

**MIL-I-16411A**

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 SUPERSEDING  
 MIL-I-16411 (SHIPS)  
 15 July 1951
**MILITARY SPECIFICATION**

# INSULATION FELT, THERMAL, GLASS FIBER (FOR TEMPERATURES UP TO 1,200°F.)

*This specification was approved by the Departments of the Army, the Navy, and the Air Force for use of procurement services of the respective Departments.*

**1. SCOPE**

1.1 This specification covers glass fiber insulation felt for thermal control of machinery and equipment such as steam turbines, boilers, boiler feed pumps, etc., at temperature up to 1,200°F.

**2. APPLICABLE SPECIFICATIONS, STANDARDS, DRAWINGS, AND PUBLICATIONS**

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

**SPECIFICATIONS****FEDERAL**

SS-C-466 —Cloth, Yarn, Thread, and Tape; Asbestos.

**MILITARY**

JAN-P-105 —Packaging and Packing for Overseas Shipment—Boxes, Wood, Cleated, Plywood.

JAN-P-106 —Packaging and Packing for Overseas Shipment—Boxes, Wood, Nailed.

MIL-B-107 —Boxes, Wood, Wire-bound (Overseas Type).

JAN-P-125 —Packaging and Packing for Overseas Shipment — Barrier-Materials, Waterproof, Flexible.

MIL-A-140 —Adhesive, Water-Resistant, Waterproof, Barrier-Material.

MIL-I-942 —Insulation Batt, Thermal, Fibrous Glass.

**NAVY DEPARTMENT**

General Specifications for Inspection of Material.

**STANDARDS****MILITARY**

MIL-STD-105— Sampling Procedures and Tables for Inspection by Attributes.

MIL-STD-129—Marking of Shipments.

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

**3. REQUIREMENTS**

3.1 Qualification.—Glass fiber insulation furnished under this specification shall be a product which has been tested and has passed the qualification tests specified in section 4 (see 6.2).

3.2 Material and construction.—The material shall consist of staple glass fibers felted into rovings and woven or bound with wire inserted asbestos thread (type III of Spec. SS-C-466) to form a flexible blanket. The construction shall conform to that of a sample submitted for qualification.

**MIL-I-16411A****3.3 Dimensions.**

**3.3.1 Length.**—Unless otherwise specified in the contract or order, the insulation shall be furnished in rolls 50 feet in length.

**3.3.2 Width.**—Unless otherwise specified in the contract or order, width of roll shall be 60 inches. A tolerance in width of plus one-half inch and minus one-fourth inch will be permitted.

**3.4 Thicknesses and weights.**—The insulation shall be furnished in the thicknesses shown in table I, as specified (see 6.1), and shall vary not more than plus or minus 10 percent from the weight specified for the ordered thickness.

TABLE I.—*Thicknesses and weights.*

Thickness	Thickness tolerance $\pm$	Weight per square foot
Inches	Inch	Ounces
$\frac{3}{4}$	$\frac{1}{8}$	9.0
1	$\frac{3}{8}$	12.0
$1\frac{1}{2}$	$\frac{1}{2}$	18.0

**3.5 Fineness of fiber.**—The diameter of the individual fibers shall average between 0.00030 and 0.00040. The maximum diameter of any fiber shall be not more than 0.00050 (see 4.6.3).

**3.6 Resistance to vibration.**—There shall be no sagging or settling of the insulation when subjected to the vibration test for a period of 100 hours (see 4.6.4).

**3.7 Alkalinity.**—The alkalinity of the finished material expressed as sodium oxide ( $\text{Na}_2\text{O}$ ) shall not exceed 0.20 percent (see 4.6.5).

**3.8 Fusing temperature.**—The fusing temperature of the fibers shall be not less than 1300°F. (see 4.6.6).

**3.9 Stability.**—The insulation shall reveal no physical changes upon completion of the stability tests specified in 4.6.7.

**3.10 Thermal conductivity.**—Thermal conductivity (k) in B.t.u. per hour per square foot of insulation for 1°F. gradient per inch thickness shall not exceed the values at the mean temperatures shown in table II (see 4.6.8).

TABLE II.—*Thermal conductivity*

Mean temperature	Thermal conductivity (k)
Degrees F.	
100	0.32
300	.45
500	.56
700	.70

**3.11 Workmanship.** — The workmanship shall be first class in every respect.

**4. SAMPLING, INSPECTION, AND TEST PROCEDURES**

**4.1 Inspection procedures.**—For Naval purchases, the general inspection procedures shall be in accordance with General Specifications for Inspection of Material.

**4.2 Qualification tests at a Government laboratory.** — Qualification tests shall be conducted at a Government laboratory designated by the Bureau of Ships. These tests shall consist of the tests specified in 4.6.

**4.3 Sampling.**

**4.3.1 Lot.**—For purposes of sampling a lot shall consist of not more than 25,000 square feet of glass fiber insulation-felt of the same thickness offered for delivery at one time.

**4.3.2 Sampling for lot acceptance inspection and tests at the place of manufacture.**

**4.3.2.1 Sampling for lot acceptance inspection.**—A random sample of rolls shall be se-

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lected from each lot of material by the Government inspector with lot acceptance based on table III in accordance with Standard MIL-STD-105.

TABLE III.—*Sampling for inspection*

Number of rolls in inspection lot	Number of rolls in sample	Acceptance number (defectives)	Rejection number (defectives)
15 and under	5	0	1
16 to 40	7	0	1
41 to 65	10	0	1
66 to 110	15	1	2
Over 110	25	2	3

**4.3.2.2 Sampling for lot acceptance tests.**—From each lot the Government inspector shall select seven samples 12 by 60 inches at random for the tests specified in 4.5.1.

**4.3.3 Sampling for production check tests at a Government laboratory.**—From the first lot offered for delivery under a contract or order, and thereafter from one lot in each group of 15 successive lots of the same thickness, the Government inspector shall select two samples 36 by 36 inches at random. These samples shall be forwarded by the Government inspector to a Government laboratory designated by the bureau or agency concerned for testing in accordance with 4.5.2.

**4.4 Inspection.**—Each of the sample rolls selected in accordance with 4.3.2.1 shall be surface inspected, weighed, and measured to determine conformance with the requirements of this specification which do not require tests. Any roll in the sample containing one or more visual or dimensional 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. Rejected lots may be offered again for Government inspection provided the contractor has removed all nonconforming rolls. The Government inspector shall again select and examine samples from such rejected lots to verify compliance with this specification.

## 4.5 Tests.

**4.5.1 Lot acceptance tests at place of manufacture.**—The samples selected in accordance with 4.3.2.2 shall be subjected to the tests specified in 4.6.1, 4.6.2, 4.6.3 and 4.6.6.

**4.5.1.1 Action in case of failure.**—If any one of the samples tested is found to be not in conformance with this specification, the lot which it represents shall be rejected. A rejected lot may be resubmitted for Government inspection only after the manufacturer, after being informed of the reasons for rejection has so reworked the entire lot as to remove or correct all nonconforming material.

**4.5.2 Production check tests at a Government laboratory.**—The samples selected in accordance with 4.3.3 shall be forwarded to the Naval Engineering Experiment Station, Annapolis, Md. to be tested as specified in 4.6.3, 4.6.5 and 4.6.6. Tests of performance as specified in 4.6.4, 4.6.7 and 4.6.8 shall also be conducted as deemed necessary by the Laboratory.

**4.5.2.1 Action in case of failure.**—Acceptance of the first lot offered for delivery under a contract or order shall be withheld until a satisfactory report is received on the production check test sample. Thenceforth, except as hereinafter specified, acceptance and rejection of lots shall normally be on the basis of the sampling and inspection specified in 4.3.2.1 and 4.4, and acceptance shall not be withheld pending receipt of test reports on production check test samples. However, upon receipt of an unsatisfactory test report on a production check test sample, the Government inspector shall select additional samples from every subsequent lot offered for delivery. The samples so selected shall be submitted to United States Naval Engineering Experiment Station, Annapolis, Md., and shall there be subjected to test or tests wherein failure was observed. Lots shall then be accepted only upon receipt of a satisfactory test report on the samples so selected.

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Additional testing shall be discontinued and lot acceptance returned to the normal basis when three successive lots have been accepted.

### 4.6 Test procedures.

**4.6.1 Thickness.**—The test specimen shall be ruled off into 10 approximately square and equal areas, and the thickness measurement taken at the center of each area. In determining the thicknesses, 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  $\frac{1}{32}$ -inch. The average of the 10 thickness measurements shall be taken as the thickness of the test specimen.

**4.6.2 Weight.**—Each sample roll selected in accordance with 4.3.2.1 shall be weighed on suitable scale to verify compliance with 3.4.

**4.6.3 Fineness of fibers.**—Diameter of fibers shall be determined microscopically on the basis of at least 7 checks on each of the samples. The average diameter for purposes of determining conformance with 3.5 shall be the average of all measurements on all samples; the maximum shall be the maximum diameter of any fiber thus measured.

**4.6.4 Resistance to vibration.**—The test for determining ability of the material to withstand vibration while subjected to a temperature of 1,200°F. shall be conducted on two 2-foot square, 2-inch thick sheets which shall be mounted on the faces of an electrical heater plate. The ends of the heater plate shall be insulated with cut sections of the

material and the entire assembly shall be fitted and mounted within a  $\frac{1}{8}$ -inch thick sheet-iron casing 30 by 30 by 6 inches. The casing shall be mounted in a vertical position on a vibration test apparatus. Five iron constantan thermocouples, equally spaced and secured in each face of the heater plate and the outer surfaces of the metal casing, shall afford a means of ascertaining the inner and the exposed temperature of the assembly. During the test the material shall be subjected to 720 vibrations per minute through an arc of 15 minutes for a period of 100 hours of operation. At the end of the 100-hour period of operation the outer metal casing of the assembly shall be removed and the condition of the sheets noted.

**4.6.5 Alkalinity.**—Weigh a  $5 \pm 0.01$  gram (gm.) representative sample 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  $\pm 5$  minutes. At the end of this period, disconnect the condenser and filter at once through No. 41 Whatman paper supported in a Buechner funnel. Wash the flask and material three times with 25 ml. portions of hot distilled water using suction. Titrate immediately with 0.02  $\text{NH}_2\text{SO}_4$ , using 6 to 8 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  $\text{Na}_2\text{O}$  is calculated from the following formula: percent  $\text{Na}_2\text{O} = 0.0124$  (ml.  $\text{H}_2\text{SO}_4$  used by sample minus ml.  $\text{H}_2\text{SO}_4$  used by blank).

**4.6.6 Fusing temperature.**—Weigh 1 gm. of glass fiber into a crucible and place in a muffle furnace at room temperature. Turn all heating elements on at start of test and adjust so that the specified temperature of 1,300°F. is reached in 45 minutes. When this temperature is reached, remove crucible from furnace immediately, allow to cool, and examine visually for fusion. Fusion shall be said to have taken place if any part of the

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sample has melted and formed a homogeneous mass.

4.6.7 *Stability*.—Samples of felt 4 inches square shall be encased in a metal wire screen and placed on a rack above the water level in a steam digester. The samples shall be subjected to saturated steam at 225 pounds per square inch (p.s.i.) gage for 1.6 hours. Samples shall then be removed, examined, and conditions noted.

4.6.8 *Thermal conductivity*.—Thermal conductivity shall be determined by the guarded hot plate method specified in Specification MIL-I-942.

## 5. PREPARATION FOR DELIVERY

### 5.1 Packing.

5.1.1 *For domestic shipment*.—The subject commodity shall be furnished in bales covered with standard 7½ ounce (weight) burlap tubing with tubing drawn together at each end with wire. The gross weight shall not exceed 200 pounds.

5.1.2 *For oversea shipment*.—The subject commodity shall be packed in cleated-plywood, nailed wood, or wirebound boxes conforming to Specification JAN-P-105, JAN-P-106, or MIL-B-107, respectively. Shipping containers shall be lined with a sealed waterproof bag, or its equivalent, made from material conforming to Specification JAN-P-125, for case liners. The seams and closures shall be sealed with adhesive conforming to Specification MIL-A-140. The gross weight shall not exceed approximately 200 pounds.

5.1.3 *For domestic or oversea shipment*.—Where practicable, shipping containers shall be of uniform size, and shall contain the identical number of rolls. Containers shall be designed to fit the contents in a compact manner.

5.2 *Marking*.—In addition to any special marking required by the contract or order, 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) Thickness of insulation required (see 3.4).
- (c) Whether packing for domestic or oversea shipment is required (see 5.1).

6.2 In the procurement of products requiring qualification the right is reserved to reject bids on products that have not been subjected to the required tests and found satisfactory for inclusion on the Military Qualified Products List. The attention of suppliers is called to this requirement, and manufacturers are urged to communicate with the Bureau of Ships, Navy Department, Washington 25, D. C., and arrange to have the products that they propose to offer to the Army, the Navy or the Air Force, tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products covered by this specification may be obtained from the Chief of the Bureau of Ships, Navy Department, Washington 25, D. C.

*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.

#### Custodian:

Army—Corps of Engineers  
Navy—Bureau of Ships  
Air Force

#### Other interest:

Army—OT  
Navy—SY.

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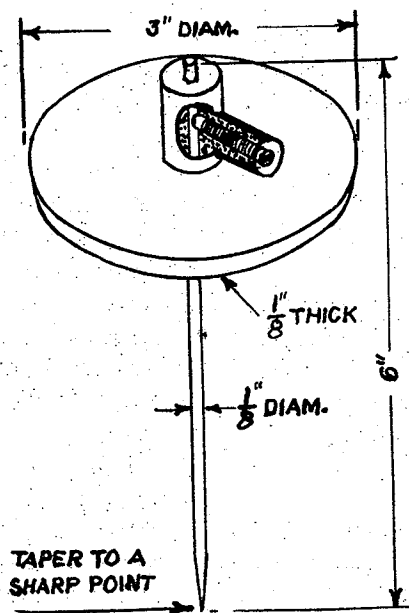


FIGURE 1.—Depth gage for thickness measurements.