ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 1893

REFRACTORY PRODUCTS

DETERMINATION OF REFRACTORINESS UNDER LOAD

(DIFFERENTIAL – WITH RISING TEMPERATURE)

1st EDITION

October 1970

For each individual country the only valid standard is the national standard of that country.

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BRIEF HISTORY

The ISO Recommendation R 1893, *Refractory products – Determination of refractoriness under load (Differential – With rising temperature)*, was drawn up by Technical Committee ISO/TC 33, *Refractories*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led to the adoption of Draft ISO Recommendation No. 1893, which was circulated to all the ISO Member Bodies for enquiry in July 1969. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Austria	Italy	Romania
Brazil	Korea, Rep. of	South Africa, Rep. of
Canada	Netherlands	Spain
Denmark	New Zealand	Sweden
France	Peru	U.A.R.
Germany	Poland	United Kingdom
Hungary	Portugal	

No Member Body opposed the approval of the Draft.

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as an ISO RECOMMENDATION.

ISO Recommendation | R 1893 | October 1970

REFRACTORY PRODUCTS

DETERMINATION OF REFRACTORINESS UNDER LOAD

(DIFFERENTIAL – WITH RISING TEMPERATURE)

1. SCOPE

This ISO Recommendation describes a test designed to determine the deformation of a refractory product subject to a constant load under conditions of progressively rising temperature. It is essentially a technological test of which the experimental results are only of conventional significance.

2. PRINCIPLE

A cylinder of specified dimensions is cut from the test sample and placed in the furnace between the supporting and loading columns of a loading device by which a constant pressure can be applied. The furnace is heated at a prescribed rate, the deformation of the test piece as the temperature increases is recorded and the temperatures corresponding to different deformations of the cylinder are determined.

3. APPARATUS

The apparatus should comprise a furnace, a means of applying an axial compressive load to the test piece, a means of measuring the change in length of the test piece, and thermocouples to measure the temperature of the furnace and to control the rate of heating. These items should conform to the following requirements :

3.1 *Furnace.* The furnace should be capable of raising the temperature of the test piece to the testing temperature at the specified rate in an atmosphere of air (or some other precisely defined atmosphere). The temperature should be uniform within ± 10 °C over a zone at least 75 mm high, in which the test piece is centrally placed.

3.2 *Loading device.* This should be capable of applying a load centred on the common axis of the test piece, the loading column and the plate, and directed vertically along this axis at all stages of the test*.

The device should comprise :

3.2.1 *a fixed column;*

3.2.2 *a moving column* drilled with an axial hole at least 18 mm in diameter;

3.2.3 *two disks* of an appropriate refractory material (sintered alumina for alumino-silicate products, spinel for basic products) not more than 10 mm thick, placed between the test piece and the columns; the disk placed between the test piece and the moving column should have a central hole 10 mm in diameter. Platinum-rhodium foil may also be used to prevent reactions between the test piece and the refractory disks.

The columns and disks should be capable of withstanding the applied load at temperatures up to the final test temperature without significant deformation.

The total load applied to the test piece, including the weight of the loading column and plate, should be 1.97 ± 0.03 bar (2 ± 0.03 kgf/cm^2), unless a different load is particularly specified**. Calculation of the total load to be applied must be based on the actual surface area of the test piece (a deduction being made for the area of the central hole).

* The arrangement described allows the measuring device to be inserted from above or below the test piece as desired. Permissible arrangements are shown in Figures 1 (*a*) and 1 (*b*).

** For example, for insulating refractories, a load less than 2 kgf/cm^2 will normally be agreed between the parties concerned.

3.3 *Measuring device.* This device should comprise :

3.3.1 *an alumina tube about 15 mm in external diameter,* placed inside the movable column and abutting on the pierced disk placed between the test piece and the movable column. This tube permits the second tube (3.3.2) to run freely through it;

3.3.2 *an alumina tube about 8 mm in external diameter,* placed inside the first tube (3.3.1), passing through the pierced disk and abutting on the intact disk placed between the test piece and the fixed column;

3.3.3 *an appropriate measuring instrument* (e.g. a dial gauge), graduated in 0.01 mm, fixed to the end of the tube (3.3.1) and actuated by the tube (3.3.2).

The alumina tubes should be capable of withstanding the applied load at temperatures up to the final test temperature without significant deformation.

3.4 *Thermocouples.* The temperature of the test piece should be measured at its geometric centre by means of an insulated thermocouple passing through the central tube (3.3.2) of the dilatometer, with its junction at the midpoint of the test piece. The control thermocouple which is used to regulate the rate of rise of temperature is placed as shown in Figures 1(*a*) and 1 (*b*).

4. TEST PIECE

The test piece should be a cylinder 50 ± 0.5 mm high*. For preference the axis of the cylinder should be in the direction of pressing of the product; otherwise, the orientation of the test piece should be reported.

The top and bottom faces of the test piece should be plane and parallel, and should be perpendicular to the axis of the cylinder. The surface of the cylinder should be free from visible defects. Measurements of the height at any two points should not differ by more than 0.2 mm. When one face of the test piece is placed on a plane surface, and a square also in contact with the surface is brought into contact with any part of the periphery (generator), the gap between the side of the test piece and the vertical arm of the square should not exceed 0.5 mm.

A hole 12.5 mm in diameter should be drilled axially through the test piece.

5. PROCEDURE

Set up the test piece and the loading and measuring devices. Raise the temperature, with the aid of the control thermocouple, at a controlled rate of 4 to 5 °C per minute. (At any instant the difference between the temperature measured by the control thermocouple and the temperature defined by the above heating schedule should not exceed 5 °C.) Maintain this rate of heating until the end of the test. Below 500 °C a heating rate of approximately 10 °C per minute may be used, if desired.

Record the temperature of the interior of the tube (3.3.2) and the readings of the measuring device regularly and continue the test until the change in height of the test piece is greater than 5 % of the original value.

NOTE. – If the test piece assumes a mushroomlike or pearlike shape, the uniformity of temperature within the furnace (3.1) is suspect and should be checked.

* If a test piece of these dimensions cannot be cut from the material, peices of other dimensions may be used by agreement between the parties concerned.

6. EXPRESSION OF RESULTS

Let H be the initial height of the test piece. The experimental curve C_1 (see Fig. 2 (*a*)) represents the percentage changes in height of the test piece, less the percentage expansion of the central tube (3.3.2), as a function of temperature.

The analysis of the curve consists, in the first instance, in establishing the curve for the changes in height of the test piece alone, as a function of temperature (Fig. 2 (*a*)). For this purpose, the expansion curve C_2 of the material forming the central tube (3.3.2) will previously have been established as a function of temperature.

Raise each point A on the experimental curve C_1 by a quantity l, equal to the percentage expansion of the material forming the central tube, for the temperature corresponding to the abscissa of the point A.

The corrected curve C_3 having thus been established, draw a straight line parallel to the temperature axis through the highest point of the curve (see Fig. 2 (*b*)).

The deformation (ΔH) of the test piece, at a given temperature (T), is by definition measured as the difference between the ordinate of the point M, of abscissa T, on the horizontal straight line, and the ordinate of the point N, of the same abscissa, on the corrected curve C_3.

Examine the curve to identify the points at which the deformation, measured in this way, corresponds to 0.5 %, 2 %, and 5 % of the initial height of the test piece, and note the corresponding temperatures $T_{0.5}$; T_2 ; T_5).

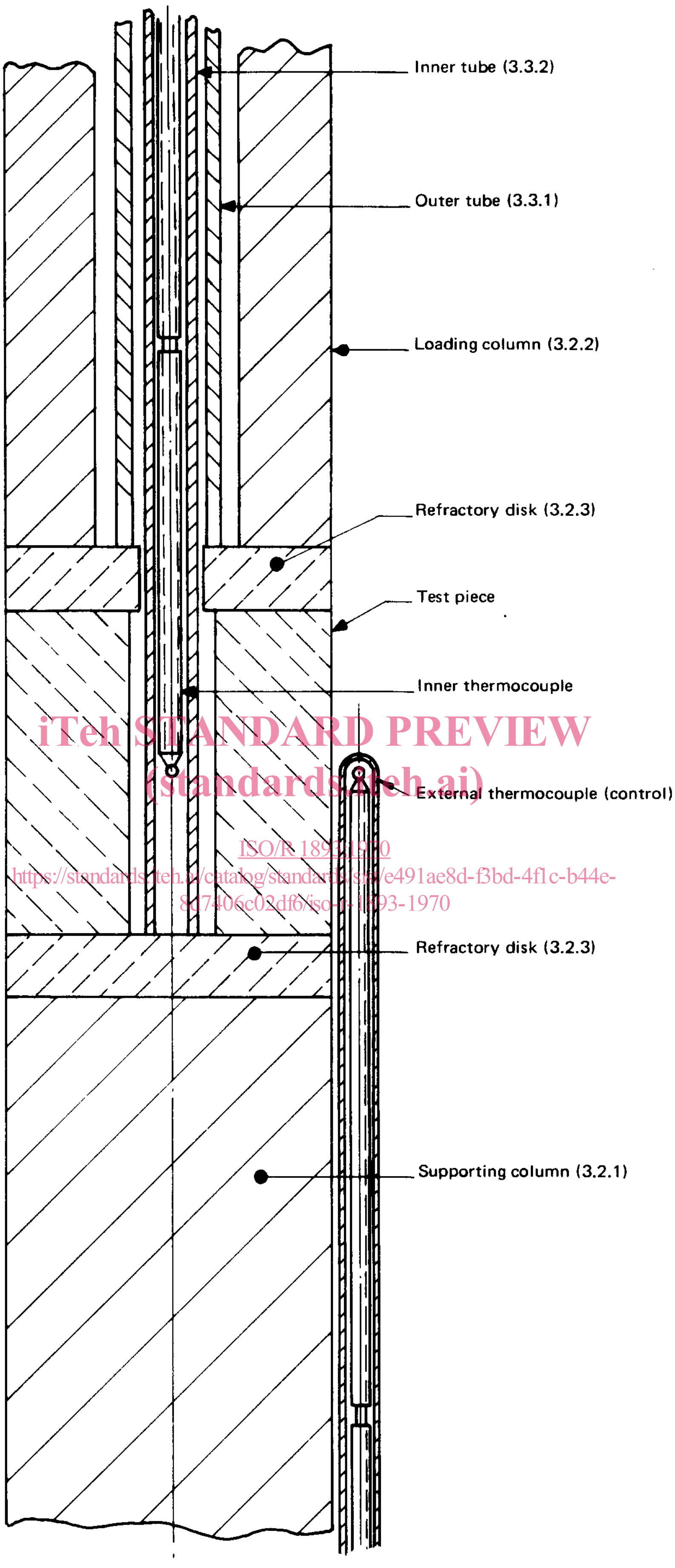

FIG. 1 (*a*) – Test apparatus – Measuring instrument above test piece

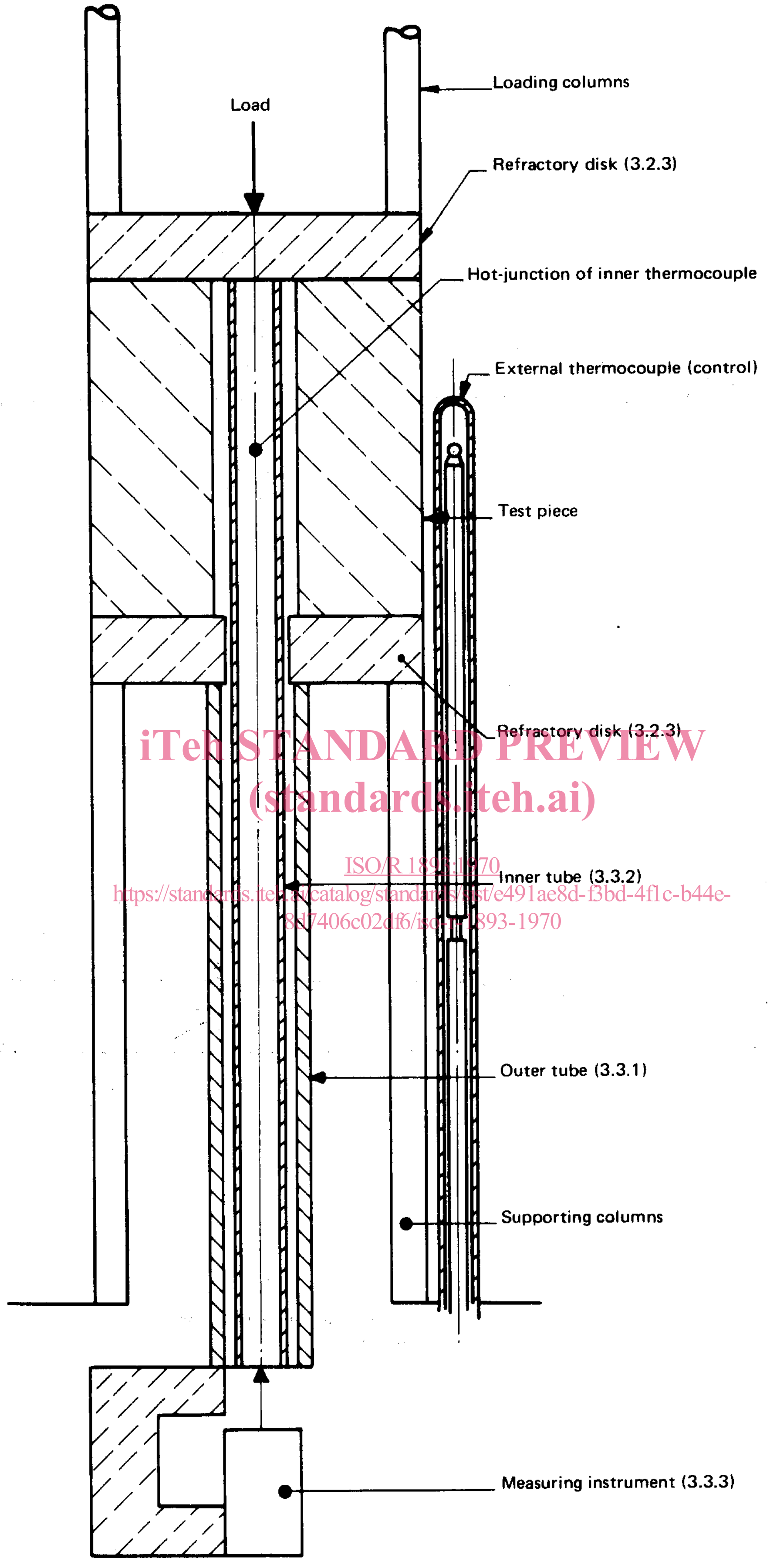

FIG. 1 (*b*) – **Test apparatus – Measuring instrument below test piece**

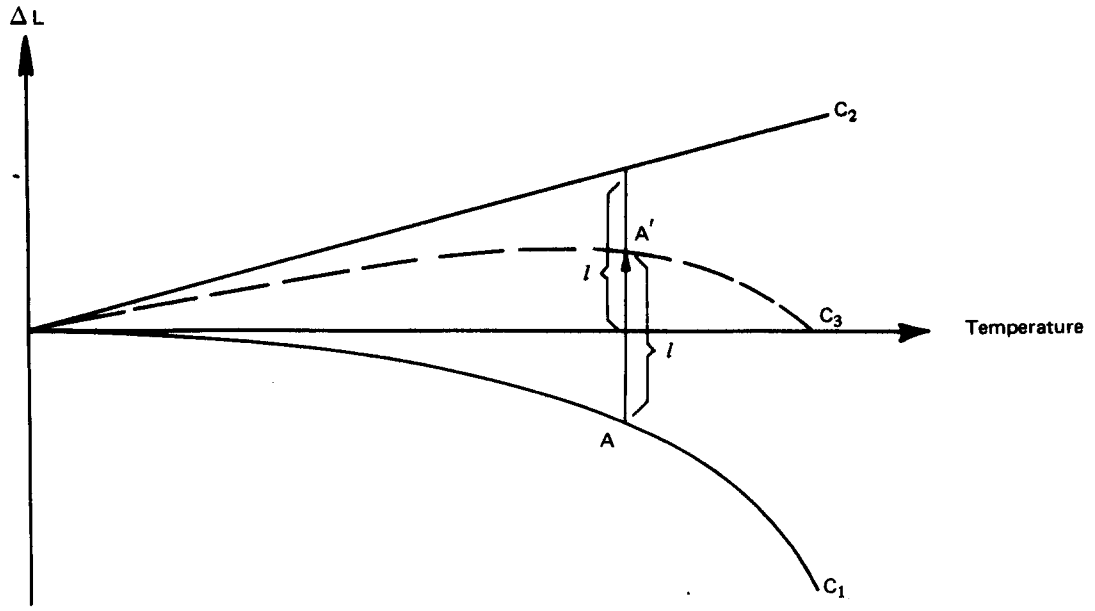

FIG. 2 (*a*) – **Correction of experimental curve**

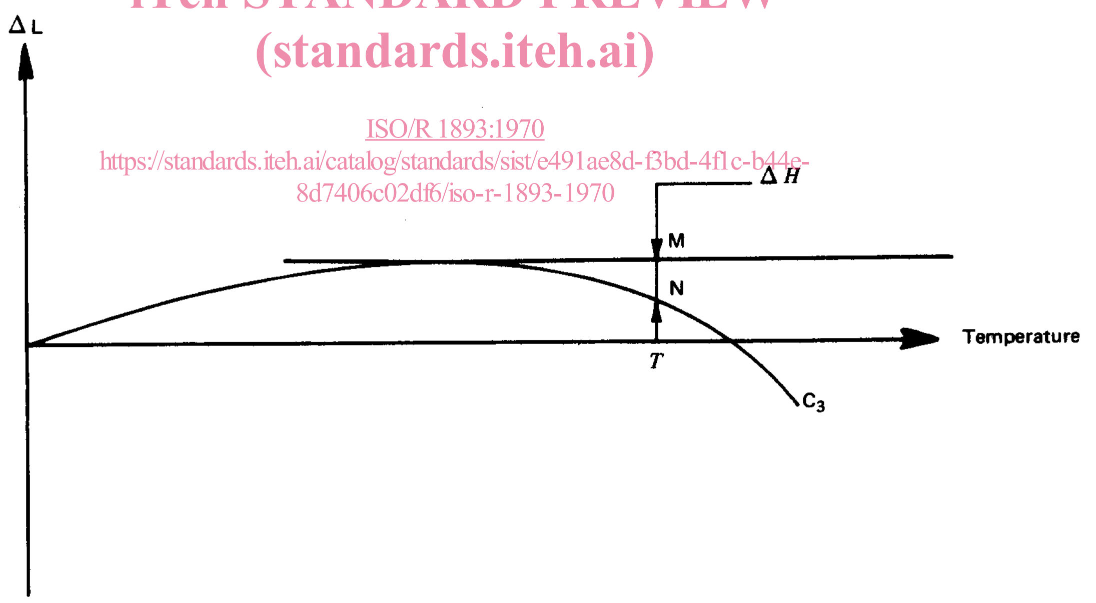

FIG. 2 (*b*) – **Measurement of actual deformation at a given temperature**

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