



Standard Specification for Mortar, Refractory (High-Temperature, Air-Setting)¹

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1. Scope

1.1 This specification covers dry air-setting refractory mortar for use in laying and bonding refractory brick in ship boiler furnaces and wet air-setting refractory mortar for use in laying refractory brick in stationary boiler furnaces, bright annealing furnaces, controlled atmosphere furnaces, and furnaces heated by electric elements.

1.2 The values stated in inch-pound units are to be regarded as standard. The ~~SI units values given~~ values given in parentheses are for information purposes only and may be approximate mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- [C24 Test Method for Pyrometric Cone Equivalent \(PCE\) of Fireclay and High Alumina Refractory Materials](#)
- [C27 Classification of Fireclay and High-Alumina Refractory Brick](#)
- [C92 Test Methods for Sieve Analysis and Water Content of Refractory Materials](#)
- [C133 Test Methods for Cold Crushing Strength and Modulus of Rupture of Refractories](#)
- [C198 Test Method for Cold Bonding Strength of Refractory Mortar](#)
- [C199 Test Method for Pier Test for Refractory Mortars](#)

2.2 *Federal Specifications³—The following documents shall apply only when one or more of the requirements of Supplementary Requirement S1 are specified in the contract or purchase order (see 4.1.3):*

- [UU-S-48 Sacks, Shipping, Paper](#)
- ~~[PPP-B-35 Bags: Textile, Shipping, Burlap, Cotton and Waterproof Laminated](#)~~
- [PPP-B-704 Pails: Shipping, Steel \(1 through 12 gallon\)](#)

2.3 *Military Standards³—The following documents shall apply only when one or more of the requirements of Supplementary Requirement S1 are specified in the contract or purchase order (see 4.1.3):*

- ~~[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](#)

2.4 ANSI/ASQ Standards:⁴

- [Z1.4 Sampling Procedures and Tables for Inspection by Attributes](#)

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

3. Classification

- 3.1 The refractory mortar shall be of the following types:
- 3.1.1 *Type 1*—Dry.
 - 3.1.2 *Type 2*—Wet.

4. Ordering Information

- 4.1 Orders for material under this specification shall include the following information, as necessary to adequately describe the material:
- 4.1.1 ASTM designation and year of issue,
 - 4.1.2 Type required (see 3.1), and
 - 4.1.3 Optional requirements, if any (see Supplementary Requirement S1).

5. Material

- 5.1 The mortar shall be composed of finely ground heat-resistant clays, minerals, or a mixture of clays and minerals in either a dry or wet condition.
- 5.1.1 *Type 1, Dry*—Mortar shall be furnished dry and shall be ready for use as soon as mixed with water. Mortar, after being mixed with water and then dried, shall be capable of being remixed with water.
 - 5.1.2 *Type 2, Wet*—Mortar shall be furnished ready for use at a trowelling consistency and shall be easily mixed with water to a dipping consistency.

6. Performance Requirements

- 6.1 *Resistance to Heat Soaking*—Mortar shall not soften nor show any evidence of fusion, and the shrinkage shall not be greater than hairline cracks when tested as specified in 11.2.
- 6.2 *Bonding Strength*—The average modulus of rupture at the brick joint when tested as specified in 11.3 shall be not less than shown in Table 1.
- 6.3 *Pyrometric Cone Equivalent (PCE)*—The PCE shall be not less than cone 32 (see 11.4).

7. Requirements

- 7.1 *Fineness*—Mortar shall be ground to such fineness that not more than 5 % shall be retained on a No. 40 ASTM sieve, and not more than 0.5 % shall be held on a No. 30 ASTM sieve (see 11.1).
- 7.2 *Shelf Life, Type 1*—Mortar shall show no deterioration after 1 year's storage.
- 7.3 *Shelf Life, Type 2*—At any time within one year of shipment from the supplier, the mortar in a previously unopened container shall not have stiffened to such an extent as to interfere with its easy removal and mixing.
- 7.4 *Consistency*—Mortar, when tempered with water, shall be of such consistency that it will be suitable for spreading easily with a trowel or for dipping and for laying refractory brick and bonding them together upon drying and upon subsequent heating at furnace temperatures. Mortar shall retain this degree of workability for 2 h.
- 7.4.1 The mixed mortar shall have sufficient water retention to permit a 1/16-in. (2-mm) joint to be made with a trowelling consistency, but not allow the newly laid brick to float out of position.

8. Workmanship

- 8.1 Workmanship shall be first class in every respect. There shall be no foreign material or caked aggregate lumps in the mortar. Wet mortar shall be easily removed from the container and shall mix easily to a uniform trowelling consistency.

9. Sampling

- 9.1 An inspection lot for tests and inspections shall consist of all material manufactured at essentially the same time and of the same type offered for delivery at one time.
- 9.2 For the tests specified in 11.1 through 11.4, the sample unit shall be 15 lb (7 kg) of mortar. No fewer than three sample units shall be randomly selected throughout the lot. No more than one sample shall be drawn from any one container.

TABLE 1 Bonding Strength of Mortar

Temperatures, °F (°C)	Average Modulus of Rupture, psi (kPa), min
230 (110)	200 (1400)
1000 (538)	100 (700)
2000 (1093)	100 (700)

9.2.1 The test sample shall be a 45-lb (20-kg) composite of the randomly selected sample units. Two or more determinations as applicable (see **Table 2**) shall be performed on the composite. There shall be no evidence of failure to meet the specified unit or average requirements.

9.3 The PCE shall be determined on two cones of different samples from each lot. If both cones fail, this shall be cause for rejection without retest. If either cone fails, three additional cones shall be made, each from a different sample. If any one of the three retest cones ~~fail~~fails, this shall be cause for rejection.

10. Specimen Preparation

10.1 The entire mortar sample for testing shall be thoroughly mixed to ensure uniformity before any portion is taken for tests. The selected portion of Type 1 (dry) mortar shall be mixed with water to a trowelling consistency for the tests of **11.2** and **11.3**. Storage time after water mixing shall be 20 to 30 minutes.

10.2 For the test specified in **11.3**, brick-mortar joints shall be prepared in accordance with Test Method **C198**, except that refractory bricks, conforming to Classification **C27**, ~~super-duty, 60 % High-Alumina~~, shall be used and shall be cut in half. The two halves of each brick shall be placed in a device suitable for bringing, with a straight motion, the molded ends together with the faces parallel at all times to form a bond.

10.2.1 A small quantity of mortar shall be spread by a trowel on the upper face forming the bond to ensure intimate contact. Sufficient mortar to give a 1/8-in. (3-mm) thick layer shall be spread evenly on the lower bond forming face and the upper half shall be lowered until it is 1/16 in. (2 mm) from the lower half. The excess mortar shall be cut from the joint, flush with the sides of the brick. The unit thus formed shall be removed at once from the bond-forming machine. The bond specimens shall be allowed to air-dry for ~~20 to 24 h~~hours.

11. Test Methods

11.1 *Fineness*—The fineness test shall be made in accordance with Test Methods **C92**.

11.2 *Heat Soak*:

11.2.1 A pier of refractory brick, conforming to Classification **C27**, super-duty, laid up with the test mortar shall be prepared and heated at 2910°F (1588°C) for ~~5 h~~hours in accordance with Test Method **C199**.

11.2.2 The cooled pier shall be examined for evidence of shrinkage, softening, or fusion of the mortar. One or more mortar joints shall be broken and the freshly broken mortar surface shall be viewed from various angles. Any shininess or light flash at the mortar surface shall be considered an indication of excessive fusion.

11.3 *Bonding Strength*:

TABLE 2 Testing Requirements

Characteristic	Specification Reference		Number of Determinations per Composite	Results Reported as	
	Requirement	Test Method		Pass or Fail ^A	Numerically to Nearest ^B
Type 1 and Type 2, as applicable					
Fineness					
Retained on No. 40 ASTM sieve	7.1	11.1	2	...	0.1 %
Retained on No. 40 ASTM sieve	7.1	11.1	2	...	0.1 %
Retained on No. 30 ASTM sieve	7.1	11.1	2	...	0.1 %
Retained on No. 30 ASTM sieve	7.1	11.1	2	...	0.1 %
Resistance to heat soaking					
Melting	6.1	11.2	2	X	...
Melting	6.1	11.2	2	X	...
Shrinkage	6.1	11.2	2	X	...
Shrinkage	6.1	11.2	2	X	...
Bonding strength	6.2	—	—	—	—
Bonding strength	6.2	—	—	—	—
After heating at					
—230°F (110°C)	—	11.3	avg of 5	...	psi
230°F (110°C)	—	11.3	avg of 5	...	psi
—1000°F (538°C)	—	11.3	avg of 5	...	psi
1000°F (538°C)	—	11.3	avg of 5	...	psi
—2000°F (1098°C)	—	11.3	avg of 5	...	psi
2000°F (1098°C)	—	11.3	avg of 5	...	psi
Pyrometric cone: ^C					
—Type 1	6.3	11.4	2	...	cone number
Type 1	6.3	11.4	2	...	cone number

^A If failure is indicated, report description of failure or numerical point of failure as applicable.

^B Test report shall include all values on which results are based.

^C See 9.3.