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**Refractory Products – Determination of Modulus of
Rupture at Elevated Temperatures**

(ISO 5013:1985, MOD)

耐火材料 高温抗折强度试验方法

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Refractory Products – Determination of Modulus of Rupture at Elevated Temperatures

1 Scope

This Standard specifies the principle, equipment, specimen, test procedures, result calculation, test report of the refractory products modulus of rupture at elevated temperature.

This method is mainly used for shaping and firing refractory products. The chemical bonded refractory products or unshaped refractory products need pre-treatment; while the pre-treatment conditions shall be negotiated by relevant parties, and indicated in the test report.

2 Normative References

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) or revisions do not apply to this Standard, however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 8170 Rules of Rounding off for Numerical Values

GB/T 10325 Shaped Refractory Products - Rule of Acceptance, Sampling and Inspection

3 Definitions

This Standard adopts the following definitions.

3.1 Modulus of rupture

The maximum stress that can be borne by the strip specimen of refractory products with certain size, while bending on the 3-point bending device.

3.2 Test temperature

and indicate the load when the specimen is broken, the accuracy of indicating value shall be $\pm 2\%$.

5.2 Test furnace

5.2.1 The test furnace can heat both the loading device and specimen at the same time; and uniformly distribute the temperature on the specimen during the testing period; the temperature difference shall not exceed $\pm 10^{\circ}\text{C}$.

5.2.2 For the easily oxidized specimen containing carbon, the atmosphere around the specimen in the test furnace shall be neutral and reductive; so as to protect the specimen from oxidation. After test, there shall be no oxidation stain on the specimen fracture surface and section. To this end, the following measures shall be taken:

- Use airtight test furnace to inject the pure argon or nitrogen and other protective gases;
- Use non-airtight test furnace to cover the specimen by cartridge containing the graphite powder.

5.3 Temperature measuring device

5.3.1 Use the calibrated thermocouple to measure the temperature nearby the midpoint of tension surface of the specimen.

5.3.2 The relationship between the measured temperature and the midpoint temperature of the tension surface of the specimen shall be predetermined, which shall be regularly inspected according to the procedure listed in Appendix A.

5.3.3 During the test, the midpoint of the tension surface of the specimen shall be maintained at the test temperature.

6 Specimen

6.1 Quantity

6.1.1 The sampling and quantity of the shaped refractory products shall be determined as per GB/T 10325; the quantity can also be determined through the agreement of the both parties.

6.1.2 For the unshaped refractory products, the specimen quantity shall be no less than 3 per group.

6.2 Shape and size

6.2.1 Normally, the specimen shall be rectangular with cross-section $(25\pm 1)\text{mm} \times$

(25±1)mm, length 150mm; the opposite surfaces in the length direction of the specimen shall be parallel to each other, the allowable deviation shall not exceed ±0.2mm; the opposite edges on the cross-section shall also be parallel to each other, the allowable deviation shall not exceed 0.1mm; the surface shall be ensured smooth, and the corners shall be intact. If other size is adopted, the specimen size change shall be occurred at the spacing of 5mm.

NOTE: the formula given in 8.1 is only valid for the strip-shaped specimen; therefore, the ratio between height and weight of specimen, and the ratio between specimen height and spacing of bearing knife-edges are recommended to be $h/b \geq 1/3$, and $h/L_s \leq 1/4$ respectively.

6.2.2 The specimen size of unshaped refractory products shall be (40±1)mm × (40±1)mm × 160mm.

6.2.3 Use the Vernier caliper to measure the length and width of the middle part of the specimen at room temperature, accurate to ±0.1mm.

6.3 Specimen preparation

6.3.1 Cut the specimen from the shaped products, if the suppressing direction of the products is known, take the original brick surface perpendicular to the suppressing direction as the pressure surface of the specimen; then make mark; while other surfaces in the length direction shall not have original brick surface.

NOTE:

The continuous flange diamond blade is recommended to be used for cutting.

If the tooth-shaped flange blade is used, the edges cut by the blade are usually broken; therefore, the surface where the blade entered is recommended to be tension surface.

6.3.2 When using the model-prepared unshaped refractory product specimen, the side surface during the shaping period shall be regarded as the pressure surface.

6.3.3 In general, the specimen shall be dried to the constant weight at (110±5)°C; for the easily hydrated specimen, it shall not be cut as much as possible; if it needs wet cutting, after that use dry cloth to wipe and immediately put it into the blowing dry box at (110±5)°C to dry to the constant weight; for the products containing carbon, after wet cutting, immediately put it into the blowing dry box at 40°C below to dry to the constant weight.

7 Test Procedures

7.1 Heating

7.1.1 The test temperature shall be agreed by the relevant parties, the times of 100°C is recommended to be used (such as 1000°C, 1100°C...); if necessary, the times of

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