MIL-I-22023B
16 October 1964
SUPERSEDING
MIL-I-22023A
2 May 1961

MILITARY SPECIFICATION

INSULATION FELT, THERMAL AND SOUND ABSORBING

FELT, FIBROUS GLASS, FLEXIBLE

This specification is mandatory for use by all Departments and Agencies of Department of Defense.

1. SCOPE

1.1 Scope. - This specification covers lightweight, flexible fibrous glass felt for thermal and acoustical control for use with temperatures up to 400° F.

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 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 documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

FEDERAL
PPP-B-636 - Boxes, Fiberboard.

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 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.

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.)

AMERICAN SOCIETY FOR TESTING MATERIALS

C167 - Method of Test for Thickness and Density of Blanket or Batt-Type Thermal Insulating Materials.

C177 - Method of Test for Thermal Conductivity of Materials by Means of the Guarded Hot Plate.

C423 - Method of Test for Sound Absorption of Acoustical Materials in Reverberation Rooms (Tentative).

D1448 - Micronaire Reading of Cotton Fibers.

(Application for copies should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pennsylvania.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Material. - The basic material shall be glass, processed from a molten state into fibrous form, containing not more than 1.5 percent by weight of nonfibrous material (shot), bonded with a binder to form a flexible felt (see 4.5.1).

3.1.1 Fiber diameter. - The average fiber diameter shall not exceed 0.00025 inch. (See 4.5.2.)

3.2 Dimensions and densities. -

3.2.1 Dimensions. -

3.2.1.1 Length. - The felt shall be furnished in rolls, 50, 100 or 200 feet in length, except where thicknesses greater than 1 inch and densities greater than 2.0 pounds per cubic foot may be furnished in cut sheets in accordance with manufacture standard practice, as specified (see 6.1). Rolls may contain more than one piece but no piece shall be less than 10 feet.

3.2.1.2 Width. - The width of the rolls shall be 24, 36, 48, or 72 inches, as specified (see 6.1).

3.2.1.3 Thickness. - The felt shall be furnished in thickness of 1/2 inch to 4 inches by 1/2 inch increments, as specified (see 6.1), except that classes 5 and 6 shall have a maximum thickness of 2 inches.

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 4.5.4).

3.4 Alkalinity. - The alkalinity of the felt expressed as equivalent sodium oxide (NA_2O) shall not exceed 0.60 percent and the pH shall be not less than 7.5 nor more than 12.0 (see 4.5.5).

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 test as specified in 4.5.6.

3.6 Resistance to smoldering. - Material shall not be smoldering at the expiration of the test specified in 4.5.7.

3.7 Fire resistance. - The felt shall be rated as incombustible or fire-retardant when tested as specified in 4.5.8.

3.8 Type I. -

3.8.1 Thermal conductivity. - The thermal conductivity (k) of the felt expressed in B.t.u.-inch per hour square feet degree Fahrenheit shall not exceed the values shown in table I (see 4.5.9).

Table I - Maximum thermal conductivities

Class	Maximum Thermal conductivity (k) at mean temperatures (°F).				
	25°	50°	75°	100°	200°
2	0.26	0.28	0.30	0.32	0.43
3	.24	.26	.28	.30	.39
4	.23	.24	.26	.28	.35
5	.22	.23	.24	.25	.31
6	.21	.22	.23	.24	.30

3.9 Type II. -

3.9.1 Vibration resistance. - There shall be not more than 0.50 percent by weight of the material passing through the screen (see 4.5.10).

3.9.2 Sound absorption coefficients. - The coefficients of absorption of the felt shall be not less than the values shown in table II (see 4.5.11):

Table II - Coefficients of absorption

felt thickness inches (nominal)	Frequency, cycles per second					
	125	250	500	1000	2000	4000
1/2	0.04	0.10	0.20	0.40	0.55	0.55
1	.06	.20	.45	.65	.65	.65
2	.15	.40	.75	.75	.75	.70
3	.20	.60	.90	.80	.80	.75
4	.25	.65	.95	.85	.85	.80

3.10 Workmanship. - Since several requirements for this material are not easily defined by a numerical value, the insulation shall have no visual defect that will adversely affect its serviceability.

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 Sampling for quality conformance inspection. -

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 or sheets shall be selected from each lot offered for inspection in accordance with MIL-STD-105 at Inspection Level II. The Acceptable Quality Level shall be 2.5 percent defective.

4.2.3 Sampling for Tests. - From each lot, samples of the proper size shall be selected at random for the tests specified in 4.4. The total quantity of felt in square feet shall be the lot size, and the number of test specimens to be in accordance with MIL-STD-105 at Inspection Level S-1.

4.3 Quality conformance inspection. -

4.3.1 Examination. - Each roll or sheet 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.

4.3.2 Density. - Each roll or sheet selected in accordance with 4.2.2 shall be weighed to verify the amount of content and density of material determined by the method specified in 4.5.3.

4.3.3 Thickness. - The thickness of each roll or sheet selected in accordance with 4.2.2 shall be determined by the method specified in 4.5.3. It will not be necessary to cut samples from the rolls or sheets 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.

4.3.4 Rejection. - Any roll or sheet containing one or more visual, dimensional or density defects shall not be offered for delivery, and if the number of defective rolls or sheets in any sample exceeds the acceptance number for that sample, this shall be cause for rejection of the lot represented by the sample.

4.4 Tests. - The samples selected in accordance with 4.2.3 shall be subjected to the tests specified in 4.5.1 through 4.5.11. If any specimen tested is found to be not in conformance with this specification, this shall be cause for rejection of the lot represented by the specimen.

4.4.1 Thermal conductivity and sound absorption tests. - The test of 4.5.9 and 4.5.11 need only be conducted for one of the following reasons:

(a) If within the three year period preceding the date of invitation for bid the felt has not been tested by an acceptable testing laboratory and found in compliance with the requirements of 3.8.1 and 3.9.2, respectively.

(b) If the felt offered for delivery is not the same in all respects as that previously tested by the testing laboratory.

4.5 Test procedures. -

4.5.1 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 remainder on the No. 30 and No. 50 sieves shall be combined and weighed as the nonfibrous material (shot) content.

4.5.2 Fiber diameter. - The diameter of the fiber shall be determined by either of the following methods:

(a) Microscopic. - Diameter of fiber shall be determined microscopically on the basis of measuring 100 fibers on each of the samples selected in accordance with 4.2.3. The average diameter for purposes of determining conformance with 3.1 shall be the average of all measurements on all samples.

(b) Air flow. - The air flow method as measured by the micronaire instrument in accordance with ASTM D 1448.

4.5.3 Thickness and density. - Thickness and density shall be determined in accordance with the method specified in ASTM C167.

4.5.4 Binder content. - The binder content of each sample tested shall be determined by heating not less than 1/2 square foot of material separated into small pieces to approximately 1000° F. for 1 hour 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.

4.5.5 Alkalinity and pH. -

4.5.5.1 Alkalinity. - The alkalinity test shall be performed as follows: Weigh a 5-gram (±0.01 gram) representative sample[1/] of the insulation 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 plus or minus 5 minutes. At the end of this period, disconnect the condenser and filter at once through

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

No. 41 Whatman paper supported in a Buechners 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:

Percent Na_2O=0.0124 (mℓs. H_2SO_4 used by sample minus mℓs. H_2SO_4 used by blank)

4.5.5.2 pH. - The pH test shall be performed as follows: A 25 gram sample shall be taken by means of a cork borer. A representative 1-gram specimen weighed to the nearest 0.001 grams shall be placed in a 500 ml pyrex Erlenmeyer flask and 100 ml of distilled water added. This water shall be made by the Rohm & Haas Amberlite Ion Exchange Resin HB-1. Macerate the glass insulation with the flattened end of a polyethylene stirring rod until the specimen is thoroughly wetted. Affix a 9 millimeter by 200 centimeter pyrex glass air condenser and set the flask on a hot plate. The hot plate shall be adjusted so that it will maintain the contents of the flask at 95° to 100°C. without boiling the water. The flask and contents shall be heated for one hour after which time the flask is cooled to 20° to 30°C. Transfer 50 mℓ of the extract to a 100 ml pyrex glass beaker and measure the pH on a pH meter with glass electrode and a saturated KCl-calomel electrode half cell capable of precision to within 0.1 pH.

4.5.6 Flexibility. - A piece of felt 12 by 18 inches by ordered thickness shall be cut 18 inches lengthwise with the felt and bent on its 12 inch dimension over a 1/2 inch iron pipe size through an angle of 90 degrees and released.

4.5.7 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.

4.5.8 Fire tests. -

4.5.8.1 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.

4.5.8.2 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 1. 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.

4.5.8.3 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.

4.5.8.4 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.

4.5.8.5 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 4.5.8.2. 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.

4.5.8.6 Incombustible. - When subjected to the test specified in 4.5.8.1, no flame shall issue from the specimen during or after flame application.

4.5.8.7 Fire retardant. - When subjected to the test specified in 4.5.8.1, 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.

4.5.9 Thermal conductivity. - Conductivity shall be determined in accordance with the method specified in ASTM C177.

4.5.10 Vibration resistance. - A test specimen 12-inches square which has been blown clean of loose cut surface particles shall be placed in a tight fitting sheet-metal box covered with No. 16 mesh wire screen tightly stretched and firmly attached to the box. The specimen shall be in intimate contact with the screen and five sides of the box. After being accurately weighed it shall 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.

4.5.11 Sound absorption coefficients. - Sound absorption coefficients shall be determined by laying felt on the floor of a reverberation room and testing in accordance with the method specified in ASTM C423.

4.6 Examination of preparation for delivery. - Sample rolls, sheets and shipping containers shall be selected and examined to determine conformance with the documents referenced in Section 5.

5. PREPARATION FOR DELIVERY

5.1 Packing. - Packing shall be Level A, B or C as specified (see 6.1).

5.1.1 Level A. - Insulation felt shall be packed in fiberboard boxes conforming to class 2 of PPP-B-636, except that limitations on inside dimensions of box shall not apply. All corners and edge seams, and manufacturer's joint shall be waterproofed with tape in accordance with the appendix to PPP-B-636.

5.1.2 Level B. - Insulation felt shall be packed in fiberboard boxes conforming to class 1 of PPP-B-636, except that limitations on inside dimensions of box shall not apply.

5.1.3 Level C. - Insulation felt shall be packed in containers, at the lowest rates, in a manner which will insure acceptance by common carrier and will afford protection against physical damage during direct shipment from the supply source to the first receiving activity for immediate use. This level in general shall conform to the Uniform Freight Classification Rules and Regulations or other carrier regulation as applicable to the mode of transportation and may be the supplier's commercial practice when such meets the requirements of this level.

5.2 Marking. - In addition to any special marking required by the contract or order, shipping containers shall be marked for shipment in accordance with 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 packing required (see 5.1).

Custodians:
Army - MO
Navy - SH
Air Force - 69

Review activity:
Army - MO
Navy - SH
Air Force - 69

Preparing activity
Navy - SH
(Project 5640-0053)

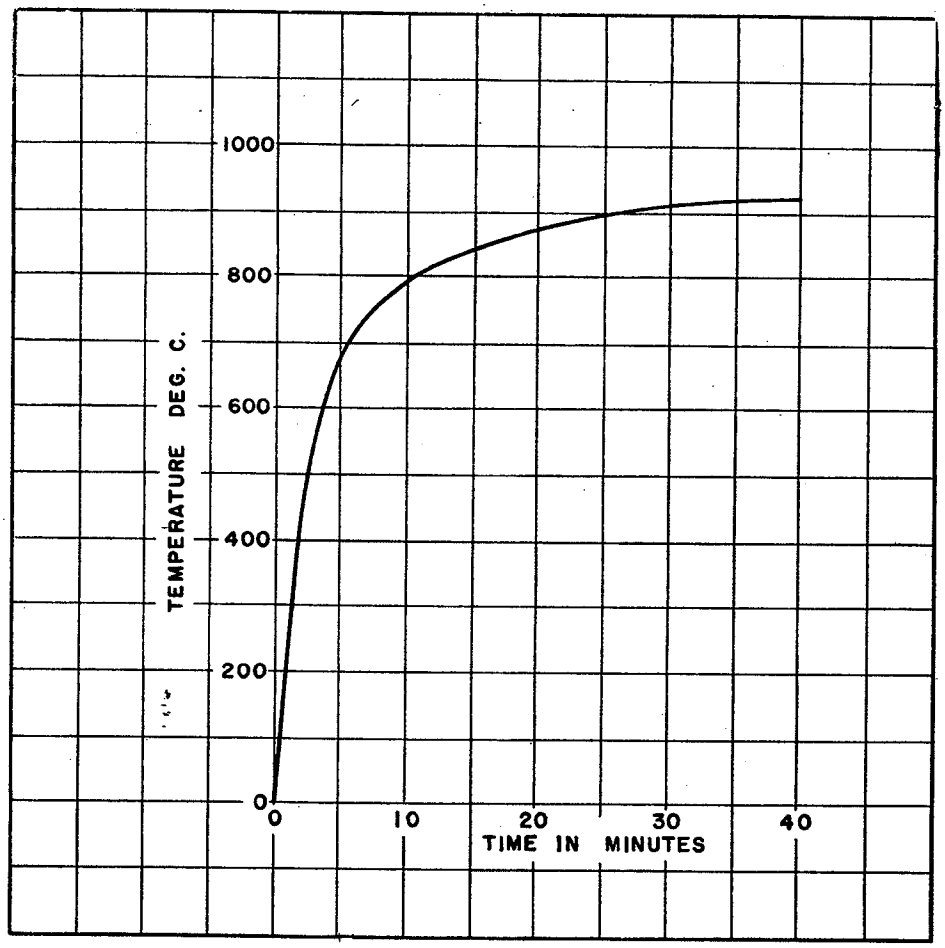

Figure 1 - Time temperature curve.

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

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 1 APR 63 1426 REPLACES NAVSHIPS FORM 4863, WHICH IS OBSOLETE

P-3700

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