U. S. Gov't
Master
Specification
No. 335

DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

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CIRCULAR OF THE BUREAU OF STANDARDS, No. 297

[Issued December 1, 1925]

UNITED STATES GOVERNMENT MASTER SPECIFICATION FOR PLASTIC FIRE-CLAY REFRACTORIES

FEDERAL SPECIFICATIONS BOARD SPECIFICATION No. 335

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 plastic fire-clay refractories.

[The latest date on which the technical requirements of this specification shall become mandatory for all Departments and Independent Establishments of the Government is January 2, 1926. They may be put into effect, however, at any earlier date after promulgation]

CONTENTS

I. GENERAL SPECIFICATIONS

There are no general specifications applicable to this specification.

II. GRADE

The material furnished under this specification shall be of one grade only.

III. MATERIAL AND WORKMANSHIP

The material covered by this specification is essentially a mixture of grog, raw clay, and sufficient water to render the mass plastic and of a stiff mud consistency. The grog is composed principally or entirely of calcined clay, and the raw clay is a plastic grade used to supply the necessary working properties and bond.

IV. GENERAL REQUIREMENTS

There are no general requirements applicable to this specification.

V. DETAIL REQUIREMENTS

1. Silica Content.—The material shall contain not more than 65 per cent total silica (SiO_2) calculated on the dry weight.

2. Softening Point.—The softening point shall be not less than that of standard pyrometric cone No. 31 (approximately 1,650° C. or 3,000° F.). Later determinations yield the following accurate values: 1,680° C or 3,056° F.

3. Water Content.—The material as delivered shall contain not more than 15 per cent water calculated on the plastic weight.

4. Shrinkage.—The total linear dry and burned shrinkage shall not exceed 4 per cent of the plastic length.

5. Simulated Service Test.—When specified, the material shall pass the simulated service test.

VI. METHOD OF INSPECTION AND TESTS

1. Sampling.—A sample of not less than 50 pounds shall be taken from one container, chosen at random, for every shipment of one carload or less and shall be so taken as to be truly representative of the material in the container.

2. Testing.—(*a*) *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.

(*b*) *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.

(*c*) *Water content.*—The water content shall be determined by drying a specimen of not less than 200 (approximately 7 ounces)

to constant weight at a temperature of not less than 110° C. and not more than 150° C. The per cent water shall then be determined in accordance with the following formula:

$$\text{Per cent water} = \frac{W - D}{W} \times 100$$

where

W = the weight of the material as received.

D = the weight of the material after having been dried to constant weight.

(*d*) *Shrinkage.*—The total linear dry and burned shrinkage shall be conducted on brick which have been prepared of the material (as delivered) by hand ramming with a wooden mallet in suitable wooden molds of inside dimensions approximately 2½ by 4½ by 9 inches. The brick shall be removed immediately from the mold and set on edge on a suitable pallet and marked on the 9 by 4½ inch faces with gauge marks approximately 8 inches apart. The sample shall then be carefully dried and burned uniformly under no load to 1,400° C. (2,552° F.) in not less than five hours and held at this temperature for five hours and allowed to cool in the kiln and without induced draft to room temperature. The distance between gauge marks shall be measured to the nearest thirty-second of an inch and the shrinkage calculated in accordance with the following formula:

$$\text{Per cent shrinkage} = \frac{L_w - L_b}{L_w} \times 100$$

where

L_w = length of the specimen in plastic state,

L_b = length of specimen after burning at 1,400° C.

The shrinkage of any one specimen shall be reported as the average of the distance between the two sets of gauge marks, and results of any one brand shall be reported as the average of five specimens.

(*e*) *Simulated service test.*—The simulated service tests shall be conducted in the following manner:

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 molded of plastic refractory of approved brands and the other side wall of plastic refractory 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 temperature 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 refractory of each side wall at front and rear of furnace.

Furnace temperatures are determined at quarter-hourly intervals with an optional pyrometer sighting on flame through front of furnace above burner.

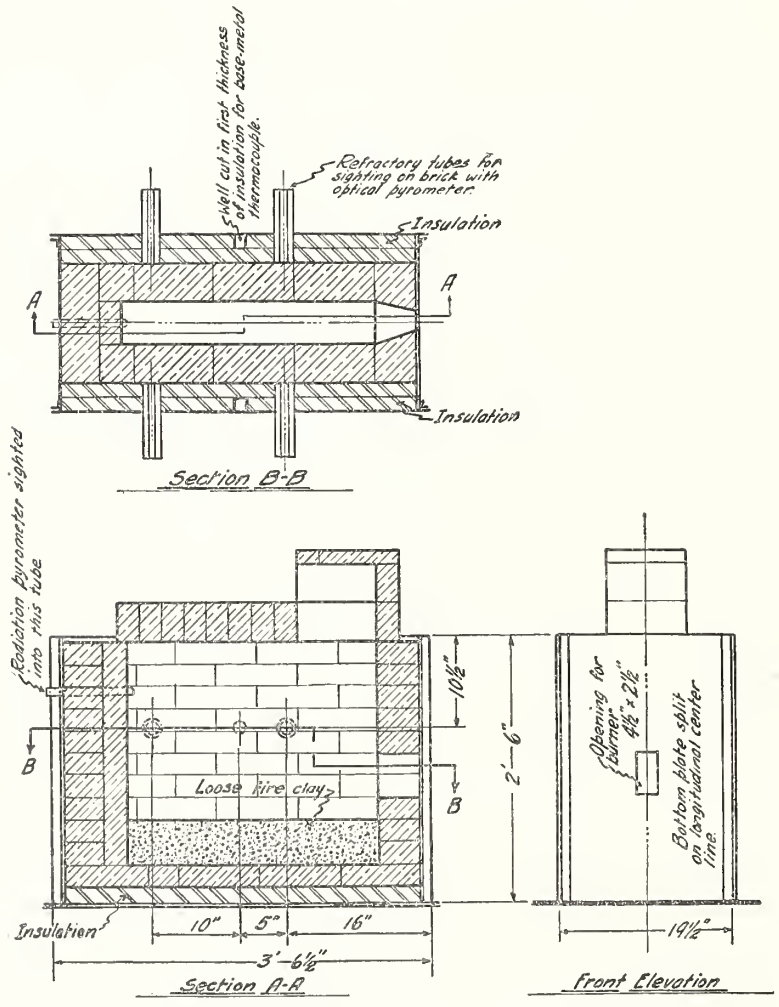

FIG. 1.—*Furnace for conducting simulated service tests on insulation and refractory materials*

Temperatures of the outer face of the refractory of each side wall are determined at half-hourly intervals with an optical pyrometer sighting on the refractory 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 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.

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.

(*f*) *Suitability test.*—The combined results of chemical analyses, softening point, water content, and shrinkage (burned) 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.

VII. PACKING AND MARKING

The material shall be packed in containers so constructed as to insure delivery of the material in satisfactory condition. The size and type of the container shall be as specified by the purchaser.

Each container shall be plainly marked with the trade name of the material, the contract number, and the name of the contractor.

VIII. NOTES

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.

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

The material covered by this specification is particularly adapted to those portions of installations where special fire-clay shapes have been or are being used. It is recommended also for the construction of small furnaces, such as are used in domestic heating plants, in baking ovens, and in laboratory apparatus.

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