

MIL-C-717F  
12 November 1987  
SUPERSEDING  
MIL-C-717E  
27 March 1981  
(See 6.6)

## MILITARY SPECIFICATION

### CASTABLE MIX, REFRACTORY, HIGH- TEMPERATURE HYDRAULIC SETTING

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

#### 1. SCOPE

1.1 Scope. This specification covers castable refractory mix for use where temperatures up to 3,000 degrees Fahrenheit (°F) may be encountered.

#### 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

##### MILITARY

MIL-STD-129 - Marking for Shipment and Storage.

MIL-STD-147 - Palletized Unit Loads.

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.

AMSC N/A

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**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)

- C 133 - Standard Test Methods for Cold Crushing Strength and Modulus of Rupture of Refractory Brick and Shapes.  
(DoD adopted)
- C 180 - Standard Method of Panel Spalling Testing Fireclay Plastic Refractories.
- C 210 - Standard Test Method for Reheat Change of Insulating Firebrick.
- C 860 - Standard Practices for Determining and Measuring Consistency of Refractory Concretes.
- C 862 - Standard Practice for Preparing Refractory Concrete Specimens by Casting.
- C 865 - Standard Practice for Firing Refractory Concrete Specimens.
- C 3951 - Standard Practice for Commercial Packaging.  
(DoD adopted)

(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 purchase order, a sample shall be subjected to first article inspection (see 4.3 and 6.3).

**3.2 Material.** The material shall be a mixture of heat-resistant clays or other alumina silicates and a hydraulic bond material. The material shall be free of foreign matter, lumps, or caked material, and shall mix readily with water.

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3.3 Time for hardening. The material shall remain in a castable consistency for at least 30 minutes after the first addition of mixing water. The hardening time shall be not greater than 24 hours at indoor ambient conditions. At the end of this period, the material shall support its own weight and keep its originally-cast shape.

3.4 Modulus of rupture. The modulus of rupture shall not be less than 400 pounds per square inch ( $\text{lb/in}^2$ ) after curing, and not less than  $300 \text{ lb/in}^2$  after being heat soaked at  $1,500^\circ\text{F}$  for 5 hours (see 4.7.1).

3.5 Permanent linear change. The permanent linear change shall not exceed 1.5 percent shrinkage when heated at  $2,550^\circ\text{F}$  (see 4.7.2).

3.6 Preheat and spalling.

3.6.1 Preheat. The castable mix shall not show evidence of spalling, excessive fusing, slumping, or dimensional change after the preheat test (see 4.7.3).

3.6.2 Spalling loss. The spalling loss after the preheat and spalling tests shall not exceed 5 percent (see 4.7.3).

3.7 Shelf life. The material, when stored at ambient conditions in the original container for a minimum period of 18 months, shall readily mix with water in accordance with manufacturer's instructions and meet the requirements as specified in 3.3, 3.4, 3.5, and 3.6.

4. QUALITY ASSURANCE PROVISIONS

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

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 herein are classified as follows:

- (a) First article inspection (see 4.3).
- (b) Quality conformance inspection (see 4.6).

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4.3 First article inspection. First article inspection shall consist of the examinations of 4.5 and the tests of 4.7.1 through 4.7.4. Materials conforming to the requirements of section 3 shall be conditional pending completion of the shelf-life requirement of 3.7.

4.4 Sampling.

4.4.1 Lot. For purposes of sampling, an inspection lot for examination and tests shall consist of all material from the same batch offered for delivery at one time.

4.4.2 Samples for examination.

4.4.2.1 Sampling for examination of appearance of refractory castable mix. Five samples shall be selected from each lot for the examination of 4.5.1 (see 4.4.3).

4.4.2.2 Sample for packaging examination. One filled container shall be subjected to the packaging inspection of 4.5.2.1 and 4.5.2.2. When palletization packing is specified, the sample unit for the examination of 4.5.2.3 shall be one palletized unit load.

4.4.3 Sampling for quality conformance testing. The test sample shall consist of a 200-pound composite of sample units. The sample shall be 5 sample units of 40 pounds of the castable mix randomly selected throughout the lot. No more than one-sample unit shall be drawn from any one container.

4.5 Examination.

4.5.1 Examination of appearance of refractory castable mix. The samples drawn for testing shall be examined for the presence of foreign matter and lumps or caked material not readily broken by hand.

4.5.2 Packaging examination.

4.5.2.1 Appearance, workmanship, closures and markings of container. The filled container selected shall be examined for defects of appearance, workmanship, closure, and marking as follows:

Examine	Defect
Appearance and workmanship	Not specified type or construction. Any tear, break, or other defect in body of container which may affect serviceability. Evidence of leakage around seams or end closure.
Closure	Closure not as specified.
Markings	Omitted, illegible, incorrect, incomplete, smeared, or not as specified. Mixing instructions missing.

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4.5.2.2 Net contents of container. The net contents of the sample container shall be not less than the specified or indicated quantity.

4.5.2.3 Palletized unit loads. When palletization packing is specified (see 6.2), an examination shall be made to determine that palletized unit loads comply with the requirements of section 5 of this specification. The palletized unit load selected shall be examined for the following defects:

Examine	Defect
Packing	Not palletized as specified. Arrangement or number of unit containers per pallet not as specified. Any nonconforming component; component missing, damaged, or otherwise defective affecting serviceability. Inadequate application of components such as incomplete closure, loose or inadequate strapping, bulged or distorted containers.
Weight	Gross or net weight exceeds specified requirements.
Markings	Exterior marking omitted, illegible, incorrect, incomplete, or not as specified.

4.6 Quality conformance inspection. The quality conformance inspection shall consist of the examinations of 4.5.1 and 4.5.2 and the tests specified in table I.

TABLE I. Instructions for testing.<sup>1/</sup>

Characteristic	Requirement	Test method	Number of determinations per composite	Results reported numerically to nearest
Modulus of rupture:				
Cured at ambient temperature	3.4	4.7.1	Average of 5	1b/in <sup>2</sup>
1,500°F, 5 hours	3.4	4.7.1	Average of 5	1b/in <sup>2</sup>
Permanent linear change	3.5	4.7.2	Average of 3	0.1 percent
Preheat and spalling (see 4.6.2)	3.6	4.7.3	1	0.1 percent

<sup>1/</sup> Test reports shall include all values on which results are based. Test values for all specimens tested for each characteristic shall be considered when calculating the average results. If failure occurs, a description of the failure shall be included in the report.

4.6.1 If the sample fails to conform to the quality conformance inspection, the lot represented by the sample shall be rejected.

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4.6.2 Waiver of preheat and spalling tests. Preheat and spalling testing may be waived when the inspection lot size is less than 20,000 pounds or if both of the following conditions exist (see 6.2):

- (a) Evidence is shown that the product has been tested by an acceptable testing laboratory and found in compliance with the requirement of 3.6 within 1 year preceding the shipping date of the lot being inspected.
- (b) The product represents the same ingredients and processing as that previously tested in (a) above.

4.7 Test procedures. Materials tested shall be mixed in accordance to manufacturer's instructions.

4.7.1 Modulus of rupture. Ten specimens 9 by 4-1/2 by 2-1/2 inches shall be prepared according to ASTM C 862 (except curing temperature) using the ball-in-hand consistency of ASTM C 860. The covered molded specimens shall be cured at 70 to 90°F for 24 + 1 hours. The specimens shall be tested for modulus of rupture after each of the following treatments:

- (a) Cured for 24 hours at ambient temperature.
- (b) Cured, oven-dried, and heat soaked at 1500°F for 5 hours.

Five specimens shall be tested at ambient conditions and five at 1500°F. Heating at 1500°F shall be in accordance with ASTM C 865, except that the rate of temperature increase to 1500°F may approximate that for group 16 of ASTM C 210. Modulus of rupture of specimens at ambient temperature shall be determined in accordance with ASTM C 133.

4.7.2 Permanent linear change. Three specimens shall be prepared, cured, and dried as described in 4.7.1. The length of each specimen shall be measured to the nearest 0.01 inch after drying and again after heating at 2550°F for 5 hours. Heating at 2550°F shall be in accordance with ASTM C 865 except that the heating schedule may be that shown for group 26 of ASTM C 210. The percentage linear change, based on the dry length, shall be calculated for each specimen, and the average of the three shall be determined.

#### 4.7.3 Preheat and spalling.

4.7.3.1 Construction of test panels. The material shall be cast into a mold 18 by 17-1/2 by 4-1/2 inches. The mold shall be divided into sections 3 inches in width along the 18-inch dimension by 1/16-inch metal strips. These metal strips shall be 4 inches in width and 17 inches in length, thus extending to within 1/2 inch of the surface and within 1/4 inch of the ends of the molded panel. The molded slab shall be cured for 48 hours at 40°F and then built into a test panel as shown on figure 1. After the panel is built, the divider strips shall be removed. The preheat test shall be started within 30 minutes after the test section is removed from the curing chamber. The top (uncovered) surfaces of the panel as cast shall be the cold face of the test material when installed in the panel. A 1/16 inch space shall be left between the sections when built into the test panel. Insulating brick behind the test panel shall be cut in a Vee-shape, 4-1/2 inches thick at the sides and 2 inches thick at the vertical center of the test area.

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4.7.3.2 Procedure. The preheat and spalling tests shall be conducted in accordance with the methods specified in ASTM C 180. The preheating temperature shall be 3,000°F.

4.7.4 Shelf life. After 18 to 20 months from the date of manufacture, the material shall meet the requirements specified in 3.7 and shall be retested to determine conformance with table I.

## 5. PACKAGING

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

5.1 Preservation. Not applicable.

5.2 Packing. Packing shall be level A, B, C or commercial, as specified (see 6.2).

5.2.1 Levels A and B. Castable refractory mix shall be furnished in unit quantities of 50 pounds (22.68 kilograms) in open head plastic pails conforming to the following:

- (a) The pail shall be of molded polyethylene, minimum 90 mil thick.
- (b) Shall be stackable and self-supporting, reinforced to prevent ovaling.
- (c) Shall not exceed 14-1/2 inches (368.30 millimeters) in length or 11-7/8 inches (301.62 millimeters) in diameter.
- (d) May be tapered to permit mating.
- (e) Shall include a metal bail with handgrip. Bails shall be minimum 7 gauge wire (standard wire gauge system).
- (f) Bail ears shall be integrally molded near the top of the pail.
- (g) Pail covers shall be of minimum 16 gauge steel or minimum 90 mil polyethylene. Covers shall be gasketed to assure a watertight seal. Metal covers shall not affect nor be affected by the castable mix.

5.2.2 Level C. Castable refractory mix shall be furnished in unit quantities of 50 pounds (22.68 kilograms) in paper shipping sacks. The sacks shall conform to UU-S-48, sack number 15 or 15X with MB grade 2. The sack type and style shall be at the contractor's option.

5.2.3 Commercial. Castable refractory mix in 50 pound (22.68 kilograms) quantities shall be packed in accordance with ASTM D 3951.

5.3 Palletization. Unless otherwise specified (see 6.2), castable mix shall be palletized in accordance with MIL-STD-147, load type IV for pails and load type XV for sacks. Stretch wrap or shrink film may be used in lieu of strapping. For palletized sacks 1 inch by 4 inch wood slats shall be placed with the nominal 4-inch dimension arranged vertically along the perimeter of the pallet to protect the layer of sacks from being damaged by forklift equipment. Pallet loads shall not exceed 2,500 pounds (1134 kilograms).



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5.4 Marking. In addition to any special marking required (see 6.2), pails, sacks, and palletized unit loads shall be marked in accordance with MIL-STD-129 for levels A, B, and C, and in accordance with ASTM D 3951 for commercial. Pails and sacks shall include the date (month and year) the castable mix was packed.

5.4.1 Instructions for mixing and application shall be marked on each container.

## 6. NOTES

6.1 Intended use. This castable mix will primarily be used in areas where standard brick shapes cannot be used.

6.2 Ordering data. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) If first article is required (see 3.1).
- (c) When the lot being acquired is greater than 20,000 pounds, whether preheat and spalling testing is waived (see 4.6.2).
- (d) Level of packing required (see 5.2).
- (e) When palletization is not required (see 5.3).
- (f) Special marking requirements, if any (see 5.4).

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 International interest. Certain provisions of this specification are the subject of international standardization agreement ABC-NAVY-STD-18. When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels including departmental standardization offices to change the agreement or make other appropriate accommodations.



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6.5 Subject term (key word) listing.

Linear change  
Preheat  
Rupture  
Shelf life  
Spalling  
Heat resistant

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

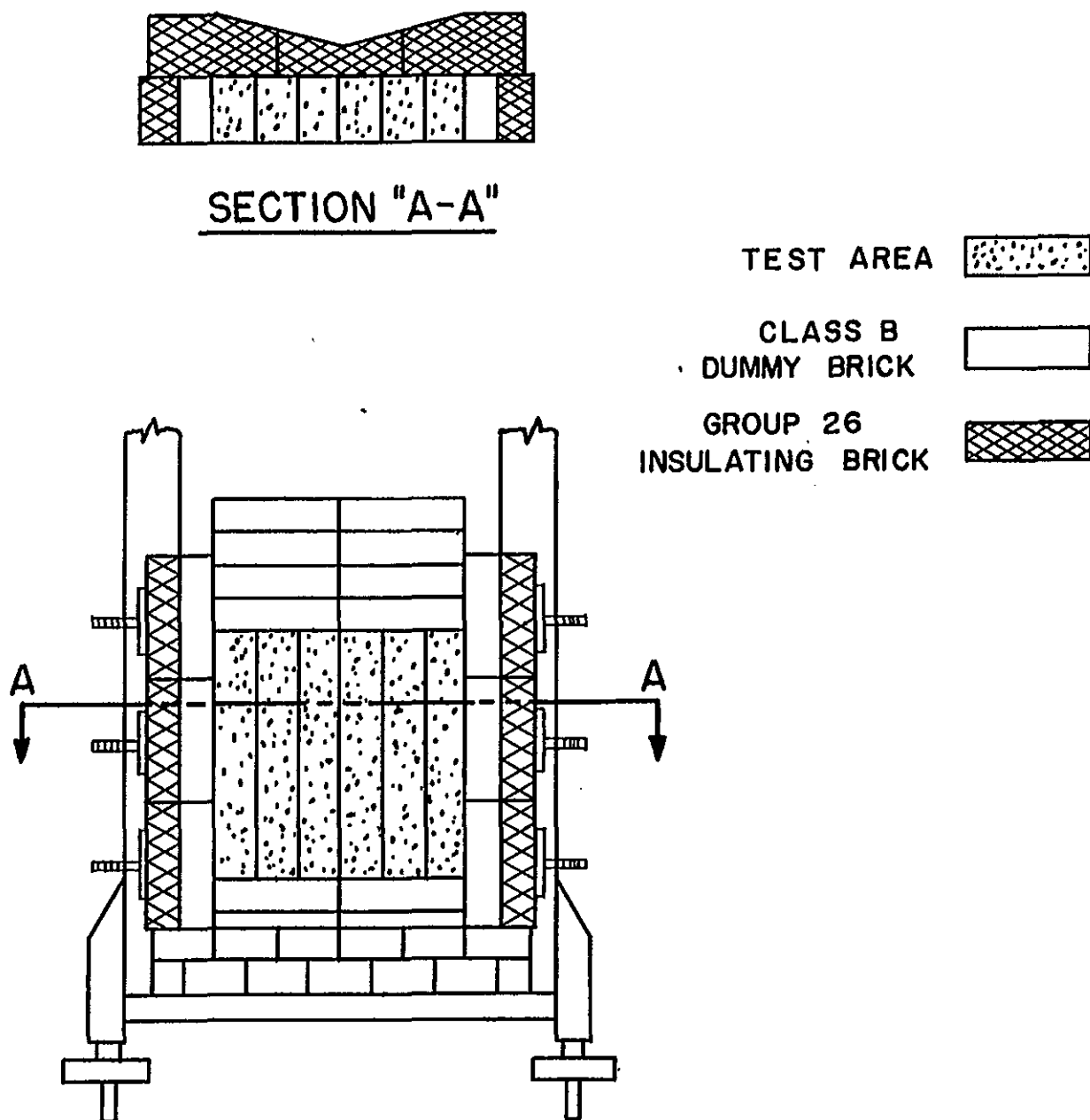
Preparing activity:

Navy - SH  
(Project 9350-0090)

User activity:

Army - MR

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SH 4744

FIGURE 1. Test panel.