reflux for 4 hours ±5 minutes. At the end of this period, disconnect the condenser and filter at once through No. 41 Whatman paper supported in a Buchners funnel. Wash the flask and material three times with 25-mℓ. portions of hot distilled water using suction. Titrate immediately with 0.02N H_2SO_4, using six to eight drops of 1 percent solution of phenol-red indicator, to the disappearance of the pink color Run a blank determination on the same amount of distilled water and alcohol and correct for any alkalinity shown. The percentage alkalinity as Na_2O shall be calculated from the following formula:

$$\text{Percent } Na_2O = 0.0124$$

(mℓs. H_2SO_4 used by sample minus mℓs. H_2SO_4 used by blank).

4.4.6 Flexibility.- A piece of felt 12 by 12 inches by specified thickness shall be bent over a sharp angle of 90 degrees and then released.

4.4.7 Smolder test.- A specimen 12 inches square shall be cut from each of six samples, and the specimens arranged in pairs. Between each pair of specimens a cherry red hot (approximately 1450°F.) rivet or rod, approximately 3/4 inch by 2 inches, shall be inserted so as to touch the center of each specimen. A uniform pressure of 2 pounds shall be placed on the upper sample and the rivet allowed to remain in place for 1 hour.

4.4.8 Fire tests.-

4.4.8.1 A specimen 36 by 36 inches by ordered thickness shall be applied directly to an incombustible backing. Before the test, the specimen shall be dried to constant weight at a temperature not injurious to the material being tested. For test, the specimen shall be placed in a horizontal position with the surface to the exposed to the fire facing downward, and shall be supported on the flat surface of a 2 by 2 by 1/8-inch steel angle frame. (Standard laboratory equipment has a 30 by 30-inch clear opening.) The flame from a 3/4 to 7/8-inch gas-air burner shall be directed against the center of the lower surface of the specimen. The top of the burner shall be directed against the center of the lower surface of the specimen. The top of the burner tube shall be 28-3/4 inches below the specimen. Temperature indications shall be obtained with a chromel-alumel thermo element made of 0.12849-inch wire placed in a 3-inch horizontal coil 1 inch below the center of the specimen. The wires shall be bare for a distance of 2 inches from the junction. Temperature readings shall be taken at intervals not exceeding 2 minutes.

4.4.8.2 For incombustible and fire retardant materials, the test duration shall be 40 minutes and the flame shall be regulated to give temperature indications according to the time temperature curve shown on figure 2. The flame shall touch the specimen during the entire test period. Exceptions can be made for the first 5 minutes, if required, for proper temperature regulation. At no time during the test shall the flame cover a greater area on the specimen than a 12-inch diameter circle.

4.4.8.3 The area under the time temperature curve obtained from the thermo element readings shall be within 5 percent of that of the reference curve being followed.

4.4.8.4 The test shall be conducted in a room which is free from appreciable air currents and which has a temperature between 60° and 85°F.

4.4.8.5 For incombustible and fire retardant materials, the specimen as a whole and the different units or portions thereof shall remain in place until the end of the flame exposure period specified in 4.4.8.2. Exception shall be made for burned, charred, or disintegrated material falling in pieces having an area smaller than 50 square inches. No glow during or after the test shall progress to the edge of the 36 by 36-inch specimen at any point.

4.4.8.6 Incombustible.- When subjected to the test specified in 4.4.8.1, no flame shall issue from the specimen during or after flame application.

4.4.8.7 Fire retardant.- When subjected to the test specified in 4.4.8.1, no sustained flaming shall issue from the specimen. Any flame which occurs shall be limited to intermittent short flames from the area directly exposed to the test flame. No flame from the specimen shall reach the angle frame at any point. No flaming shall occur more than 2 minutes after the test flame is discontinued.

4.4.9 Thermal conductivity.- Thermal conductivity shall be determined by the guarder hot plate method specified in Specification MIL-I-16688.

4.4.10 Vibration resistance.- A test specimen 12 inches square shall be placed in a sheet-metal box and covered with No. 16 mesh bronze wire screen. After being accurately weighed it shall

[1/] A representative sample is conveniently prepared by taking borings with a large cork borer through the cross section of the felt.

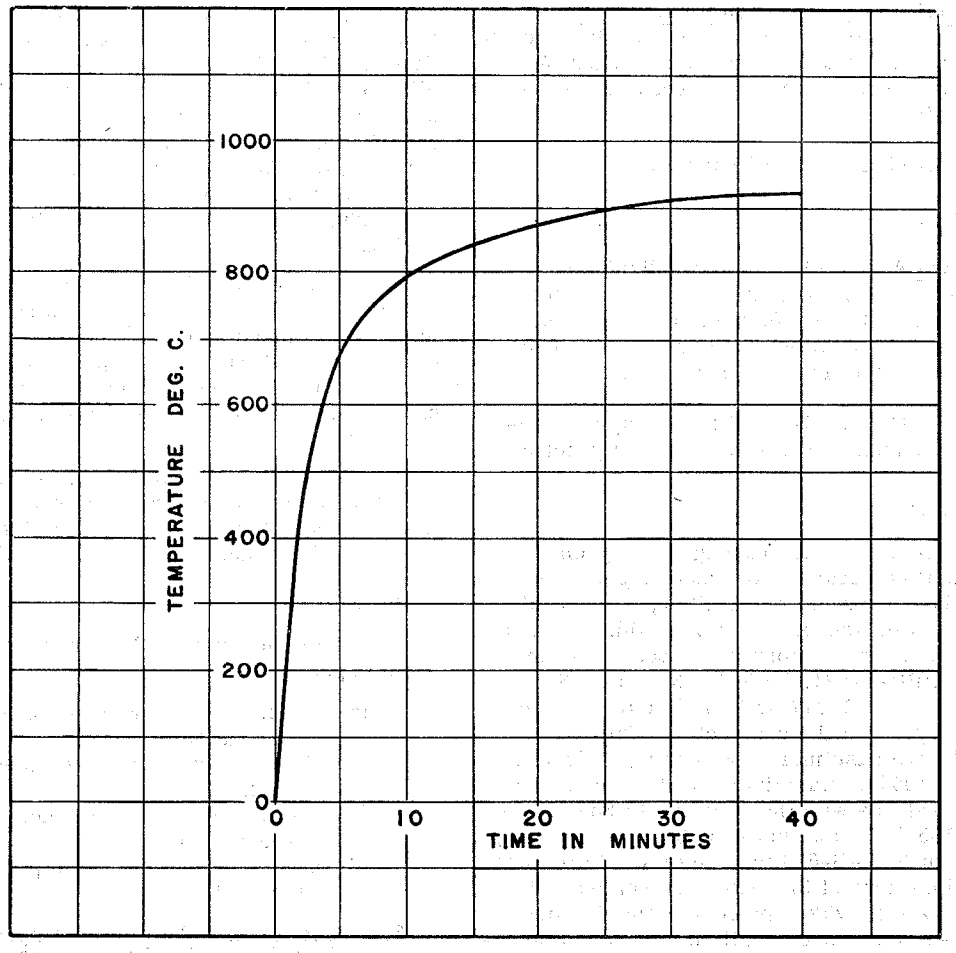

Figure 2 - Time temperature curve.

be installed horizontally, exposed face down, in the vibration test machine. The specimen shall then be subjected to 700 horizontal vibrations per minute, through an arc of 15 minutes, with a radius of 30 inches, for a period of 100 hours. Any particles which sift through the wire screen shall be collected in a pan secured under the screen. Upon completion of the test the specimen shall be removed, gain weighed, and examined for compliance with 3.9.1.

4.4.11 Acoustic performance. - The blanket shall be sandwiched between (20 gage) 26.5 ounces per square foot zinc-coated (galvanized) sheet iron and (26 gage) 12.29 ounces per square foot terneplate, the latter being perforated by 0.091 inch diameter holes, uniformly spaced, with 15 holes per square inch. The resulting compound sheet shall then be formed into a duct 11-1/2 feet long and 15 inches square inside, with the perforated surface inside. Single-frequency sound shall be sent through the duct from a loud-speaker affixed to one end. The other end of the duct shall be connected to an acoustic terminal having, at the frequency in question, an acoustic input impedance approximately equal to the characteristic impedance of the duct. Sound levels shall be measured on the central longitudinal axis of the duct at 11 points, 1 foot apart, starting at 9 inches, from either end of the duct. From these data shall be determined the average attenuation rate in decibels per foot at frequencies of 75, 150, 300 and 600 cycles per second. The performance rating, P. shall be computed from the following formula:

$$\text{Where } P = P_{75} + P_{150} + P_{300} + P_{600}$$

$$P_i = \frac{180 \text{ X } (5\text{-}t) \text{ X } (\text{db/ft at i})}{(W\text{-}6) \text{ X i}}$$

and i = frequency in cycles/second.
t = thickness of blanket in inches.
W = weight per unit length, in pounds/foot, of the entire duct.

4.5 Inspection of preparation for delivery. - Sample rolls and shipping containers shall be selected and inspected in accordance with Specification MIL-P-116 to verify conformance to the requirements of Section 5 herein.

5. PREPARATION FOR DELIVERY

5.1 Packaging. -

5.1.1 Level A. - Rolls shall be individually wrapped with 70-pound basis weight kraft paper conforming to Specification UU-P-268 with ends enclosed. All ends and seams shall be glued and taped. Tape shall conform to Specification PPP-T-76.

5.1.2 Level C. - Rolls shall be packaged in accordance with manufacturer's commercial practice.

5.2 Packing. -

5.2.1 Level A. - Rolls, packaged as specified (see 6.1), shall be packed in overseas type, wood cleated fiberboard, nailed wood, fiber, wirebound wood, wood cleated veneer paper overlaid, or wood cleated plywood boxes conforming to Specifications PPP-B-591, PPP-B-621, PPP-B-636, class 3, PPP-B-585, MIL-B-10377 or PPP-B-601, respectively, at the option of the contractor. Shipping containers shall have caseliners conforming to Specification MIL-L-10547. Caseliners shall be closed and sealed in accordance with the appendix to Specification MIL-L-10547. Caseliners for boxes conforming to Specification PPP-B-636 may be omitted provided all joints and corners of the boxes are sealed with minimum 1-1/2 inch wide tape conforming to Specification PPP-T-76. Boxes shall be closed and strapped in accordance with the applicable box specification or appendix thereto, except fiber boxes may be banded with tape conforming to type IV of Specification PPP-T-97 and the appendix thereto. The gross weight of wood or wood cleated boxes shall not exceed 200 pounds; fiber boxes shall not exceed the weight limitations of the applicable box specification. In lieu of caseliners, rolls may be wrapped with waterproof barrier material conforming to class C-1, E-1 or E-2 of Specification UU-P-271. All seams, joints and closures shall be sealed with adhesive conforming to Specification MIL-A-140 or other suitable materials to afford waterproofness equal to that of the barrier material.

5.2.2 Level B. - Rolls, packaged as specified (see 6.1), shall be packed in domestic type wood cleated fiberboard, nailed wood, wirebound wood, cleated plywood or wood cleated veneer paper overlaid boxes or class 2 fiber boxes conforming to Specifications PPP-B-621, PPP-B-585, PPP-B-601, MIL-B-10377 or PPP-B-636, respectively, at the option of the contractor. Box closure shall be as specified in the applicable box specification or appendix thereto. The gross weight of wood or wood cleated boxes shall not exceed 200 pounds; fiber boxes shall not exceed the weight limitations of the applicable box specification.

5.2.3 Level C. - Rolls, packaged as specified (see 6.1), shall be packed in containers which will insure acceptance by common carrier and safe delivery at destination. Shipping containers shall comply to the Uniform Freight Classification Rules or other regulations as applicable to the mode of transportation.

5.3 Marking. - In addition to any special marking required by the contract or order or herein, interior and exterior shipping containers shall be marked in accordance with Standard MIL-STD-129.

6. NOTES

6.1 Ordering data. - Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Type and class required (see 1.2 and 3.2.2).
(c) Length, width and thickness required (see 3.2.1).
(d) Levels of packaging and packing required (see 5.1 and 5.2).

6.3 Supersession data. - This specification supersedes Specifications MIL-I-22023(SHIPS) dated 20 May 1959, MIL-I-15365B(SHIPS) dated 21 November 1952, MIL-I-15365A dated 17 December 1951 and MIL-I-16022B dated 14 July 1955.

Notice. - When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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Preparing activity:
Navy - Ships
(Project 5640-0019)