

INCH-POUND
MIL-C-2861E
5 August 1988
SUPERSEDING
MIL-C-2861D
4 December 1967
(See 6.6)

MILITARY SPECIFICATION
CEMENT, INSULATION, HIGH TEMPERATURE

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

1. SCOPE

1.1 Scope. This specification establishes the requirements for high temperature insulation cement for thermal control of irregular surfaces and for piping operating at temperatures between 100 and 1800 degrees Fahrenheit (°F).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specification and standards. The following specification and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATION

FEDERAL

UU-S-48 - Sacks, Shipping Paper.

STANDARDS

FEDERAL

FED-STD-313 - Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities.

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 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-129 - Marking for Shipment and Storage.
- MIL-STD-147 - Palletized Unit Loads.
- MIL-STD-1623 - Fire Performance Requirements and Approved Specifications for Interior Finish Materials and Furnishings (Naval Shipboard Use).

2.1.2 Other Government publication. The following other Government publication forms a part of this specification to the extent specified herein. Unless otherwise specified, the issue shall be that in effect on the date of the solicitation.

U.S. COAST GUARD

- USCG 164.009 - Incombustible Materials for Merchant Vessels.

(Application for copies should be addressed to the Commandant (MMT), U.S. Coast Guard Headquarters, 400 Seventh Street, S.W., Washington, DC 20013.)

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A 109 - Standard Specification for Steel, Strip, Carbon, Cold-Rolled. (DoD adopted)
- C 166 - Standard Test Methods for Covering Capacity and Volume Change Upon Drying of Thermal Insulating Cement.
- C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus. (DoD adopted)
- C 353 - Standard Test Method for Adhesion of Dried Thermal Insulating or Finishing Cement.
- C 354 - Standard Test Method for Compressive Strength of Thermal Insulating or Finish Cement.
- C 356 - Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.
- C 405 - Standard Practice for Estimating Consistency of Wet-Mixed Thermal Insulating Cement.
- C 421 - Standard Test Method for Tumbling Friability of Preformed Block-Type Thermal Insulation.
- D 3951 - Standard Practice for Commercial Packaging. (DoD adopted)

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

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified in the contract or order, a sample shall be subjected to first article inspection (see 4.3 and 6.3).

3.2 Material. The insulation cement shall be composed of a dry mixture of heat-resistant material of rock or mineral fiber and clay binder, thoroughly mixed to obtain uniform distribution of the ingredients. The insulation cement shall not contain asbestos, ceramic (refractory) fibers, or free silica. When specified in the contract or order, a certificate of compliance shall be prepared (see 6.2.2). The composition of the cement shall be such that, when properly mixed with fresh water, it can be applied with a trowel or by hand (see 4.5.1).

3.3 Physical requirements. The cement shall conform to the physical requirements shown in table I.

TABLE I. Physical requirements.

| Characteristic | Requirement | Test |
|--|-------------|-------|
| Troweling consistency, | | |
| percent deformation | 35-45 | 4.5.1 |
| inches of penetration | 7-9 | |
| Coverage (wet) (min) | 50.0 | 4.5.2 |
| ft ² , 1 inch in thickness/ 100 lb of dry cement | | |
| Coverage (dry) (min) | 30.0 | 4.5.2 |
| ft ² , 1 inch in thickness/ 100 lb of dry cement | | |
| Shrinkage (volumetric) | 15.0 | 4.5.2 |
| max wet to dry, percent | | |
| Density | 30.0 | 4.5.3 |
| max lb/cubic ft after being molded and dried | | |
| Compressive strength | 10.0 | 4.5.4 |
| min lb/in ² at 5 percent deformation | | |

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TABLE I. Physical requirements. - Continued

| Characteristic | Requirement | Test |
|--------------------------------------|------------------|--------|
| Mechanical stability | | 4.5.5 |
| max percent loss in weight | | |
| after first 10 minutes | 40.0 | |
| after second 10 minutes | 60.0 | |
| Dry adhesion to steel | 4.0 | 4.5.6 |
| min lb/in ² | | |
| Linear shrinkage | | 4.5.7 |
| max percent after 6 hours | | |
| at 750°F | 1.0 | |
| at 1200°F | 2.0 | |
| at 1500°F | 3.0 | |
| Thermal conductivity | | 4.5.8 |
| max Btu in/hr ft ² degree | | |
| Fahrenheit, at a mean | | |
| temperature of | | |
| 200°F | 0.70 | |
| 500°F | .85 | |
| 700°F | .95 | |
| Corrosion of steel | None | 4.5.9 |
| Fire resistance | See MIL-STD-1623 | 4.5.10 |

3.3.1 Certificate of compliance. Non-combustible material for fire resistance shall be U.S. Coast Guard approved. When specified in the contract or order, a certificate of compliance shall be prepared (see 6.2.2).

3.4 Material safety data sheet. The contracting activity shall be provided a material safety data sheet (MSDS) at the time of contract award. The MSDS is Form OSHA-20, found in and part of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification (see 6.4).

3.5 Toxicity. The material shall have no adverse effect on the health of personnel when used for its intended purpose as stated herein (see 4.5.11 and 6.1). Questions pertinent to this effect shall be referred by the contracting activity to the Naval Medical Command (NAVMEDCOM), who will act as an advisor to the contracting activity.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, 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.

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4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

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).

4.2.1 Inspection conditions. Unless otherwise specified (see 6.2.1), all inspections shall be performed in accordance with the test conditions specified herein.

4.3 First article inspection. First article inspection shall consist of the examination and tests specified in table II.

TABLE II. First article inspection.

| Inspection | Requirement | Test |
|------------------------|-------------|--------|
| Troweling consistency | 3.3 | 4.5.1 |
| Coverage (wet) | 3.3 | 4.5.2 |
| Coverage (dry) | 3.3 | 4.5.2 |
| Shrinkage (volumetric) | 3.3 | 4.5.2 |
| Density | 3.3 | 4.5.3 |
| Compressive strength | 3.3 | 4.5.4 |
| Mechanical stability | 3.3 | 4.5.5 |
| Dry adhesion to steel | 3.3 | 4.5.6 |
| Linear shrinkage | 3.3 | 4.5.7 |
| Thermal conductivity | 3.3 | 4.5.8 |
| Corrosion of steel | 3.3 | 4.5.9 |
| Fire resistance | 3.3 | 4.5.10 |

4.3.1 First article inspection report. When specified in the contract or order, a first article inspection report shall be prepared (see 6.2.2).

4.4 Quality conformance inspection. Quality conformance inspections shall be as specified in table III.

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TABLE III. Quality conformance.

| Inspection | Requirement | Test |
|------------------------|-------------|--------|
| Troweling consistency | 3.3 | 4.5.1 |
| Coverage (wet) | 3.3 | 4.5.2 |
| Coverage (dry) | 3.3 | 4.5.2 |
| Shrinkage (volumetric) | 3.3 | 4.5.2 |
| Density | 3.3 | 4.5.3 |
| Compressive strength | 3.3 | 4.5.4 |
| Dry adhesion to steel | 3.3 | 4.5.6 |
| Linear shrinkage | 3.3 | 4.5.7 |
| Thermal conductivity | 3.3 | 4.5.8 |
| Corrosion of steel | 3.3 | 4.5.9 |
| Fire resistance | 3.3 | 4.5.10 |

4.4.1 Sampling for quality conformance inspection. Sampling for quality conformance inspections shall be performed in accordance with MIL-STD-105, except where otherwise indicated. A random sample of bags of cement shall be selected from each lot offered for examination at inspection level II. The acceptable quality level (AQL) shall be 2.5 percent defective. For purposes of sampling, an inspection lot shall consist of all material offered for delivery at one time.

4.4.2 Examination of filled containers. A random sample of filled containers shall be taken from each lot in accordance with MIL-STD-105 at inspection level I and acceptable quality level 4.0 percent defective to verify compliance with requirements regarding fill, closure, marking, and all other requirements not involving tests. Containers shall be examined for defects of construction of the container and the closure, for evidence of leakage, and for unsatisfactory markings; each sample filled container shall also be weighed to determine the amount of contents. Any container in the sample, having one or more defects, or under required fill, shall not be offered for delivery. If the number of defective containers in any sample exceeds the acceptance number for the appropriate sampling plan as specified in MIL-STD-105, this shall be cause for rejection of the lot represented by the sample.

4.4.3 Testing. Sample containers shall be selected at random from each inspection lot as follows for the tests specified in 4.4. There shall be no evidence of failure to meet the specified requirement.

| <u>Lot size</u> | <u>Sample size</u> |
|-----------------|--------------------|
| 15 or less | 1 |
| 16 to 300 | 2 |
| 301 to 800 | 3 |
| 801 and over | 4 |

4.4.4 Quality conformance inspection report. When specified in the contract or order, a quality conformance inspection report shall be prepared (see 6.2.2).

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4.5 Tests.

4.5.1 Water-cement ratio for proper troweling consistency. A weighed quantity of dry cement shall be mixed with a weighed quantity of water to determine the water-cement ratio for satisfactory troweling consistency in accordance with ASTM C 405.

4.5.2 Coverage capacity and volumetric shrinkage. The coverage capacity and volumetric shrinkage shall be determined in accordance with ASTM C 166.

4.5.3 Density. Molded specimens shall be air dried for 24 hours, and then dried at 300°F in an electric oven to constant weight. Then the density shall be computed on the oven-dried volume.

4.5.4 Compressive strength. Compressive strength shall be determined in accordance with ASTM C 354.

4.5.5 Mechanical stability. Mechanical stability as measured by weight loss shall be determined in accordance with ASTM C 421.

4.5.6 Dry adhesion to steel. Dry adhesion to steel shall be determined in accordance with ASTM C 353.

4.5.7 Linear shrinkage. Linear shrinkage shall be determined in accordance with ASTM C 356, at the temperature and duration specified in table I.

4.5.8 Thermal conductivity. Thermal conductivity shall be determined in accordance with ASTM C 177. This test need only be conducted if, within 2 years prior to the last test approval, the material has not been tested and found in conformance to 3.3, or the material being offered for delivery is not manufactured the same in all respects as that previously tested.

4.5.9 Corrosion-resisting properties. Cement in troweling form shall be applied to a polished steel test plate conforming to ASTM A 109 and measuring 4 inches wide and 5 inches long. The test plate shall be of clear finish, cold-rolled strip steel, 0.020 inch thick, American quality quarter hard, temper number 3, weighing 0.85 pound per square foot. The cement shall be built up to a 3-inch thickness on the test plate in a wooden mold 4 inches wide and 5 inches long and allowed to stand at room temperature for 30 days. Then the material shall be removed from the test plate. The test plate shall be immediately cleaned with water, wiped dry, and examined for corrosion. Any pitting, flaking, or rusting of the steel plate surface shall be considered evidence of corrosion. Corrosion along the edges of the plate shall be disregarded.

4.5.10 Fire resistance. The cement shall be tested in accordance with USCG 164.009. This test only needs to be conducted if, within 2 years prior to the last test approval, the material has not been tested and found in conformance to 3.3, or the material being offered for delivery is not manufactured the same in all respects as that previously tested.

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4.5.11 Toxicity. To determine conformance to 3.5, the manufacturer of the material shall disclose the formulation of his product to the Naval Medical Command, MEDCOM-242, Washington, DC 20372. The disclosure of proprietary information, which shall be held in confidence by the Naval Medical Command, shall include the name, formula, and approximate percentage by weight and volume of each ingredient in the product; the results of any toxicological testing of the product; identification of its pyrolysis products; and any such other information as may be needed to permit an accurate appraisal of any toxicity problem associated with the handling, storage, application, use, disposal, or combustion of the material. Information submitted shall be clearly marked or identified to show it is being provided in connection with MIL-C-2861.

4.6 Inspection of packaging. Sample packs, and the inspection of the packing and marking for shipment, stowage, and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply for direct Government acquisition.)

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

5.1.1 Levels A and B. The cement shall be packed in quantities of 50 pounds in paper shipping sacks conforming to the level A packing requirements specified in the appendix of UU-S-48. Sack number shall be as applicable.

5.1.2 Level C. The cement shall be packed in quantities of 50 pounds in paper shipping sacks conforming to the level B packing requirements specified in the appendix of UU-S-48. Sack number shall be as applicable.

5.1.3 Commercial. The cement shall be packed in 50-pound quantities in accordance with ASTM D 3951.

5.2 Palletized unit loads. When specified (see 6.2.1), shipping containers shall be palletized in accordance with MIL-STD-147.

5.3 Marking.

5.3.1 Levels A, B, and C. In addition to any special markings required (see 6.2.1 and herein), markings (including bar coding) shall be in accordance with MIL-STD-129 and UU-S-48.

5.3.2 Commercial. In addition to any special markings required (see 6.2.1 and herein), marking shall be in accordance with ASTM D 3951, and bar coding shall be in accordance with MIL-STD-129.

5.3.3 Special marking. Each unit pack (paper sack) shall be marked "Free of Asbestos, Ceramic (Refractory) Fibers, and Free Silica".

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6. NOTES

6.1 Intended use. This insulation cement material is intended for use on heated piping and equipment. The cement can be used over irregular shaped areas where the use of either pipe or block insulation may be impractical; for example, insulation for small fittings and for hot patches.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Inspection conditions, if other than as specified (see 4.2.1).
- (c) Level of packing required (see 5.1).
- (d) When palletization is required (see 5.2).
- (e) Special marking required (see 5.3.1 and 5.3.2).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.475-1 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

| <u>Paragraph no.</u> | <u>Data requirement title</u> | <u>Applicable DID no.</u> | <u>Option</u> |
|----------------------|---------------------------------|---------------------------|---------------|
| 3.2 and 3.3.1 | Certificate of compliance | DI-E-2121 | ---- |
| 4.3.1 | First article inspection report | DI-T-4902 | ---- |
| 4.4.4 | Inspection and test reports | DI-T-5329 | ---- |

(Data item descriptions related to this specification and identified in section 6 will be approved and listed as such in DoD 5010.12-L, AMSDL. Copies of data item description required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this 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).

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6.3 First article. When a first article inspection is required, the item should be a first article sample. The first article should consist of one unit. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection 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.

6.4 Material safety data sheet. Contracting officers will identify those activities requiring copies of completed material safety data sheets (MSDS) prepared in accordance with FED-STD-313. The pertinent Government mailing address for submission of data are listed in FED-STD-313. In order to obtain the MSDS, federal acquisition regulation (FAR) clause 52.223-3 must be in the contract.

6.5 Subject term (key word) listing.

Consistency
Thermal conductivity

6.6 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:
Army - ME
Navy - SH
Air Force - 99

Preparing activity:
Navy - SH
(Project 5640-0448)

Review activity:
Army - MI

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

| | | | |
|---|--|---|--|
| 1. DOCUMENT NUMBER MIL-C-2861E | | 2. DOCUMENT TITLE CEMENT, INSULATION, HIGH TEMPERATURE | |
| 3a. NAME OF SUBMITTING ORGANIZATION | | 4. TYPE OF ORGANIZATION (Mark one) | |
| b. ADDRESS (Street, City, State, ZIP Code) | | <input type="checkbox"/> VENDOR | |
| | | <input type="checkbox"/> USER | |
| | | <input type="checkbox"/> MANUFACTURER | |
| | | <input type="checkbox"/> OTHER (Specify): _____ | |
| 5. PROBLEM AREAS | | | |
| a. Paragraph Number and Wording: | | | |
| | | | |
| b. Recommended Wording: | | | |
| | | | |
| c. Reason/Rationale for Recommendation: | | | |
| | | | |
| 6. REMARKS | | | |
| | | | |
| 7a. NAME OF SUBMITTER (Last, First, MI) - Optional | | b. WORK TELEPHONE NUMBER (Include Area Code) - Optional | |
| c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional | | 8. DATE OF SUBMISSION (YYMMDD) | |
| | | | |

TO DETACH THIS FORM, CUT ALONG THIS LINE.