

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 679

METHOD OF TESTING STRENGTH OF CEMENTS

COMPRESSIVE AND FLEXURAL STRENGTHS

(OF PLASTIC MORTAR)

(RILEM-CEMBUREAU METHOD)

ISO/R 679:1968

<https://standards.iteh.ai/catalog/standards/sist/653eb39e-21f7-45b8-b70e-ad31015bd3a9/iso-r-679-1968>

1st EDITION

March 1968

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Printed in Switzerland

Also issued in French and Russian. Copies to be obtained through the national standards organizations.

BRIEF HISTORY

The ISO Recommendation R 679, *Method of testing strength of cements – Compressive and flexural strengths of plastic mortar (Rilem-Cembureau method)*, was drawn up by Technical Committee ISO/TC 74, *Hydraulic binders*, the Secretariat of which is held by the Institut Belge de Normalisation (IBN).

Work on this question by the Technical Committee began in 1952 and led, in 1964, to the adoption of a Draft ISO Recommendation.

In January 1965, the Draft ISO Recommendation (No. 772) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Argentina	Ireland	Romania
Austria	Israel	Sweden
Belgium	Italy	Turkey
Czechoslovakia	Japan	U.A.R.
Denmark	Korea Rep. of	United Kingdom
France	Netherlands	U.S.S.R.
Germany	Norway	Yugoslavia
Hungary	Poland	
India	Portugal	

Two Member Bodies opposed the approval of the Draft :

New Zealand
U.S.A.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council which decided, in March 1968, to accept it as an ISO RECOMMENDATION.

METHOD OF TESTING STRENGTH OF CEMENTS
COMPRESSIVE AND FLEXURAL STRENGTHS
OF PLASTIC MORTAR
(RILEM-CEMBUREAU METHOD)

1. SCOPE

This ISO Recommendation describes the *Rilem-Cembureau* method of testing the compressive and flexural strength of plastic mortar.

2. PREPARATION OF MORTAR

2.1 Standard sand

The standard sand should be a natural, rounded, siliceous sand (with the maximum possible amount of quartz, particularly in its fine fraction). The Belgian standard sand* should be the standard reference sand.

The sand should be subdivided into three fractions : fine, medium and coarse, separated by 0.5 mm and 1 mm sieves.

The particle size distribution of the coarse, medium and fine fractions should be such that by mixing equal masses of the fractions, a sand grading is obtained which falls within the limits defined by Table 1.

If the available sands make it necessary, any other subdivision into fractions is permissible provided that the combined grading complies with the limits given in Table 1. However, sand fractions having too wide a range of particle sizes should be avoided as they may cause segregation of the mixed materials.

Each country should use those of its own current standard sieves whose aperture sizes are nearest to the six apertures specified in Table 1.

TABLE 1

Sieve aperture Square mesh mm	Cumulative retained %	Sand fraction
0.08 0.15	98 ± 2 88 ± 5	fine
0.50	67 ± 5	
1.00 1.70 2.00	33 ± 5 5 ± 5 0	coarse

* As defined in the Belgian Standard NBN 715 — *Standard sand*.

The sieve analysis of the sand should be made on a representative 100 g sample. Both the sand and the test sieves should be perfectly dry. Sieving should be continued until the amount of sand passing through each sieve is less than 0.5 g per minute.

The results obtained should be reported in the form of a curve, such as that shown in Figure 1, the aperture sizes of the sieves used being plotted on the x-axis to a logarithmic scale.

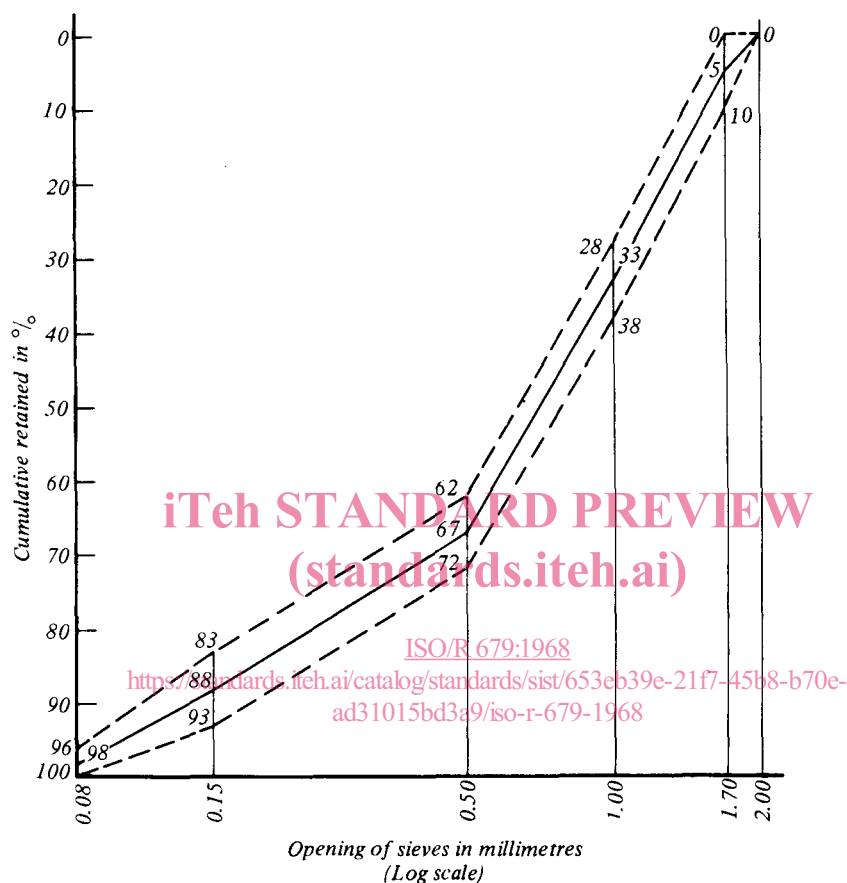


FIG. 1 – Standard sand – Particle size distribution

2.2 Composition of mortar

The proportions by mass should be one part of the cement under test, three parts of perfectly dry standard sand and one-half part drinking water (water/cement ratio = 0.50).

2.3 Preparation of mortar

Each batch should be sufficient for three test specimens, i.e. 450 g of cement, 1350 g of sand and 225 g of water. If the sand is subdivided into three equal parts, weigh in succession 450 g of the cement and 450 g of each of the coarse, medium and fine sand fractions. Weighing should be carried out by means of a balance accurate to $\pm 0.5\%$. Mixing should be done mechanically by means of the mixer shown in Figure 2. For the preparation of the mortar, the cement, sand, water, gauging room and apparatus should be at a temperature of $20 \pm 2^\circ\text{C}$. The relative humidity of the air in the gauging room should be not less than 65 %.

2.3.1 *Mixer.* The electrically-driven mixer should consist essentially of

- a stainless steel mixing bowl with a capacity of about 4.7 litres and of the shape and dimensions shown in Figure 2, and provided with means by which it can be securely fixed to the mixer frame during mixing;
- a mixer blade of the form and dimensions shown in Figure 2, revolving about its axis as it is driven in a planetary movement around the bowl by an electric motor at controlled speeds. The two directions of rotation should be opposite and the ratio between the two speeds should not be a whole number.

Dimensions in millimetres

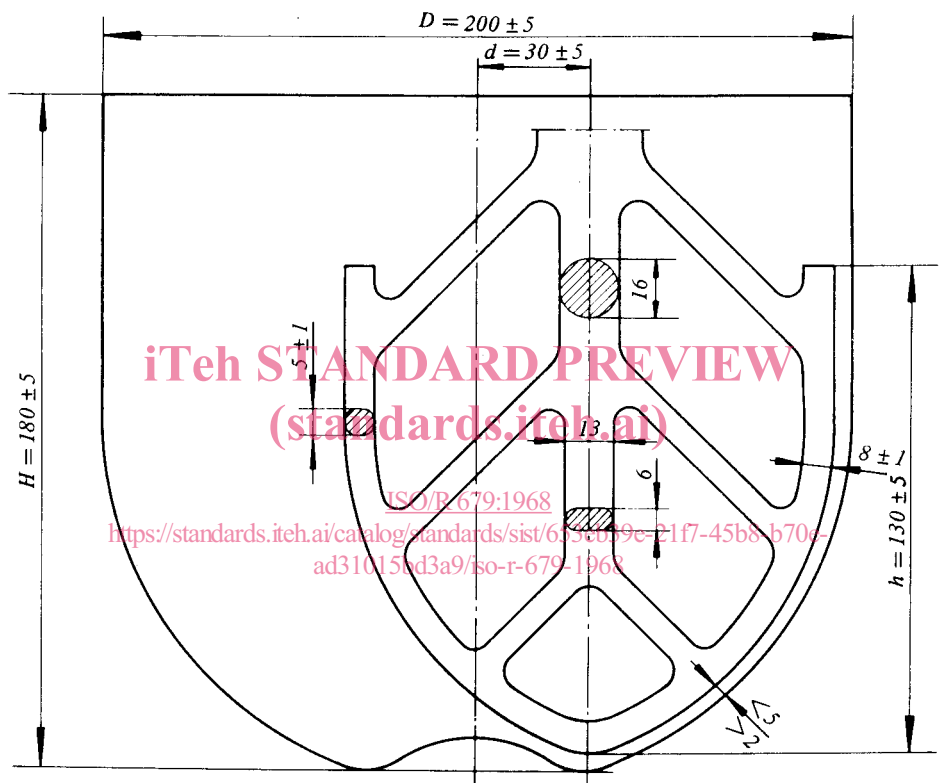


FIG. 2 – Type of mortar mixer

The following speeds should be observed during mixing.

TABLE 2

	Mixer blade revolutions per minute	Planetary movement revolutions per minute
Low speed	140 ± 5	62 ± 5
High speed	285 ± 10	125 ± 10

2.3.2 *Mixing.* With the mixer in the operating position

- pour the water into the bowl and add the cement;
- start the mixer at the low speed and, after 30 seconds, add steadily during the next 30 seconds, the fine, medium and coarse sand fractions -- in that order if they are separated. Switch the mixer to the higher speed and continue the mixing for an additional 30 seconds.

stop the mixer for 1 minute 30 seconds. During the first 15 seconds, remove by means of a rubber scraper all the mortar adhering to the wall of the bowl and place in the middle of the bowl. Cover the bowl during the remaining 1 minute 15 seconds;

- continue the mixing at the higher speed for 1 minute.

3. PREPARATION AND CONSERVATION OF TEST SPECIMENS

3.1 Description of test specimens

The test specimens should be prisms, 40 mm × 40 mm × 160 mm in dimensions.

3.2 Moulds

Moulds should be made from hard steel (minimum recommended Vickers hardness : 400), and should consist of three compartments to enable three specimens to be prepared simultaneously. A typical design is illustrated in Figure 3.

Their internal dimensions, in millimetres, should be the following :

length : 160 ± 0.4

width : 40 ± 0.1

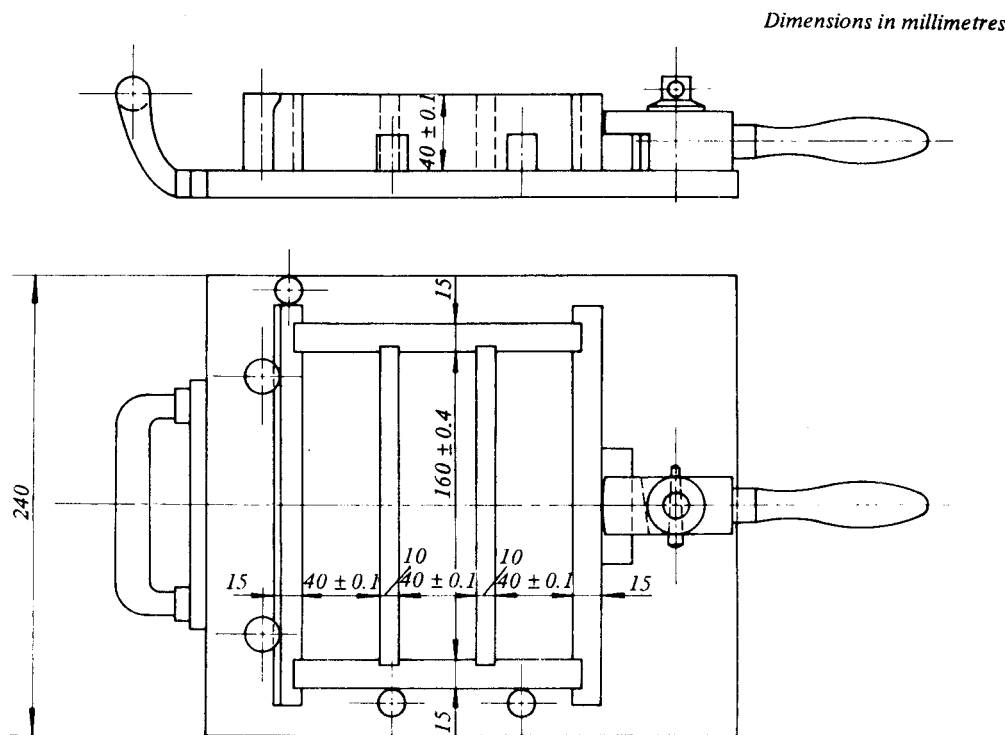
height : 40 ± 0.1

The mould walls should be at least 10 mm thick; the two internal opposite ("side") faces of 40 mm × 160 mm should be plane to within 0.01 mm; the angle between them and the base of the mould should be $90 \pm 0.5^\circ$.

Moulds should be replaced when their dimensions and form differ from the specified mean by twice the permitted tolerance in any respect.

The mould should rest on a machined steel base plate to which it should be securely clamped.

The mould should be surmounted by a metal hopper with vertical walls 20 to 40 mm in height. When viewed in plan these walls should not overlap the internal walls of the mould by more than 1 mm.



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FIG. 3 – Type of mould for three prisms

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3.3 Moulding of test specimens

Immediately after the preparation of the mortar the specimens should be moulded mechanically by means of a jolting apparatus as described below.

3.3.1 *Jolting apparatus.* The jolting apparatus should conform to the following requirements :

- (1) The apparatus consists essentially of a rectangular table rigidly connected by two light arms to a spindle at a horizontal distance of 80 cm from the centre of the table. The mass of the arms holding the table should be 1 ± 0.3 kg. The table should incorporate on its lower face a projecting lug with a plane face, beneath which is a small stop with a rounded upper surface. When the projecting lug rests on the stop its plane face and that of the table should be horizontal.
- (2) By means of a cam made of hard steel (Vickers hardness = 400) or of case-hardened steel, the table should be raised and then allowed to fall freely from a height of 15 mm before the lug strikes the stop.
- (3) By means of an electric motor of about 250 W and a reduction gear, the cam should be driven at a speed of one revolution per second. It is recommended that the motor be provided with a device which automatically stops it after sixty jolts.
- (4) The mould should be placed on the table in such a way that the length of the compartments is perpendicular to the axis of rotation of the cam. The mould should be located on the table with the aid of suitable reference marks so that the centre of the central compartment be directly above the point of impact. The mould surmounted by its hopper should be clamped rigidly to the table, e.g. by means of wing nuts.

- (5) The combined mass of the table, mould, hopper and clamps should be 20 ± 1 kg.
- (6) The apparatus should be fixed on a concrete base 1 m long, 30 cm wide and 80 cm high. The base plates of the two frames carrying the cam and the spindle about which the table rotates should each be fixed to the concrete base by means of four anchor bolts and, when fixing them, a thin layer of rich mortar should be placed between the base plates and the concrete base in order to ensure perfect contact.
- (7) To reduce noise, the concrete base should be placed on four rubber pads 10×10 cm and 1 cm thick. The table should be horizontal when at rest, and the common normal through the point of contact of the lug and stop should be vertical. The lug striking face and the stop should be replaced as soon as the above condition is no longer satisfied. Ball bearings should be employed for the spindles about which the table and the cam rotate. If plain bearings are used, the play of the spindles in them should not exceed 0.1 mm.

Figure 4 shows a typical design of jolting apparatus.

Dimensions in millimetres

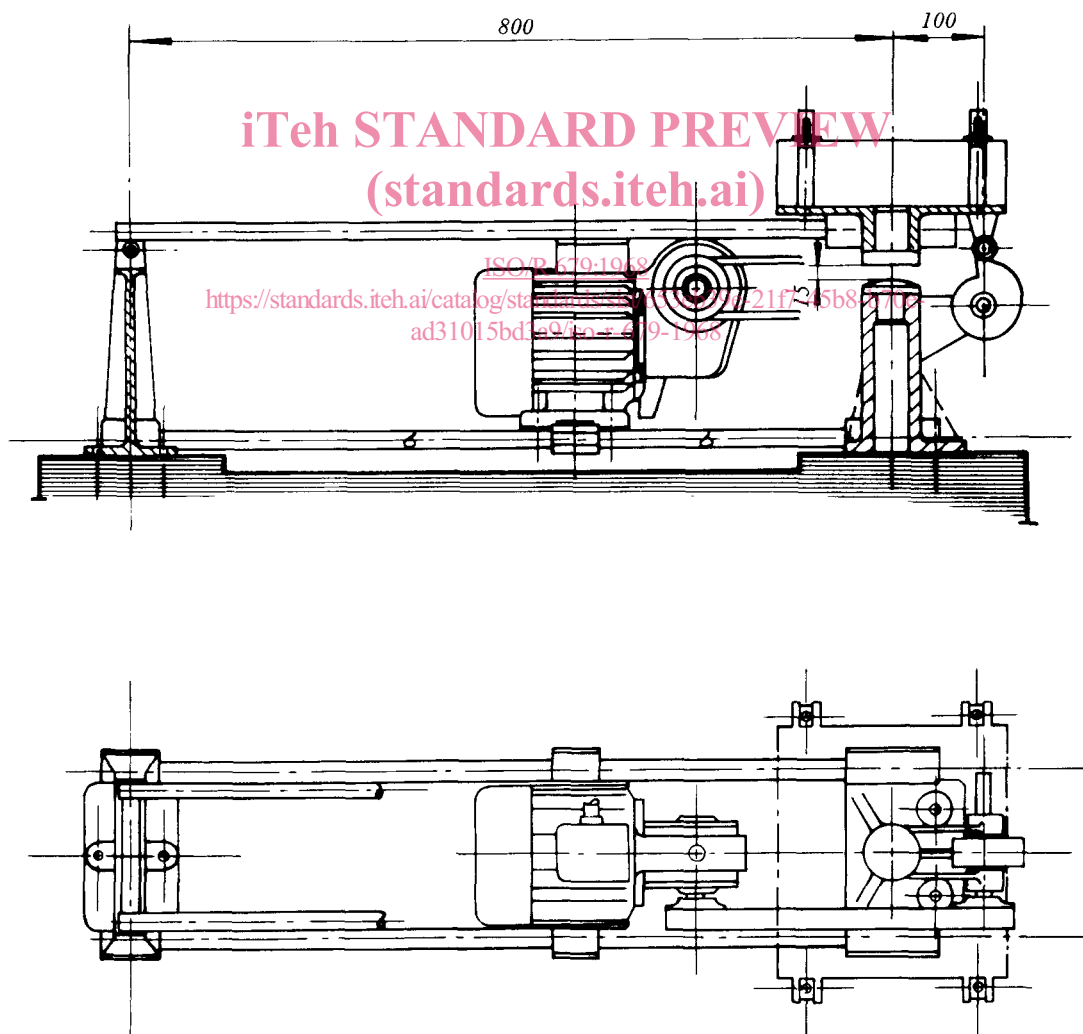


FIG. 4 -- Type of jolting apparatus

- 3.3.2 *Moulding the test specimens.* Oil the moulds lightly inside and seal their external joints (using for example a mixture of three parts of paraffin wax to one part rosin (colophony)).

The mould and its hopper being fixed on the jolting table, introduce the first layer of mortar of about 320 g directly from the mixer into each of the mould compartments (e.g. by using a spoon of a known capacity). Spread this layer by means of a spatula of flat steel tool which is drawn twice forwards and backwards along the mould while pressing its edges against the top of the hopper. Give sixty jolts to the first mortar layer in 60 seconds. Then introduce a second identical layer of mortar levelled and trans-compacted as previously.

Lift the mould from the jolting table and remove its hopper. Strike off the excess mortar with a metal straight edge held nearly vertically and moved slowly along the length of the mould with a transverse sawing motion.

Then smooth the surface lightly using the same straight edge held almost flat.

Make marks identifying the specimens on the moulds.

3.4 Conservation of test specimens

Cover the moulds (e.g. by a steel or rubber sheet) in order to prevent evaporation of water and place until demoulding in a storing room or cabinet which should be maintained at a temperature of 20 ± 1 °C and a relative humidity of not less than 90 %.

For tests on 24 hours old samples, demoulding should be carried out 15 to 20 minutes before the test is due.

For tests on samples other than 24 hours old, the demoulding should be carried out between 20 and 24 hours after moulding.

Demoulding may be delayed by a further 24 hours if the mortar has not acquired sufficient strength after 24 hours to be handled without danger of damage, but the fact should be mentioned in the test report.

Demoulding should be done with due precautions, preferably with the device shown in Figure 5.

Each demoulded test specimen should be weighed and the mass marked on its bottom face. This mass is a check on the procedure.

After demoulding, the specimens should be stored at 20 ± 1 °C in still tap water, until the time for testing. Vertical faces as cast should remain vertical during storage. The specimens should be kept apart from each other, allowing free access of water to all their faces. The water should be replaced every 15 days.