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APPROVAL OF THE NAVAL SHIP SYSTEMS COMMAND

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12 February 1974  
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MIL-I-24244(SHIPB)  
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(See 6.5)

MILITARY SPECIFICATION  
INSULATION MATERIALS, THERMAL, WITH SPECIAL  
CORROSION AND CHLORIDE REQUIREMENTS

1. SCOPE

1.1 Scope. This specification covers mineral-based thermal insulation, cement, and adhesives with special corrosion and chloride requirements.

1.2 Types. The insulation material shall be of one of the following types and subtypes as specified (see 6.2):

- Type 1 - Insulation, pipe, thermal (MIL-I-2781).
  - 1A - Grade I, class b - compounded - temperatures up to 600°F.
  - 1C - Grade II, class d - compounded - temperatures up to 750°F.
  - 1D - Grade III, class e - compounded - type I - light density - temperatures up to 1200°F.
  - 1E - Grade III, class e - compounded - type II - heavy density - temperatures up to 1200°F.
- Type 2 - Insulation blanket, thermal, fibrous mineral (MIL-I-2818).
- Type 3 - Insulation block, thermal (MIL-I-2819).
  - 3A - Class 1 - temperatures up to 600°F.
  - 3B - Class 2 - temperatures up to 1200°F.
  - 3D - Class 3 - temperatures up to 1500°F.
  - 3E - Class 4 - temperatures up to 2000°F.
- Type 4 - Cement, insulation, high temperature (MIL-C-2861).
- Type 5 - Cements, insulation, thermal (SS-C-160, type III, grade F, finishing cement).
- Type 6 - Adhesives, fire-resistant, thermal insulation (MIL-A-3316).
  - 6A - Class 1 - For bonding fibrous glass cloth to unfaced fibrous glass insulation. For bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board. For sealing the edges of, and bonding fibrous glass tape to the joints of, fibrous glass board. For bonding lagging cloth to thermal insulation.
  - 6B - Class 2 - For attaching fibrous glass insulation to metal surfaces.
  - 6C - Class 3 - For attaching cork and fibrous glass insulation board to metal surfaces.
- Type 9 - Insulation tape, thermal (MIL-I-15349).
  - 9A - Type I - For spiral wrapping.
  - 9B - Type II - For lateral wrapping.
- Type 10 - Insulation felt, thermal, glass fiber (MIL-I-16411).
  - 10A - Type I - Felted rovings.
  - 10B - Type II - Laminated and felted.
- Type 11 - Insulation blanket, thermal, refractory fiber, flexible (MIL-I-23128).
  - 11A - Grade A - Temperatures up to 1200°F.
  - 11B - Grade B - Temperatures up to 2000°F.
- Type 14 - Cloth, thread and tape, asbestos (SS-C-466).
  - 14A - Form 1, cloth, grade U.G., style 1 - regular weight.
  - 14B - Form 1, cloth, grade U.G., style 2 - light weight.
  - 14C - Form 1, cloth, grade U.G., style 3 - No. 1 construction.
  - 14D - Form 1, cloth, grade U.G., style 4 - No. 2 construction.
  - 14E - Form 1, cloth, grade U.G., style 5 - glass-asbestos - No. 3 construction.
  - 14F - Form 1, cloth, grade U.G., style 6 - glass-asbestos - No. 4 construction.
  - 14G - Form 1, cloth, grade AA, style 1 - regular weight.

Classification (canceled)(changed to  
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- Type 14H - Form I, cloth, grade AAA, style 1 - regular weight.  
 14I - Form I, cloth, grade AAA, style 2 - light weight.  
 14J - Form I, cloth, grade AAA-M, style 7 - weight per square yard 2.60 (nominal).  
 14K - Form I, cloth, grade AAA-M, style 8 - weight per square yard 2.75 (nominal).  
 14L - Form I, cloth, grade AAA-M, style 9 - weight per square yard 3.50 (nominal).  
 14M - Form II, thread, sewing, reinforced with wire.  
 14N - Form III, thread, sewing, without wire.  
 14P - Form IV, tape, grade U.G., style 1 - plain weave.
- Type 15 - Tape asbestos (MIL-T-4117).  
 15A - Class 1, grade AAA, type XX.  
 15B - Class 1, grade AAA, type XXI.
- Type 16 - Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type) (MIL-I-558).  
 16A - Form A, rigid, class 2.  
 16B - Form A, rigid, class 3.  
 16C - Form A, rigid, class 4.  
 16D - Form A, rigid, class 5.  
 16E - Form B, type II, class 9.  
 16F - Form C, class 10.  
 16G - Form C, class 11.  
 16H - Form D, type III, class 12.

**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**

- MIL-I-558 - Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type).  
 RD-C-160 - Cements, Insulation, Thermal.  
 SS-C-466 - Cloth, Thread and Tape; Asbestos.  
 UI-P-268 - Paper, Kraft, Untreated, Wrapping.

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- MIL-I-2781 - Insulation, Pipe, Thermal.  
 MIL-I-2818 - Insulation Blanket, Thermal, Fibrous Mineral.  
 MIL-I-2819 - Insulation Block, Thermal.  
 MIL-C-2861 - Cement, Insulation, High Temperature.  
 MIL-A-3316 - Adhesives, Fire-Resistant, Thermal Insulation.  
 MIL-T-4117 - Tape, Asbestos.  
 MIL-I-15349 - Insulation Tape, Thermal.  
 MIL-I-16411 - Insulation Felt, Thermal, Glass Fiber.  
 MIL-I-23128 - Insulation blanket, Thermal, Refractory Fiber, Flexible.  
 MIL-I-45208 - Inspection System Requirements.

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

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.

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

- ASTM B 167 - Nickel-Chromium-Iron Alloy Seamless Pipe and Tube.  
 ASTM D 512 - Methods of Test for Chloride Ion in Industrial Water and Industrial Waste Water.  
 ASTM D 1428 - Standard Methods of Test for Sodium and Potassium in Water and Water-Formed Deposits by Flame Photometry.

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- AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (continued)
- ASTM E 60 - Practice for Photometric Methods for Chemical Analysis of Metals.
  - ASTM E 62 - Photometric Methods for Chemical Analysis of Copper and Copper-Base Alloys.
  - ASTM E 120 - Chemical Analysis of Titanium and Titanium-Base Alloys.
  - ASTM E 146 - Chemical Analysis of Zirconium and Zirconium-Base Alloys.
  - ASTM Bulletin No. 225, TP196, dated October 1957.

(Xerographic or microfilm copies of Technical Paper TP196 from ASTM Bulletin No. 225 are available from University Microfilms, Inc., Article Reprints, Ann Arbor, Michigan 48106.)

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

AMERICAN IRON AND STEEL INSTITUTE (AISI)  
Steel Products Manual

(Application for copies should be addressed to the American Iron and Steel Institute, 150 East 42nd Street, New York, New York 10017.)

(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 Type. The type and subtype shall be as required by the ordering data (see 1.2 and 6.2). Types and subtypes other than those listed in 1.2 may be supplied only with written approval of the command or agency concerned.

3.2 Type requirements. In addition to the requirements of this specification, the material supplied shall conform in all respects to the specification listed in 1.2 for the specific type and subtype material. When types and subtypes other than those covered in specifications listed in 1.2 are required, the type requirement shall be given in the ordering data (see 6.2).

#### 3.3 Chemical requirements.

3.3.1 Analysis. The specific material supplied shall be analyzed for the following leachable ions: (1) chloride, (2) sodium or silicate (if necessary to meet the acceptance requirement of figure 1, both sodium and silicate should be analyzed). The "plot point" of these analyses shall fall in the acceptable area of figure 1. The acceptance-rejection curve may be extrapolated, as necessary, to determine the acceptability of "plot points" which fall outside the area actually bounded by figure 1. However, the minimum allowable value of sodium plus silicate shall be 50 parts per million (ppm).

3.3.2 pH: Leach water from the specific material supplied shall have a pH (Hydrogen ion concentration negative exponent) not greater than 11.2.

3.4 Preproduction requirements. Prior to supplying any type and subtype of thermal insulation to this specification, a supplier shall comply with the preproduction requirements specified in either 3.4.1 or 3.4.2 for the particular type and subtype supplied.

3.4.1 A supplier who has previously supplied thermal insulation of the specific type and subtype to this specification, or who has and can supply a copy of a certificate of compliance (see 6.3.2) to the requirements of this specification, shall have met the preproduction requirements of this specification when the following requirements have been met:

- (a) The thermal insulation previously produced to this specification, or to the certificate of compliance, shall have met all the requirements of this specification.
- (b) The thermal insulation previously produced was produced to the same formulation, by the same production processes, and using ingredients of the same kind, nature and quality as those which will be employed to produce thermal insulation to this specification. If any such change has been made, the requirements of 3.4.2 shall apply.

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3.4.2 A supplier who has not previously produced the required type and subtype of thermal insulation to this specification, or cannot supply an equivalent certification of compliance (see 6.3.2), or when required by 3.4.1(b), shall test a sample from a production lot of the type and subtype required as specified in 6.2.1. The production lot from which the sample is taken shall be of the same formulation, made by the same production processes and from the same kind, nature, and quality of ingredients as those which will be employed for production of thermal insulation to this specification. The supplier shall have complied with the preproduction requirements of this specification when the following requirements have been met:

- (a) The production lot from which the sample was taken has met all the requirements of the specification listed in 1.2 for the specific type and subtype. The sample from this lot shall be analyzed for pH, chlorides, sodium and silicate in accordance with the chemistry methods permitted by this specification.
- (b) The sample has been tested as required by the preproduction corrosion test (see 4.3), and not more than one of the four prepared coupons shows a crack when examined as required by 4.3.4(h).
- (c) The actual numerical results of all chemistry tests including analyses for both sodium and silicate content, and actual numerical results of preproduction corrosion test shall have been submitted to the command or agency concerned for information.

3.5 Mercury contamination. During the manufacturing process, tests and inspections, the insulation shall not have come in direct contact with mercury or any of its compounds, nor with any mercury containing device employing a single boundary of containment.

#### 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.<sup>1/</sup> 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.

4.1.1 The performance of the examinations or tests set forth in this specification does not relieve the supplier of his responsibility to provide a product which meets all the requirements of this specification.

4.1.2 Inspection system. The supplier shall provide and maintain an inspection system acceptable to the Government for supplies and services covered by this specification. The inspection system shall be in accordance with MIL-I-45208.

4.1.3 The supplier shall have documented his quality control system procedures, and the documents shall be available for review by the quality control representative of the command or agency concerned.

#### 4.2 Quality conformance inspection.

4.2.1 Lot. For the purpose of this specification, a lot shall consist of one production batch produced at one time, of the same type and subtype as defined by the applicable basic specification (see 1.2), under the same conditions and from ingredients of the same kind, nature, and quality. However, for molded thermal pipe and block insulation which is produced by a continuous process, a lot shall consist of all pipe or block insulation produced under the same conditions, from ingredients of the same kind, nature and quality offered for delivery at one time.

<sup>1/</sup>The term "Government" in this instance denotes "Command or agency concerned".

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4.2.2 Sampling. A minimum of three samples shall be taken from each lot, as defined in this specification, for the quality conformance tests except as noted below:

Where the type specification (see 1.2) requires a greater number of samples for product quality testing, the number of samples required by the type specification should be used for the quality conformance tests. However, for molded thermal pipe and block insulation which is produced by a continuous process, sampling shall be in accordance with table I. The sample shall be fully representative of the cross section of the material; that is, it shall include proportionate amounts of facing fabrics or surface finish of insulations; and cements and adhesives shall be thoroughly stirred or mixed, prior to sampling. Samples shall be wrapped in clear polyethylene sheets, placed in polyethylene envelopes or in polyethylene bottles as is suitable to protect the sample from contamination. Cleaned rubber or plastic gloves shall be worn while taking and handling the sample to avoid chloride contamination from perspiration or other contamination. The gloves shall be in accordance with 4.3.2(c)(4).

Table I - Sampling for tests.

Lot size of pieces <sup>1/</sup>	Minimum number of quality conformance test samples
Up to 63	1
64 to 160	2
161 to 400	3
401 to 1,000	5
1,001 to 2,500	8
2,501 to 6,300	13
6,301 to 16,000	20
Over 16,000	32

<sup>1/</sup>A piece is defined as one segment, section, or block.

4.2.3 Reports. Three copies of certified reports (see figure 3) shall be furnished by the supplier with the materials offered for delivery. They shall include the following:

- The purchaser's order number.
- The type and subtype of material.
- The supplier's lot (or production batch) number.
- Certification of compliance with 3.5.
- The actual results of chemical analyses and pH determinations. Identification of the chemistry analysis procedures (methods) used.

#### 4.2.4 Quality conformance tests.

4.2.4.1 Leaching procedure prior to chemical tests. Equipment, tools, and reagents used for specimen preparation and leaching shall be clean and sufficiently free of chlorides, silicates, sodium or acidic, or alkaline materials which might otherwise affect the chemical tests. Water used in leaching shall be in accordance with 4.3.2.(c)(1).

4.2.4.1.1 Specimen preparation. Two 20 gram (g) specimens shall be taken from each sample. The specimen shall be proportionally representative of the entire cross section of the composition except that metal screen or expanded metal used as a supporting facing shall not be included. Specimens shall be prepared as follows:

- Dry materials, calcium silicate, and other hard types shall be pulverized in a Waring blender, or equal, operated at high speed for 30 to 60 seconds. The sample shall contain no large lumps. Sample portions may be cut or broken into smaller pieces prior to pulverizing.

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- (b) Materials having metal wire insertions such as cloths or cloth-faced types shall be cut into pieces having a 1/2 inch maximum dimension.
- (c) Specimens of insulation cements, approximately 20 g dry basis, shall be air dried for 24 hours in tared 70 millimeter (mm) (minimum) diameter metal, teflon, or polyethylene dishes. Actual dry weight shall be determined after drying. If the cement cakes, it shall be pulverized. Caution: Protect from contamination during air drying.
- (d) Liquid adhesive specimens shall be prepared as follows:
- (1) Two 70 mm (minimum) tared aluminum dishes shall be used for each determination. Liquid adhesive, 5 - 7-1/2 g dry basis, shall be placed in each dish for a total of 10-15 g dry basis of adhesive for each determination. Dishes containing adhesive shall be dried in a convection type oven at 160° ± 2°F for 24 ± 1 hours. Drying under these conditions will result in a material that is not powder dry, but it shall be free of fluid adhesive trapped under a surface film.
  - (2) Dried specimens shall be removed from the oven and cooled to room temperature in a desiccator. Cooled specimens shall be weighed to the nearest 0.1 g. Weight of dried adhesive shall be determined by subtracting weight of aluminum dishes determined above.

4.2.4.1.2 Water leaching. Hard materials, materials having wire insertions, and dry cements (see 4.2.4.1.1(a), (b), and (c)). Place each specimen in an individual 600 milliliter (ml) pyrex beaker (or equal) and cover the specimen with 400 ml of water. Cover the beaker with a watch glass and heat for 1/2 hour at 205° to 212°F, then remove heat. Cool the beaker and its contents naturally (do not agitate) to room temperature of 68° to 86°F. Filter the leach solution through a prewashed No. 41 Whatman or equal filter in a Buchner funnel, or equal, transferring the specimen to the funnel and using light suction as necessary. The beaker and the specimen shall be washed thoroughly using a minimum of ten small washes to make up the filtrate to 500 ml. (Centrifuge filtration may be used as an alternate method). The filtrate shall be transferred to a polyethylene container and marked as solution "A". This solution "A" shall be the source of aliquots for the chemical tests. Approximately 150 ml of solution "A", from which aliquots for the sodium and silicate tests are to be taken, shall be refiltered through a 0.45 millipore filter.

4.2.4.1.3 Adhesive (see 4.2.4.1.1(d)).

- (a) After dry weight has been determined, pairs of dishes comprising each determination shall be placed back to back in acid washed (15 percent HNO<sub>3</sub>) 600 ml pyrex beakers containing approximately 400 ml of demineralized water. The beaker shall be covered with an acid washed watch glass and heated for 1 hour at 207° ± 4°F in a boiling water bath. The beaker and contents shall then be cooled to room temperature.
- (b) The leachate as prepared above shall be filtered through a 0.45 millipore filter; the beaker and contents shall be washed thoroughly using a minimum of ten small washes. (To facilitate filtering, the leachate, especially if cloudy, may be centrifuged to remove the majority of the particulate material, which interferes with filtration.) The filtrate shall be transferred quantitatively to a 500 ml polyethylene volumetric flask, diluted to volume, and marked as solution "A". This solution "A" shall be the source of aliquots for all chemical tests.

4.2.4.2 Chemical tests. The chemical tests shall be performed on the duplicate leach solutions "A" obtained from the duplicate specimens. The chemical analyses for chlorine, sodium, and silicate ions shall be calculated on the basis of the weight of the specimen. The pH shall be reported as the pH of solution "A".

4.2.4.2.1 pH. The pH shall be determined on the aliquot from solution "A" using a Beckman Ferranti (or equal) pH meter. Aliquots shall be discarded after the determination. The pH shall be corrected to 77°F.

4.2.4.2. Chemical analyses. The chemical analyses for the chloride, silicate and sodium ions shall be made by the methods contained in this specification, or equal, as approved in writing by the command or agency concerned. Requests for approval of alternate chemistry procedures shall be accompanied by justification evidence of their accuracy, e.g., such as by measuring differences in test results when known amounts of chlorides, silicates

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or sodium are added and comparing these differences with comparable results obtained when using the procedures contained in this specification on the same samples of insulation. The analysis shall be made on suitable aliquots from solution "A".

4.2.4.2.2.1 Analysis for chloride. An aliquot of solution "A" shall be analyzed by either of the following methods:

- (a) Amperometric-coulometric titrator method. An amperometric-coulometric titrator method such as the Linco-Lotlove Automatic Chloride Titrator method (or equal).
- (b) Colorimetric methods:
  - (1) Optical density shall be measured on a prepared solution against a water reference solution in 5 centimeter (cm) cells by a Beckman Model "B" spectrophotometer (or equal) at 470 nanometers (nm) and the chloride content read from a calibration curve made from aliquots of a standard chloride solution representing 20, 40, 60, 80, and 100 micrograms of chloride ion. Both a sample blank and a reagent blank shall be used and the reading obtained on solution "A" shall be corrected by subtracting the sum of the blank readings.

**Notes:** Sulphate and phosphate cause positive interference at concentrations exceeding 0.2 weight percent.

- (2) Add in turn to a 50 ml volumetric flask: an aliquot of solution "A" which contains a 20-60 micrograms of chloride ion (adjusted to pH 6 to 8 with 6N HNO<sub>3</sub> using indicating paper), 2 ml each of reagents (a) and (b), and water to 50 ml, mixing thoroughly at each addition. Read 15 minutes after preparation, mixing the solutions thoroughly just prior to reading.
- (3) Reagents. Reagents shall be of suitable analytical grade. Reagent solutions shall have the following composition:
  - a. 99.7 grams of Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> · (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> · 24H<sub>2</sub>O per liter dissolved in 6N nitric acid. Store in a brown bottle for at least 24 hours before use. (Stable for several months).
  - b. A saturated solution of Hg(SCN)<sub>2</sub> in methyl alcohol prepared by adding 7.5 g of Hg(SCN)<sub>2</sub> to 500 ml of methyl alcohol, stirring for one hour, and filtering through a Whatman No. 41 paper to remove undissolved Hg(SCN)<sub>2</sub>. (Store in brown bottle).
  - c. Water shall be distilled water containing less than 0.1 ppm of chloride ion.

**Notes:** For reference, see method C of ASTM D 532.

4.2.4.2.2.2 Colorimetric methods for silicate. An aliquot of millipore filtered solution "A" shall be analyzed photometrically (see ASTM E 60) for silicates by either of the following methods, modified as required to suit the leach water.

- (a) The molybdosilicic acid method given in ASTM E 62.
- (b) The molybdenum blue method given in ASTM E 120 or ASTM E 146.

4.2.4.2.2.3 Analysis for sodium. A 100 ml aliquot of millipore filtered solution "A" shall be analyzed by one of the following methods:

- (a) Spectrographic method. The solution shall be reduced to dryness. The residue shall then be analyzed spectrographically for sodium.
- (b) Flame photometric method. The solution shall be analyzed by Methods A, B, or C of ASTM D 1478.
- (c) Atomic absorption. The solution shall be analyzed using atomic absorption.

**NOTE:** Corrections must be made if high concentration of alkaline or alkaline earth metals such as calcium, potassium, or magnesium are present.

4.2.4.2.3 Acceptance. If the average analysis of the two specimens taken from any sample fails to conform to the requirements of 3.3, the lot represented by that sample shall be rejected.

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4.2.4.2.4 Retest. At the option of the supplier, each individual unit of supply (i.e. carton, bag, roll, sheet, drum, etc.) in rejected lots may be retested at the supplier's expense by testing two samples taken at random from the unit of supply in accordance with 4.2. If the average analysis of the two specimens taken from either sample fails to conform to the requirements of 3.3, the unit of supply represented by that sample shall be rejected.

#### 4.3 Preproduction corrosion test.

4.3.1 Corrosion test. The corrosion test shall be performed as a preproduction test by each supplier as required by 3.4.3(L). It need not be repeated for subsequent orders from any source unless required by the ordering data (see 6.2). The supplier shall keep records of the test results available for review by the command or agency concerned.

4.3.1.1 Alternate corrosion test. The apparatus and corrosion coupon size as described in article 5, Stress Corrosion Cracking of Insulated Austenitic Stainless Steel of ASTM Bulletin No. 225, TP196, may be used if the following modifications in apparatus, test specimen preparation, and test procedure are made:

- (a) The water container (bath) shall be of suitable corrosion resistant material. Glass, ceramic or chlorided plastic materials shall not be used.
- (b) The water level shall be controlled to assure that the insulation under test is wetted continuously.
- (c) Suitable precautions shall be taken to avoid contamination either by corrosive agents or by significant amounts of corrosion inhibitors, such as silicates, phosphates, sulfates or alkalies.
- (d) The corrosion coupon shall be sensitized and polished as required by 4.3.3(a), and shall be cleaned as required in 4.3.4(a) (1) using reagents defined in 4.3.2(c).
- (e) The insulation material specimen shall be one inch thick.
- (f) The water evaporation rate for each 2 inch by 7 inch coupon shall be 800 ml per day, minimum.

#### 4.3.2 Test method, apparatus and reagents.

- (a) Method. Pure water is transferred by wicking action through the insulation under test to the prepared surface of four heated stainless steel coupons for 4 weeks (28 days). The water, on evaporation on the heated metal, causes a concentration of soluble materials leached from the insulation on the heated surface. At the end of the test the prepared stainless steel coupons are examined for cracks.
- (b) Apparatus. The arrangement of a test station is shown on figure 2. The parts of the apparatus are described as follows:
  - (1) Heat source. The heat source for the prepared stainless steel surface is shown as a length of 1/2 inch nickel-chromium-iron standard weight pipe, into which steam is admitted through a pressure control valve, adjustable from 5 to 20 pounds per square inch (psii), and a trap to discharge the condensate. Alternately, thermostatically controlled electric heating may be used.
  - (2) Water container. The water container shown on figure 2 is a light gage, one pint stainless steel container which has three overflow holes placed closely under the container rim. A corrosion-resistant metal or plastic overflow container shall be placed under the water container to catch water overflow if the level control system should fail.
  - (3) Water makeup and control system. The water makeup system shall be of polyethylene, polypropylene or other material which will not release chlorides, silicates or sodium to the makeup water. The control system shall maintain the water within the level range shown on figure 2. A simple control system would consist of a closed, elevated (about 3 feet), graduated makeup water container from which a tube having a flow limiting control such as screw clamp leads to the makeup connection shown on figure 2. A second tubing connection, not shown on figure 2 but similar to the makeup connection, has its lower end set at the minimum water level shown on figure 2 and is connected to the air space in the makeup water container through its stopper or closure. This second connection acts as an overriding control on the makeup water flow limiting device when the water level approaches the

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- minimum level by admitting air to the closed air space in the makeup water container. The increased air pressure in the makeup water container results in an increased flow rate.
- (4) A ventilated AISI 304 type stainless steel cover, shown on figure 2, is required to protect the test station assembly from contamination while permitting the escape of water vapor.
  - (5) Fine Ni-Cr-Fe alloy 600 screening, detailed on figure 2, held in place with alloy 600 wire ties, holds the insulation under test snugly against the stainless steel coupons.

Note: Ni-Cr-Fe alloy 600 metal is used for portions of the apparatus in contact with the wet insulation because this metal is not subject to chloride stress corrosion cracking and also does not generate undesirable electrolytic effects when in contact with stainless steel.

- (c) Reagents and auxiliary material. The grades of material specified below shall be used in all cases and for all rinsing, washing, etc.

(1) Water. Demineralized water meeting the following specifications:

Chlorides, max - 0.1 ppm  
 Conductivity, max - 2.5 micro-mho/cm<sup>3</sup>  
 pH, min-max - 6.0 - 8.0

(Water shall not be stored in glass, ceramic, or any other container in which it could pick up chloride, silicate, or sodium ions.)

- (2) Detergent. The detergent shall be a low chloride alkaline sodium phosphate detergent, such as Pennsalt A-27, or equal. Manufactured by Pennsalt Chemical Company, Three Penn Center, Philadelphia, Pennsylvania 19102.
- (3) Quartz wool. The quartz wool shall be clear fused quartz fine wool as manufactured by Amersil, Inc., 665 Hameoy Avenue, Hillside, New Jersey 07205, or equal. The fine quartz wool shall be rinsed twice in separate lots of boiling water; each rinsing shall be followed by thorough draining. The prepared quartz wool shall be air dried and stored in a closed container.
- (4) Rubber (or plastic) gloves. Rubber (or plastic) gloves shall be made of a material which does not have chloride containing compounds such as neoprene, sarah or metallic chlorides in its formulation. Prior to use, the gloves shall be rinsed, drained, and dried in the same manner as the quartz wool in 4.3.2(c)(3) of this specification.

4.3.3 Test specimens. Insulation specimens and corrosion coupons after cleaning shall be handled with cleaned rubber or plastic gloves. They shall be prepared as follows:

- (a) Corrosion coupons. The coupons shall be cut from 16 gage AISI type 304 stainless steel sheet which has been sensitized in argon at 1200°F for 3 hours. The coupons shall be 1/4 inch wide by 3-1/2 inches long and shall have a 5/32 inch diameter hole centered 7/32 inch from each end. The coupons shall be polished on one side, in the direction parallel to their length, using a dry 80 grit aluminum oxide belt with just sufficient pressure to remove the dull finish and leave the metal bright. The coupons shall be bent to "U" shape to an inside radius approximately 1/64 inch less than the outside radius of the steam pipe, with the polished surface on the outside of the bend. After bending, the coupons shall be cleaned by the procedures of 4.3.4(a). The coupons shall be examined for cracks under 30X magnification, and any coupon showing evidence of a crack shall be discarded. Stainless steel bolts and nuts No. 6-32 by 1-1/4 inches long shall be used for installation of the coupon.
- (b) Insulation material specimen. Insulation specimen approximately, but not less than, one inch thick and 2-1/2 inches in axial length, fully representative of the cross section of the material (except metal facings) as required by 4.2.2, shall be prepared in the shape shown on figure 2 as follows:
  - (1) Block or rigid insulation shall be cut into fitted strips with the strip length parallel to the pipe (see figure 2) and applied so that the insulation will bear evenly on the surface of the corrosion coupon below the attachment of the bolt.

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- (2) Felt tip and adhesive or other sealant shall be assembled in design of...
- (3) Coupons shall be mixed with water to a stiff paste and built up to a pad of suitable thickness on the 40 mesh Ni-Cr-Fe screen shown on figure 2. The wet cement and screen are then installed as shown on figure 2.
- (4) Liquid type adhesive shall be applied evenly to the surface of a pad of prepared quartz wool which contacts the coupons. A minimum of 50 g of the adhesive, dry basis, shall be applied as determined by weighing the pad before application and after the pad has air dried.

#### 4.3.4 Test procedure.

- (a) The water container, corrosion coupon, and corrosion-resistant metal overflow container shall be cleaned by procedure (1); the outside surface of the steam pipe shall be cleaned by procedure (2); and plastic overflow container shall be cleaned by procedure (3). Following this cleaning, cleaned rubber gloves shall be worn when working on the test station. The final cleaning procedures are detailed as follows:
  - (1) Immerse containers (or coupons) in a water solution containing 50 g of detergent per liter and hold at 170°F to 180°F for 20 to 30 minutes. Remove from the detergent solution, shake well, insert and hold in boiling water for 20 to 30 minutes. Remove from the boiling water and rinse by dipping in a second boiling water solution. Then rinse in cold running water.
  - (2) Scrub the steam pipe with 170°F to 180°F detergent solution (50 g per liter), using a stiff bristle brush. Immediately rinse twice by pouring hot (180°F) water over the pipe.
  - (3) Rinse plastic overflow containers with the following, in turn; water, then acetone then water, and finally with pure ethyl alcohol.

Water items shall be visually clean prior to final cleaning.
- (b) Four corrosion coupons and the insulation material specimens shall be installed as shown on figure 1. The spacing between the coupons shall be approximately one-fourth inch and the coupons shall contact the lower 180 degrees of the pipe surface evenly. The legs of the corrosion coupon are drawn slightly off parallel by tightening the bolt and nut. The supporting screen shall hold the insulation specimen snugly and evenly in contact with the corrosion coupons without reducing the insulation thickness to less than 1 inch over the lower 180 degrees.
- (c) Heat the specimens to 200°F to 225°F by establishing the steam pressure within the pipe to 5 to 10 psig and holding at temperature for 1 hour. Then shut off the steam supply.
- (d) Add water slowly to the water container to the normal water level. Re-establish the steam pressure at 5 to 10 psig and adjust the water level control system to maintain the levels shown on figure 2 (that is, 1/8 inch to 3/4 inch below the corrosion coupon surface). Keep the cover in place except when working on the station.
- (e) Check the makeup water flow rate and adjust the steam pressure until the water makeup rate is 200 ml per day. Normal rate should be in the range 200 to 400 ml per day; however, a makeup water rate in excess of 600 ml per day is acceptable.
  - (1) If steam pressure adjustment up to 10 psig does not bring the evaporation rate (water makeup) to 200 ml per day, indicating a poor wicking action, place a layer (about 1/2 inch) of quartz fine wool between the insulation and the supporting screen to improve the wicking action.
  - (2) If any water overflows from the water container, it shall be caught in the overflow container and shall be returned to the water container as opportunity permits.
- (f) Continue the test on a 24 hours a day, 7 days a week, basis for four weeks.
- (g) At the completion of the four-week test, shut off the steam, disassemble the station, remove the coupons and clean the coupons by thoroughly scrubbing in water with a stiff fiber bristle brush.
- (h) Examine each cleaned coupon under 20X magnification for evidence of cracking.

Notes: Areas of attack are frequently identified by reddish corrosion product located around the crack.

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4.3.4.1 Acceptance. If the coupons fail to conform to the requirements of 3.4.2(b), the specific type and subtype tested shall have failed to meet the corrosion test requirements.

## 5. PREPARATION FOR DELIVERY

5.1 Packaging, packing, and marking. Packaging, packing, and marking shall be as required by the specification listed in 1.2 for the specific type material and the packaging and packing levels shall be specified in the ordering data (see 6.2), except as follows:

5.1.1 Packaging. When the level specified in the ordering data does not include a container or a wrap which will completely protect the material from contamination by loose soil, or other outside dirt, the insulation in appropriate bundles shall be completely wrapped in a kraft paper, grade D, 50-pound weight or heavier, conforming to UU-P-268 (or approved equal material).

### 5.1.2 Marking.

5.1.2.1 For containers of insulation larger than 5 gallons. In addition to the marking required in the specification listed in 1.2 for the specific type material, the title and number of this specification shall be labeled in green letters at least 1/2 inch high in a minimum of 3 locations on the container.

5.1.2.2 For 5 gallon containers or smaller. In addition to the marking required in the specification listed in 1.2 for the specific type material, the number and title of this specification shall be labeled in green letters at least 1/4 inch high in a minimum of 2 locations on the container.

5.1.2.3 For all containers. Supplier's lot number shall be marked on each container. Lot numbers shall be preceded by the proper designation, e.g., Lot No. 53.

## 6. NOTES

6.1 Intended use. Mineral type thermal insulation conforming to this specification is intended for use on hot piping, machinery, and equipment having surfaces of AISI 300 type stainless steel. These thermal insulations may also be used on other heated metal surfaces such as iron, Ni-Cu alloy, and Ni-Cr-Fe alloy surfaces.

6.2 Ordering data. Procurement documents shall specify the following:

- (a) Title, number and date of this specification.
- (b) Type and subtype required (see 1.2 and 3.1).
- (c) Applicable ordering data of this specification for specific type material (see 1.2 and 3.2).
- (d) Size, weight or thickness.
- (e) Requirements for other types (Government or industrial) (see 3.2).
- (f) Corrosion test repeated, if required (see 4.3.1).
- (g) Level of packaging and level of packing required (see 5.1).

6.2.1 If an additional preproduction test is required (see 3.4.2), the procurement document shall specify (a), (b), and (c) separately for the preproduction material.

### 6.3 Definitions.

6.3.1 Command or agency concerned. The Government or prime contractor who has design or procurement responsibility acting under contract to the Government.

6.3.2 Certificate of compliance. An acceptable certificate of compliance for the type and subtype shall include the following:

- (a) The date and source of a laboratory report giving numerical determinations of chemical and corrosion test results performed in accordance with and meeting the requirements of this specification.
- (b) Certification that the material tested had met the requirements of the specification for the specific type material. For those specifications that require qualification (see 1.2), the material must be a product on the applicable qualified products list.

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6.4 Management control system document. The following management control system document should be included on DD Form 1660:

(a) MIL-I-45208 (see 4.1.2).

6.5 THE MARGINS OF THIS SPECIFICATION ARE MARKED "I" TO INDICATE WHERE CHANGES (ADDITIONS, MODIFICATIONS, CORRECTIONS, DELETIONS) FROM THE PREVIOUS ISSUE HAVE BEEN MADE. THIS WAS DONE AS A CONVENIENCE ONLY AND THE GOVERNMENT ASSUMES NO LIABILITY WHATSOEVER FOR ANY INACCURACIES IN THESE NOTATIONS. BIDDERS AND CONTRACTORS ARE CAUTIONED TO EVALUATE THE REQUIREMENTS OF THIS DOCUMENT BASED ON THE ENTIRE CONTENT IRRESPECTIVE OF THE MARGINAL NOTATIONS AND RELATIONSHIP TO THE LAST PREVIOUS ISSUE.

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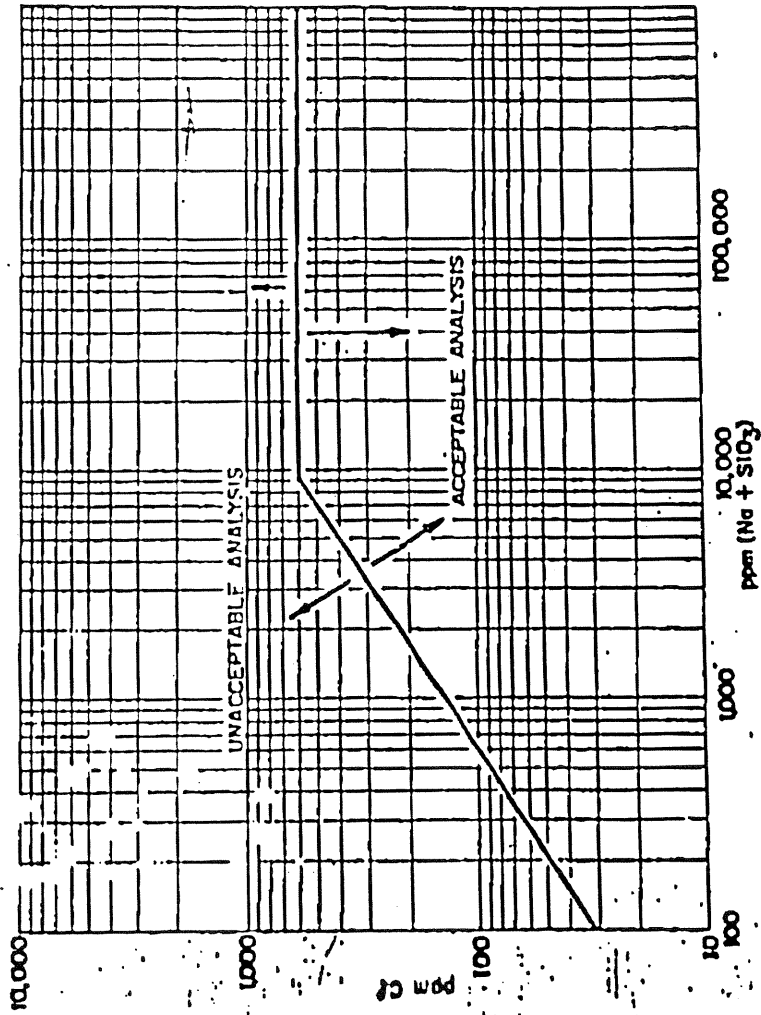
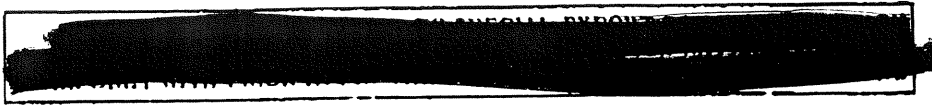


Figure 1 - Acceptability of insulation material on the basis of the plot points.

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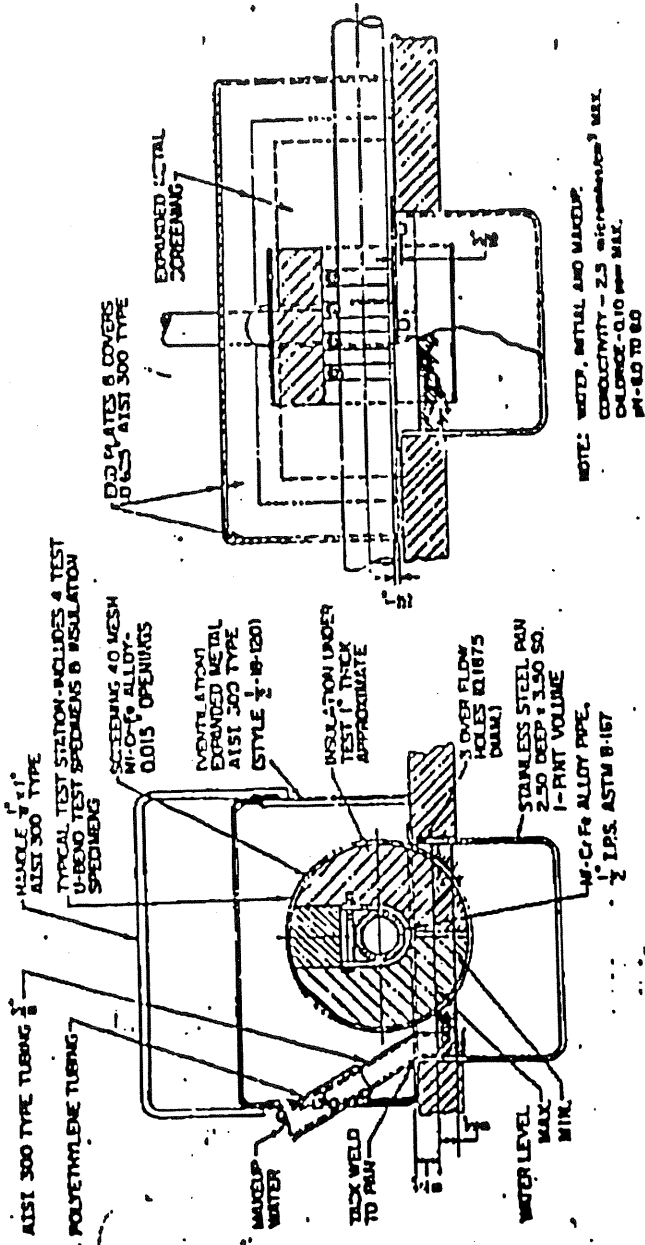


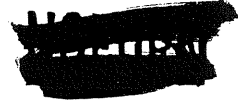
Figure 2 - Thermal insulation corrosion test station.

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Manufacturer or distributor \_\_\_\_\_ Customer's Name \_\_\_\_\_  
 Address \_\_\_\_\_ Customer's Order No. \_\_\_\_\_  
 Date \_\_\_\_\_  
 Type<sup>1/</sup> \_\_\_\_\_ Subtype<sup>1/</sup> \_\_\_\_\_ (Complete Description)  
 Lot No. \_\_\_\_\_

Lot Analysis

Testing Laboratory \_\_\_\_\_  
 Date of Report \_\_\_\_\_  
 Leachable Chloride, ppm \_\_\_\_\_  
 Sodium, ppm \_\_\_\_\_  
 Silicate, ppm \_\_\_\_\_  
 pH of Leach Water \_\_\_\_\_

Preproduction Corrosion Test

Testing Laboratory \_\_\_\_\_  
 Date of Report of Acceptable Test \_\_\_\_\_

Specification for Specific Type of Material

Specification No. \_\_\_\_\_

We hereby certify that the above material has been tested in accordance with the listed specification and is in conformance with all the requirements. We further certify that the material was manufactured, tested and inspected in accordance with the requirements of Paragraph 3.5.

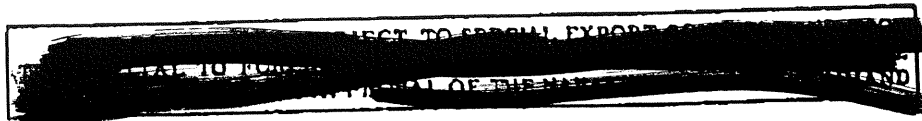
Signature of Responsible Company Official \_\_\_\_\_

Date \_\_\_\_\_

Figure 3 - Certification of Quality Conformance.<sup>2/</sup>

<sup>1/</sup> See paragraph 6.3.2.

<sup>2/</sup> This form is applicable to the quality conformance tests required for each lot, and a copy shall be forwarded with each shipment.



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