MIL-I-22344C
26 May 1981
SUPERSEDING
MIL-I-22344B
6 August 1963
(See 6.5)

MILITARY SPECIFICATION

INSULATION, PIPE, THERMAL, FIBROUS GLASS

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

1. SCOPE

1.1 Scope. This specification covers fibrous glass pipe insulation for use as thermal control on pipes, valves, and fittings for temperatures up to 370°F.

2. APPLICABLE DOCUMENTS

2.1 Issues of 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.

SPECIFICATION

FEDERAL

PPP-B-636 - Boxes, Shipping, Fiberboard.

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-1623 - Fire Performance Requirements and Approved Specification for Interior Finish Materials and Furnishings. (Naval Shipboard Use).

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 3112, Department of the Navy, Washington, D.C. 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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 AGENT
Uniform Freight Classification Ratings, Rules and Regulations

(Application for copies should be addressed to the Uniform Classification Committee Agent, Tariff Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC. AGENT
National Motor Freight Classification

(Application for copies should be addressed to the National Motor Freight Traffic Association, Inc., ATA TRAFFIC Dept., 1616 "P" Street, N.W., Washington, DC 20036.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
C 302 - Density of Preformed Pipe-Covering-Type Thermal Insulation.
C 335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulations.
C 411 - Hot-Surface Performance of High-Temperature Thermal Insulation
D 1448 - Micronaire Reading of Cotton Fibers.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103).

(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 First article. When specified (see 6.2.1), the contractor shall furnish a first article unit(s) for first article inspection and approval (see 4.3 and 6.4).

3.2 Material. The basic material shall be glass, processed from a molten state into fibrous form, essentially shot-free, impregnated with a binder, and compressed or otherwise formed into pipe insulation (see 6.3). The insulation may be split or slit lengthwise.

3.2.1 Fiber diameter. The average fiber diameter shall not exceed 0.0004 inch (see 4.7.2)

3.3 Dimensions. Pipe insulation shall be furnished in the following dimensions:

3.3.1 Length. Pipe insulation shall be furnished in lengths of 3 feet up to 6 feet with tolerance of plus or minus 3/16 inch.

3.3.2 Size. Insulation shall be furnished to fit standard pipe and tube sizes (see 6.2.1), from 1/4 inch to 36 inches. The longitudinal seam shall close to within 1/8 inch along the entire length of the section. The inside diameter of the insulation shall not exceed the outside diameter of the pipe by 1/4 inch up to 4-1/2 inches iron pipe size (IPS) or by 5 percent on sizes over 4-1/2 inches IPS.

3.3.3 Thickness. Insulation shall be furnished either single or double layer in nominal thicknesses of 1/2 inch to 4 inches in increments of 1/2 inch, according to simplified standard sizes (see 6.2.1) with tolerance of plus or minus 3/32 inch in thickness.

3.3.4 Density. Insulation shall have a nominal density of 5.0 pounds per cubic foot (lb/ft^3) with a tolerance of plus or minus 2.0 lb/ft^3.

3.4 Alkalinity and pH. Alkalinity of the pipe insulation 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 4.7.3 and 4.7.4).

3.5 Hot surface performance. Pipe insulation shall be suitable for use at temperatures up to 370°F, and thicknesses up to 4 inches. Pipe insulation shall show no evidence of flaming, glowing, smoldering, or smoking. There shall be no degradation which will seriously affect performance. Minor loss of binder or slight discoloration of the binder shall be acceptable. There shall be no cracking or delamination of the insulation. The insulation thickness along the top of the pipe shall decrease by no more than 10 percent, when tested in accordance with 4.7.5.

3.6 Fire performance. Insulation shall conform to the requirements of MIL-STD-1623 (see 4.7.6).

3.7 Thermal conductivity (k). Thermal conductivity shall not exceed the following values (see 4.7.7):

Mean temperature, °F	Conductivity, British thermal units per square foot per hour per °F ($Btu/hr-ft^2-°F$) (1 inch thickness)
25	0.23
50	0.24
75	0.25
100	0.26
200	0.31

3.8 Workmanship. Insulation shall be free of defects in appearance and dimensions (see 4.5.1).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor 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 inspection requirements specified herein are classified as follows:

(a) First article inspection (see 4.3).
(b) Quality conformance inspection (see 4.4)

4.3 First article inspection. First article inspection shall consist of the examination of 4.5.1 and tests specified in 4.7, except for fire resistance (see 4.7.6) and thermal conductivity (see 4.7.7), for which certificates of compliance are acceptable (see 4.6).

4.3.1 First article inspection report. The contractor shall prepare a first article inspection report in accordance with the data ordering document included in the contract (see 6.2.2).

4.3.2 First article unit. The first article unit shall consist of one segment of each thickness acquired at any one time.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the examination of 4.5.1, and the tests of 4.7.1 and 4.7.2. Unless otherwise specified (see 6.2.1), certificates of compliance (see 4.6) shall be acceptable as proof that the pipe insulation furnished has passed the remaining tests of this specification.

4.4.1 Lot. A lot shall consist of units representative in material and manufacturing process of all items offered under this specification, except that samples for testing to conformance to 3.3 and 3.8 shall be taken from the actual lots to be shipped. Units of different size and thickness may be considered in one lot, provided there is no variation in material or process across the range. Where material and process varies across the range of size and thickness offered, additional samples shall be tested to characterize these variations. A unit is defined as a single length of pipe insulation of either the split or slit form.

4.4.2 Samples. Samples shall be selected randomly from the lot. The number of samples subjected to the examination of 4.5.1 shall be in accordance with MIL-STD-105. The inspection level shall be S-2, with an acceptance quality level (AQL) of 2.5. The number of samples and the number of tests performed on each sample shall be in accordance with the requirements of each test.

4.5 Inspection.

4.5.1 Examination of the end item for defects in appearance and dimensions. Each of the samples selected in accordance with 4.4.2 shall be examined, weighed, and measured, as applicable to determine conformance with the requirements of 3.3 and 3.8. These test shall be conducted on the actual lots to be shipped. Any sample unit containing one or more visual or dimensional defects as shown in table I shall be cause for rejection of the unit. If the number of defective units in the sample exceeds the AQL, this shall be cause for rejection of the lot represented by the sample.

TABLE I. Visual and dimensional defects.

Appearance:	Binder spots or foreign inclusions larger than one inch in any two perpendicular dimensions. Delamination larger than four square inches. Sections not slit or split as ordered. Dents, depressions, or voids affecting more than 10 percent of the surface face and 20 percent of the thickness.
Dimensions:	Not within limits or tolerances specified in 3.3.

4.6 Certificates of compliance. The contractor shall prepare certificates of compliance in accordance with the data ordering document included in the contract (see 4.3, 4.4, and 6.2.2). The certificates of compliance shall be acceptable proof that the product being offered meets the requirements of this specification, provided the vendor furnishes actual test results indicating that tests have been performed to substantiate the certification. The certification shall also state that the required tests (see 4.3 and 4.4) have been performed on products manufactured from the same basic ingredients and manufacturing process as the items being offered and that any changes in basic ingredients or process shall be promptly reported to both the contracting activity and Commander, Naval Sea Systems Command (Materials Engineering Office), Department of the Navy, Washington, DC 20362. In this event, the Government at its sole discretion reserves the right to require that tests for conformance to this specification be conducted on all lots before shipment is made.

4.7 Test procedures.

4.7.1 Density. Density of the pipe insulation shall be determined in accordance with the method specified in ASTM C 302. On the jacketed product (see 6.3), density shall be determined by individual piece weight, using nominal facing and adhesive weight.

4.7.2 Fiber diameter. Diameter of the fiber shall be determined by either of the following methods:

(a) Microscopic. Diameter of fibers shall be determined microscopically on the basis of measuring 50 fibers from samples selected in accordance with 4.4.2. The average diameter for determining conformance shall be the arithmetic means of all measurements.

(b) Air flow. The air flow method as measured by the micronaire instrument in accordance with ASTM D 1448, with the addition that the micronaire unit shall be calibrated for the purpose of testing fibrous glass.

4.7.2.1 In case of dispute, the microscopic test method shall be the referee test method.

4.7.3 Alkalinity. The alkalinity test shall be performed as follows:

4.7.3.1 Weigh a 5 ± 0.01 gram representative sample[1/] of pipe insulation and introduce into a 500-milliliter (mL) Pyrex Erlenmeyer flask or equal. Wet with 5 mL of 96 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 a No. 42 Whatman paper, or its equivalent, supported in a Buechner funnel or equal, and connected to a suction source. Wash the flask and residual material three times with 25 mL portions of hot distilled water. Titrate the combined filtrate and wash solution immediately with 0.02N H_2SO_4, using 6 to 8 drops of a 1-percent solution of phenol-red indicators, to the disappearance of the pink color. Run a blank determination of the total amount of distilled water and alcohol, and substitute the nitrate value in the formula below:

$$\text{Percent alkalinity as } Na_2O = \frac{(A-B)N \times 0.031 \times 100}{W}$$

Where:

A = mL H_2SO_4 required to titrate sample
B = mL H_2SO_4 required to titrate the blank
N = Normality of the H_2SO_4
W = Weight of sample in grams

4.7.4 pH. The pH test shall be performed as follows: A 25-gram sample shall be taken 1/. A representative 1-gram specimen weighed to the nearest 0.001 gram shall be placed in a 500-mL Pyrex Erlenmeyer flask or equal, and 100 mL of distilled water added. The distilled water shall be made by the Rohm and Haas Amberlite Ion Exchange Resin HB-1 method. Macerate the glass insulation with the flattened end of a polyethylene stirring rod until the specimen is thoroughly wetted. Afflix a 9-millimeter (mm) by 200-centimeter (cm) Pyrex glass air condenser or equal, 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 194°F to 212°F, without boiling the water. The flask and contents shall be heated for one hour after which time the flask shall be colled to 68°F to 86°F. Transfer 50 mL of the extract to a 100-mL Pyrex glass beaker or equal, and measure the pH with a glass electrode and a saturated KC1-calomel electrode half-cell capable of precision to within 0.1 pH.

1/ A representative sample may be conveniently prepared by taking borings with a large cork borer through the cross-section of the pipe insulation.

4.7.5 Hot surface performance. Hot surface performance of one sample of pipe insulation shall be determined in accordance with method specified in ASTM C 411. Insulation for 3-inch pipe shall be tested at a temperature of 370°F, and a thickness of 4 inches.

4.7.6 Fire performance. Three flat samples of pipe insulation shall be tested in accordance with MIL-STD-1623.

4.7.7 Thermal conductivity. One sample of pipe insulation shall be tested in accordance with the method specified in ASTM C 335. Determinations shall be made at three mean temperatures, 100°F, 150°F, and 200°F. Results of these tests shall be extended, through reasonable curve fit or numerical techniques, to establish the thermal conductivity at the levels specified in 3.7.

4.8 Inspection of packaging. Packing and marking shall be examined for conformance with the requirements of section 5.

5. PACKAGING

5.1 Packing. Packing shall be level A, B, or C, as specified (see 6.2.1).

5.1.1 Level A. Insulation shall be packed in containers conforming to PPP-B-636, class weather resistant, except that limitations on inside dimensions of box shall not apply. Containers shall be closed, waterproofed and reinforced with tape in accordance with method V of the appendix to PPP-B-636. The weight limitations of the specification shall not be exceeded.

5.1.2 Level B. Insulation shall be packed in fiberboard boxes conforming to class domestic of PPP-B-636; the weight limitations of the specification shall not be exceeded. Box closures shall conform to method I, as specified in the appendix to PPP-B-636.

5.1.3 Level C. Insulation shall be packed in containers in a manner which will insure acceptance by common carrier at the lowest rates, 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 or National Motor Freight Classification Rules and Regulations or other carrier regulations as applicable to the mode of transportation. The contractor's normal retail or wholesale packing methods may be utilized when such meet the requirements of this level.

5.2 Marking. In addition to any special marking required by the contract (see 6.2.1), exterior shipping containers shall be marked for shipment in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. This specification covers material intended for use on pipes as an antisweat insulation for temperatures of 32°F to 100°F, and as a heat insulation for surface temperatures of 100°F to 370°F.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) When a first article is required for inspection and approval (see 3.1, 4.3 and 6.4).
(c) Nominal pipe and tube sizes, length, and thickness required (see 3.3)
(d) When certificates of compliance shall not be required (see 4.4).
(e) Levels of packing required (see 5.1).
(f) Special marking, if required (see 5.2).

6.2.2 Data requirements. When this specification is used in a contract which incorporates a DD Form 1423 and invokes the provisions of 7-104.9(n) of the Defense Acquisition Regulation (DAR), the data requirements identified below will be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (DD Form 1423) incorporated into the contract. When the provisions of DAR-7-104.9(n) are not invoked, the data specified below will be delivered by the contractor in accordance with the contract requirements. Deliverable data required by this specification is cited in the following paragraphs:

Paragraph	Data requirement	Applicable DID
4.3.1	First article inspection report	DI-T-4902
4.6	Certificate of compliance	DI-E-2121

(Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in section 3, 4, or 5 of the specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract, regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 Pipe insulation is also furnished with factory-applied jackets. The jacketed insulation shall meet all of the requirements of this specification. Preformed fibrous glass fittings are also available. If multilayer combinations of single standard layers are required, the layers shall be specified as "factory-nested".

6.4 First article inspection. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection as to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.5 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:
Navy - SH
Air Force - 99

Review activity:
Navy - MS

Preparing activity:
Navy - SH
(Project 5640-0300)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval
No. 22-R255

INSTRUCTIONS: The purpose of this form is to solicit beneficial comments which will help achieve procurement of suitable products at reasonable cost and minimum delay, or will otherwise enhance use of the document. DoD contractors, government activities, or manufacturers/ vendors who are prospective suppliers of the product are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.

DOCUMENT IDENTIFIER AND TITLE
MIL-I-22344C

NAME OF ORGANIZATION AND ADDRESS

CONTRACT NUMBER

MATERIAL PROCURED UNDER A
☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?
   A. GIVE PARAGRAPH NUMBER AND WORDING.

   B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3. IS THE DOCUMENT RESTRICTIVE?
   ☐ YES ☐ NO *(If "Yes", in what way?)*

4. REMARKS

SUBMITTED BY *(Printed or typed name and address - Optional)*

TELEPHONE NO.

DATE

DD FORM 1 JAN 72 1426 REPLACES EDITION OF 1 JAN 66 WHICH MAY BE USED

S/N 0102-014-1802

FOLD

DEPARTMENT OF THE NAVY

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 12503 WASHINGTON D. C.

POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE NAVY

COMMANDER
NAVAL SEA SYSTEMS COMMAND (SEA 3112)
DEPARTMENT OF THE NAVY
WASHINGTON, DC 20362

FOLD

☆ U.S. GOVERNMENT PRINTING OFFICE: 1981—703-023/4644 2-1