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Specification
No. 334a

BUREAU OF STANDARDS
George K. Burgess, Director

CIRCULAR OF THE BUREAU OF STANDARDS, No. 298

[2d ed. Issued October 20, 1926]

UNITED STATES GOVERNMENT MASTER SPECIFICATION FOR
CLAY, FIRE

FEDERAL SPECIFICATIONS BOARD SPECIFICATION No. 334a

[Revised August 7, 1926]

This specification was officially promulgated by the Federal Specifications Board on October 1, 1925, for the use of the departments and independent establishments of the Government in the purchase of fire clay.

[The latest date on which the technical requirements of this revision of this specification shall become mandatory for all departments and independent establishments of the Government is November 8, 1926. They may be put into effect, however, at any earlier date after promulgation.]

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I. GENERAL SPECIFICATIONS

There are no general specifications applicable to this specification.

II. CLASSES

Fire clay shall be of the following classes: (F.) fine; (C.) commercial.

III. MATERIAL

This specification covers a heat-resistant material composed entirely, or principally, of fire clay and which is used in laying up fire-clay refractories. It shall be sufficiently free from grit and of such quality and plasticity that it will spread satisfactorily with a trowel when tempered with water.

IV. GENERAL REQUIREMENTS

There are no general requirements applicable to this specification.

V. DETAIL REQUIREMENTS

1. CLASS F.—(a) *Fineness*.—The material as furnished shall be air-dry and ground to the following fineness: Not more than 4 per cent shall be retained on a United States standard sieve No. 20.

(b) *Bond*.—The material shall show satisfactory bonding power.

(c) *Softening point*.—The softening point shall be not more than three cones (approximately 60° C. or 108° F.) lower than that of the fire-clay brick or shape with which it is to be used.

(d) *Navy simulated service test*.—When specified the material shall pass the Navy simulated service test.

2. CLASS C.—(a) *Fineness*.—The material as furnished shall be air-dry and ground to the following fineness: Not more than 10 per cent shall be retained on a United States standard sieve No. 20.

(b) *Bond*.—The material shall show satisfactory bonding power.

(c) *Softening point*.—The softening point shall be not more than three cones (approximately 60° C. or 108° F.) lower than that of the fire-clay brick or shape with which it is to be used.

VI. METHOD OF INSPECTION AND TESTS

1 SAMPLING.—(a) *Containers*.—When shipped in containers a sample shall be taken from one of every 100 containers or less. The sample shall be taken by dumping the container and quartering the material to provide a 5-pound sample for the laboratory.

(b) *Bulk*.—When shipped in bulk, the sample shall be so taken that it will represent an average of all parts of the shipment from

top to bottom and shall not contain a disproportionate share of the top and bottom layers. The sample shall consist of 1 shovelful for each 3 tons of material but not less than 10 shovelfuls taken from different parts of the shipment. The total sample taken shall weigh at least 100 pounds and shall be mixed thoroughly and "quartered" to provide a 5-pound sample for the laboratory. In case a shipment consists of more than one car, a sample shall be taken from each car.

2. TESTING.—(a) *Fineness*.—One hundred grams of the sample as received shall be placed on a No. 20 sieve and shall be washed by means of a stream of water from a faucet. The washing shall be continued until the water coming through the sieve is clear, but in no case should the washing be continued for more than 30 minutes. The residue on the sieve shall be dried to constant weight at a temperature between 110 and 150° C. The sieve carrying the dried residue shall then be held in one hand in a slightly inclined position, so that the sample will be well distributed over the sieve, at the same time gently striking the side about 150 times per minute against the palm of the other hand on the upstroke. The sieve shall be turned every 25 strokes about one-sixth of a revolution in the same direction. The operation shall continue until not more than 0.05 g passes through in one minute of continuous sieving. The fineness shall be determined from the weight of the original sample.

A piece of rubber tubing attached to a water faucet is to be used for the washing. The velocity of the water may be increased by pinching the tubing but should not be sufficient to cause any splashing of the sample over the sides of the sieve.

Mechanical sieving devices may be used, but the material shall not be rejected if it meets the fineness requirements when tested by the hand method described.

(b) *Bond*.—The material shall be tested for bonding power by mixing one portion with water to a creamy consistency and another portion to a good troweling consistency. These mixtures shall then be used in laying up a pier of three of the fire-clay brick, laid flat, with which the clay is to be used in service. The faces of the brick to be bonded shall be dipped in the mixture of creamy consistency, a thin layer of the other mixture added, and the brick then firmly rubbed into place. In no case shall the mortar "joint" exceed $\frac{1}{8}$ inch.

When the pier is air dry, it is to be fired uniformly in a suitable furnace to a temperature 300° C. or 540° F. lower than the minimum allowable softening point of the fire-clay brick as defined in the Federal Specifications Board Specification for Fire-Clay Brick No. 268. The pier shall be allowed to cool in the furnace and when cold shall be sufficiently well bonded to remain intact when lifted by grasping the top brick.

(c) *Softening point.*—The softening point is to be determined according to the A. S. T. M. Standard Method of Test for Softening Point, Serial Designation C24-20.

(d) *Navy simulated service tests.*—Tests are conducted in small oil-fired furnaces, the dimensions and method of construction of which

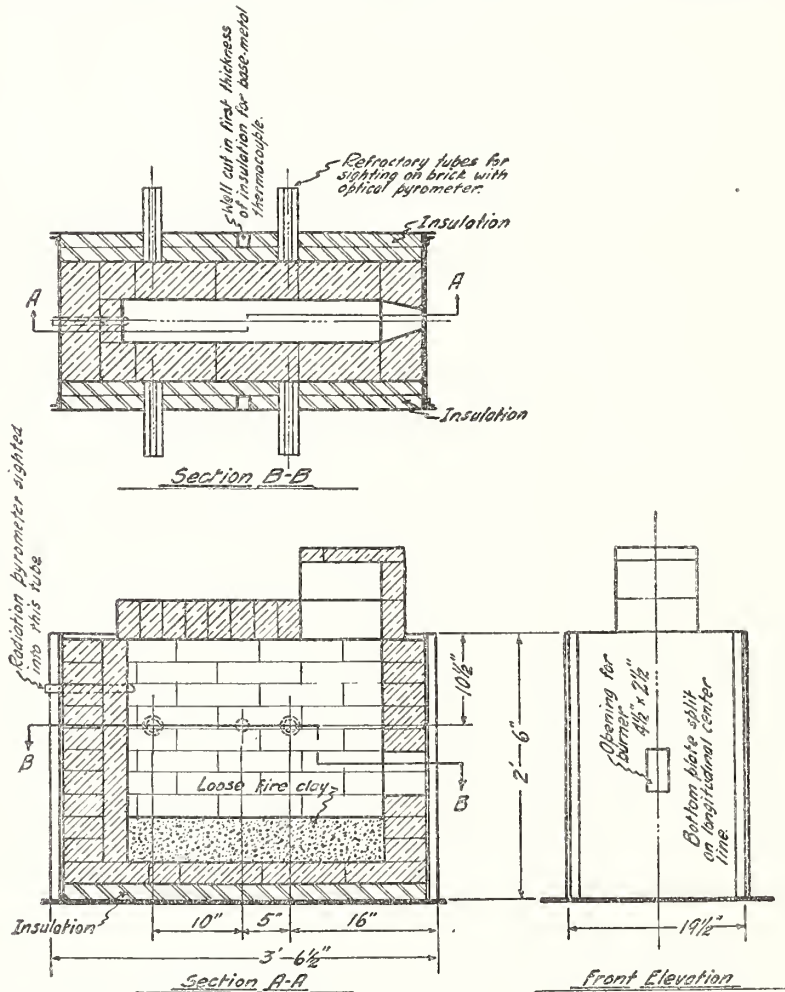


FIG. 1.—Furnace for conducting simulated service tests on insulation and refractory materials

are shown in Figure 1. For comparative purposes one side wall of the combustion chamber is built up of brick and fire-clay of approved brands and the other side wall of brick and fire-clay of the samples under examination. Both walls are backed uniformly with 3 inches of insulation. An air-atomizing fuel-oil burner is used. The flame sweeps the length of the furnace, curves upward and returns to the

front, then up the stack from which it escapes horizontally toward the rear of the furnace.

The test consists of two runs, each of 24 hours' duration, at furnace temperatures of 1,590 and 1,650° C. (approximately 2,895 and 3,000° F.), respectively.

During each run the following temperature determinations are made.

Furnace temperatures.—Temperatures of outer face of brickwork of each side wall at front and rear of furnace.

Refractory furnace face temperatures are recorded at 30-second intervals by means of a recording radiation pyrometer sighted into a closed end refractory tube placed in the rear wall of the furnace (fig. 1). The radiation pyrometer is checked at quarter-hourly intervals with an optical pyrometer sighted on the refractory walls through the front of the furnace above the burner. Control of the furnace is ordinarily carried out from observations of the recording radiation pyrometer.

Temperatures of the outer face of the brickwork of each side wall are determined at half-hourly intervals, with an optical pyrometer sighting on the brickwork through suitable tubes, the ends of which are placed flush with the wall. The tubes are carefully lagged and plugged to prevent radiation losses.

A spalling test is conducted at the conclusion of each run by injecting cold air at high velocity into the furnace immediately after shutting off the oil supply to the burner. The injection continues until the walls are cool.

The comparative heat-insulating properties, together with the relative conditions of the side walls, determine whether or not the material under test is acceptable for use in service.

(e) *Suitability.*—The combined results of fineness, bonding power, and softening point shall be considered as a suitability test, but (at the discretion of the purchaser) the simulated service test may replace all other tests included in the suitability test.

(f) *Control.*—Fineness and softening point shall be considered as a control test.

VII. PACKING AND MARKING

When delivered in containers, each container shall be plainly marked with the trade name of the material, the contract number, and the name of the contractor.

VIII. NOTES

Fire-clay of class F is intended particularly for use by the Navy.

Notice of the rejection of a shipment based on this specification must be in the hands of the consignor, unless otherwise specified,

within 10 days after the receipt of the shipment at the point of destination. If the consignor desires a retest, he shall notify the consignee within 5 days of receipt of said notice.

The cones referred to in this specification are known as the Orton pyrometric cone.

The sieve used shall meet the requirements given in the United States standard sieve series (United States Bureau of Standards Letter Circular No. 74).

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