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DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

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UNITED STATES GOVERNMENT MASTER SPECIFICATION FOR FIRE-CLAY BRICK

FEDERAL SPECIFICATIONS BOARD SPECIFICATION No. 268

This specification was officially promulgated by the Federal Specifications Board on January 22, 1925, for the use of the departments and independent establishments of the Government in the purchase of fire-clay brick.

[The latest date on which the technical requirements of this specification shall become mandatory for all departments and independent establishments of the Government is April 22, 1925. 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 brick shall be of the following classes: SH75, H75, H57, M73, H25, M7.

For derivation of the class nomenclature used see Section VIII of this specification.

III. MATERIAL AND WORKMANSHIP

The material covered by this specification is a brick of standard or special shape composed of heat-resistant clay or clays and which has been burned to produce the desired strength and structure. The brick shall be compact, of homogeneous structure, free from checks, cracks, voids, or soft centers. All corners shall be sufficiently solid and strong to prevent excessive crumbling or chipping when handled.

IV. GENERAL REQUIREMENTS

All brick of the standard 9-inch series shall not vary from specified dimensions more than $\frac{1}{8}$ inch in width and thickness, and $\frac{3}{16}$ inch in length. For special shapes no dimension shall vary more than 2 per cent from the dimension specified unless greater variation is allowed by contract, but in no case shall a variation of less than $\frac{1}{8}$ inch be specified, and they shall be free from such swells, warps, twists, or distortions as shall prevent ready and accurate laying up with a maximum joint of $\frac{1}{8}$ inch.

V. DETAIL REQUIREMENTS

1. Class SH75.—(*a*) The material shall contain not more than 65 per cent total silica (SiO_2).

(*b*) The softening point shall be not less than that of standard pyrometric cone No. 31 (approximately 1,680° C. or 3,056° F.).

(*c*) The material shall withstand 15 quenchings without failure.

(*d*) When specified, the brick shall pass the simulated service test.

2. Class H75.—(*a*) The softening point shall be not less than that of standard pyrometric cone No. 31 (approximately 1,680° C. or 3,056° F.).

(*b*) The material shall withstand 12 quenchings without failure.

3. Class H57.—(*a*) The softening point shall be not less than that of standard pyrometric cone No. 31 (approximately 1,680° C. or 3.056° F.).

(*b*) The material shall withstand five quenchings without failure.

(*c*) The absorption after reheating shall be not less than 6 per cent nor more than 16 per cent.

4. CLASS M73.—(*a*) The softening point shall be not less than that of standard pyrometric cone No. 29 (approximately 1,640° C. or 2,984° F.).

(*b*) The refractory shall withstand two quenchings without failure.

5. CLASS H25.—(*a*) Siliceous brick shall contain 70 per cent or more total silica (SiO_2).

(*b*) The softening point shall be not less than that of standard pyrometric cone No. 28 (approximately 1,615° C. or 2,939° F.).

(*c*) The material shall withstand six quenchings without failure.

(*d*) The deformation under load shall not exceed 3 per cent.

6. CLASS M7.—(*a*) Siliceous brick shall contain 70 per cent or more total silica (SiO_2).

(*b*) The softening point shall be not less than that of standard pyrometric cone No. 28 (approximately 1,615° C. or 2,939° F.).

(*c*) The material shall withstand three quenchings without failure.

(*d*) The deformation under load shall not exceed 4 per cent.

VI. METHOD OF TESTING

1. SILICA CONTENT.—The content of total silica shall be determined by analytical methods described under the A. S. T. M. Standard Method, Serial Designation C 18–21.

2. SOFTENING POINT.—The softening point shall be determined according to the A. S. T. M. Standard Method of Test for Softening Point, Serial Designation C 24–20.

3. QUENCHING TEST.—The quenching test shall be conducted on standard 9-inch straight brick which have been brought uniformly under no load at 1,400° C. (2,552° F.) in not less than five hours and held for five hours and allowed to cool in the kiln and without induced draft to room temperature.

The quenching is conducted in the following manner: The brick is heated by placing in the door of a suitable furnace which is being held at a temperature of 850° C. (1,560° F.). The heated end of the brick should be flush with the inner face of the furnace and the outer end should be exposed to the free circulation of air.

At hourly intervals the hot end of the brick is immersed in running water for three minutes and to a depth of 4 inches. The brick is then removed, allowed to steam in the air for five minutes, and returned to the furnace door. This cycle is repeated until the specimen has failed.

The brick is considered to have failed when the entire plane surface of the heated end has completely spalled away, or when the structure

of the brick has become so weakened that the end can be easily removed with the fingers.

The results of any one brand shall be reported as the average of five specimens.

4. Absorption.—The absorption shall be determined for brick which have been brought uniformly under no load to 1,400° C. in not less than five hours and held for five hours and allowed to cool in the kiln and without induced draft to room temperature.

The test shall be conducted on specimens not less than 100 g in weight, one specimen to be taken from each of five bricks of any one brand and the average result reported.

The per cent absorption shall be determined according to the following formula:

$$\text{Per cent absorption} = \frac{W-D}{D}\,0.100$$

W = weight of specimen after having been boiled in water for two hours and allowed to cool in the water.

D = weight of specimen after having been dried to constant weight at 110° C.

5. Load Test.—The load test shall be conducted according to the A. S. T. M. Standard Method of Test for Heavy Duty Fire-Clay Refractory Material Under Load at High Temperatures, Serial Designation C 16–20.

6. Simulated Service.—The simulated service tests shall be conducted in the following manner:

(*a*) Tests are conducted in small oil-fired furnaces, the dimensions and method of construction of which are shown in Figure 1. For comparative purposes, one side wall of the combustion chamber is built up of brick and cement of approved brands and the other side wall of brick and cement 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.

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

(*c*) 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.

(*d*) Furnace temperatures are determined at quarter-hourly intervals with an optical pyrometer sighting on flame through front of furnace above burner.

(*e*) 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.

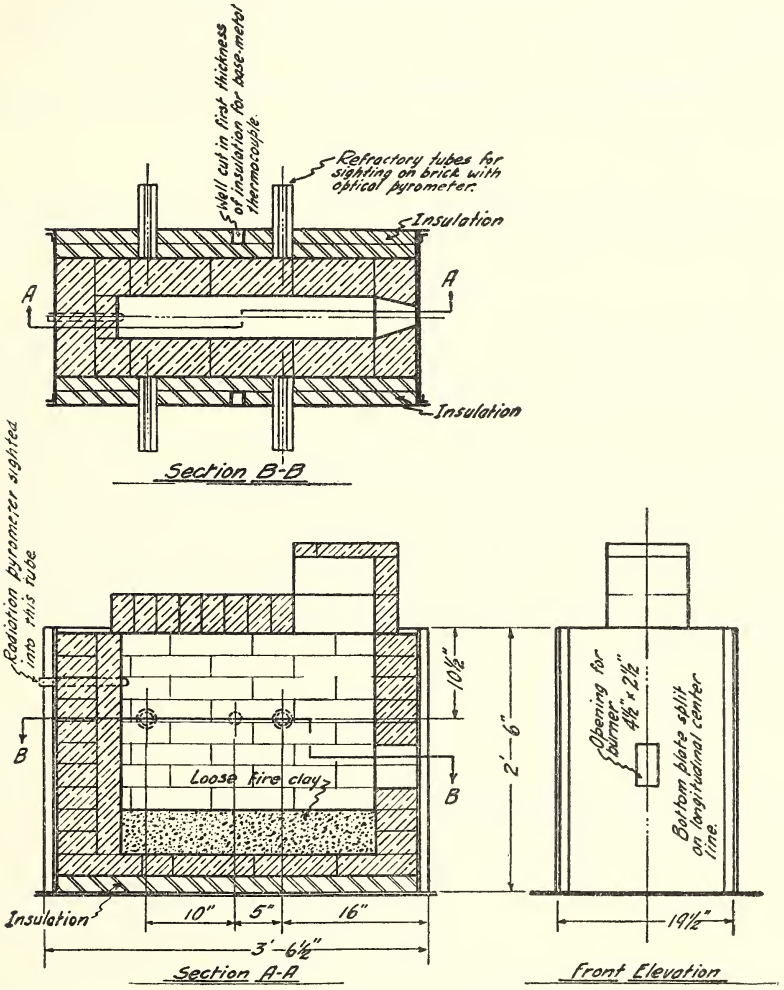

FIG. 1.—*Furnace for conducting simulated service tests on insulating and refractory materials*

(*f*) A spalling test is conducted at the conclusion of each run by injecting air at room temperature under forced draft into the furnace immediately after shutting off the oil supply to the burner. The injection is continued for two hours.

(*g*) 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.

7. The combined results of workmanship, chemical analyses, softening point, and absorption and load tests where required shall be considered as a suitability test, but (at the discretion of the purchaser) the simulative service test may replace all other tests included in the suitability test.

8. Workmanship and softening point determination shall be considered as a control test.

VII. MARKING

In each brick shall be molded the trade name, or the name of the manufacturer, or such a mark as will serve to identify the material.

VIII. NOTES

1. Notice of Rejection.—The consignor shall be notified of the rejection of a shipment based on this specification, unless otherwise specified, within 10 days after receipt of a shipment at the point of destination. If the consignor desires a retest, he shall notify the consignee within five days of receipt of said notice.

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

3. Class Nomenclature.—The class nomenclature used in Section I of this specification is based on the following scheme devised by Committee C–8 on Refractories, of the American Society for Testing Materials:

Temperature: Indicated by prefixing proper letter to number—H=high temperature; M=moderate temperature; L=low temperature		Load unimportant			Load moderate			Load important		
		Abrasion unimportant	Abrasion moderate	Abrasion important	Abrasion unimportant	Abrasion moderate	Abrasion important	Abrasion unimportant	Abrasion moderate	Abrasion important
Slag action unimportant.	Spalling unimportant.	1	2	3	4	5	6	7	8	9
	Spalling moderate.	10	11	12	13	14	15	16	17	18
	Spalling important.	19	20	21	22	23	24	25	26	27
Slag action moderate.	Spalling unimportant.	28	29	30	31	32	33	34	35	36
	Spalling moderate.	37	38	39	40	41	42	43	44	45
	Spalling important.	46	47	48	49	50	51	52	53	54
Slag action important.	Spalling unimportant.	55	56	57	58	59	60	61	62	63
	Spalling moderate.	64	65	66	67	68	69	70	71	72
	Spalling important.	73	74	75	76	77	78	79	80	81

Note.—Class S1175 (special high temperature) is so designated because it is meant to apply to especially severe service.

4. Class Definitions.—*Class SH75.*—Brick of this class are intended for use under the most severe conditions of boiler practice, such as marine boilers used by the Navy and in plant installations designed to operate at an average rating of not less than 175. Material of this class should have high resistance to slagging, spalling, and severe temperatures.

In the United States Navy service brick of class SH75 are used in oil-fired boilers operated at greater than 500 per cent rating and where severe vibrations and rapid changes in temperature occur. In this service the brick are secured by anchor bolts.

Class H75.—Brick of this class are intended for use under conditions such as are encountered in general boiler practice. For this class resistance to slagging, spalling, and high temperature is important.

Class H57.—Brick of this class are intended for use under conditions where resistance to spalling is not of great importance and where resistance to slagging and high temperature is important. In general boiler practice they may be used in the side walls, but, if the refractories used are limited to one brand, material of class H75 is recommended.

Class M73.—Brick of this class are intended for use at moderate temperatures, such as are encountered in hand-fired boilers operated at average rating not exceeding 125. Resistance to spalling and slagging is important under these conditions of temperature.

Class H25.—This class is intended primarily for brick of siliceous nature and for service in which resistance to slagging and spalling is not of particular importance, but in which the refractory is expected to resist deformation under load at relatively high temperatures.

Brick of class H25 are particularly adapted for service under conditions where resistance to deformation under load, with soaking heats at relatively high temperatures, is important, but where there is no marked fluctuation of temperature below approximately 650° C. (1,202° F.).

Brick of class H75 which withstand the load test satisfactorily may be included in this class.

Class M7.—This class is intended primarily for brick of siliceous nature, for service at moderate temperatures, and under the conditions where resistance to spalling and slagging is not important, but where resistance to deformation under load is important.

Brick of this class are particularly adapted for service under conditions where resistance to deformation under load, with soaking heats at moderate temperatures, is important, but where there is no marked fluctuation of temperature below approximately 650°C. (1,202° F.).

Brick of class M73 which withstand the load test satisfactorily may be included in this class.

5. General Information.—United States Bureau of Standards Circular No. 282 contains general information on the manufacture, properties, and uses of fire-clay brick.

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