**DRAFT INTERNATIONAL STANDARD** ISO/DIS 679

ISO/TC **74** Secretariat: **IBN**

Voting begins on **2002-07-11** Voting terminates on **2002-12-11**

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

# Methods of testing cement — Determination of strength

[Revision of first edition (ISO 679:1989)]

*Méthodes d'essais des ciments — Détermination des résistances mécaniques*

ICS 91.100.10



## ISO/CEN PARALLEL ENQUIRY

This draft International Standard is a draft European Standard developed within the European Committee for Standardization (CEN) and processed under the CEN-lead mode of collaboration as defined in the Vienna Agreement. The document has been transmitted by CEN to ISO for circulation for ISO member body voting in parallel with CEN enquiry. Comments received from ISO member bodies, including those from non-CEN members, will be considered by the appropriate CEN technical body. **Accordingly, ISO member bodies who are not CEN members are requested to send *a copy* of their comments on this DIS directly to CEN/TC 51** (IBN, Avenue de la Brabançonne, 29, B-1000 Bruxelles) **as well as returning their vote and comments in the normal way to the ISO Central Secretariat.** Should this DIS be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month FDIS vote in ISO and formal vote in CEN.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# DRAFT
# prEN ISO 679

July 2002

ICS

English version

## Methods of testing cement - Determination of strength (ISO/DIS 679:2002)

Méthodes d'essais des ciments - Détermination des résistances mécaniques (ISO/DIS 679:2002)

Prüfverfahren für Zement - Bestimmung der Festigkeit (ISO/DIS 679:2002)

This draft European Standard is submitted to CEN members for parallel enquiry. It has been drawn up by the Technical Committee CEN/TC 51.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.



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COMITÉ EUROPÉEN DE NORMALISATION
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# Contents

## Foreword

This document (prEN ISO 679) has been prepared by Technical Committee CEN/TC 51 “Cement and building limes", the secretariat of which is held by national standard body, in collaboration with Technical Committee ISO/TC 74 "Cement and lime".

This document is currently submitted to the parallel Enquiry.

This European Standard shall be given the status of a National Standard, either by publication of an identical text or by endorsement, at the latest day by xxxx 200y, and conflicting national standards shall be withdrawn at the latest by xxxx 200y.

This European Standard supersedes EN 196-1:1994 which is withdrawn.

This edition introduces the following technical changes based on comments received by the Secretariat.

a) The testing procedure has been revised with respect to hardness and surface texture of moulds (4.5) and compression strength testing machine platens (4.8) as supplied; suitability of mould oil (4.5); frequency of operation of jolting apparatus (4.6); the inclusion and accuracy of a balance (4.10); deionised water is now permitted (5.3); procedures for mixing mortar (6.2) and the moulding (7) and conditioning (8) of test specimens have been revised to reflect current best practice.



b) Test results (10) are now reported in megapascals replacing newtons per square millimetre. (One megapascal is equivalent to one newton per square millimetre).



c) The requirement for a flexural strength testing machine (4.7) is now optional.

d) Estimates of the precision for compressive strength testing (10.2.3) have been revised to include both short and long term repeatability together with reproducibility data for laboratories of ‘normal’ performance and an indication of precision data for ‘expert’ laboratories.

e) The procedure for validation testing of CEN Standard sand (11.2) includes initial certification testing, validation criteria, verification testing and annual confirmation testing.

f) The procedure for validation testing of alternative compaction equipment (11.3) has been revised and a normative annex (annex A) has been introduced detailing two alternative vibration compaction equipments which have been validated.

## 1 Scope

This European Standard describes the method for the determination of the compressive and, optionally, the flexural strength of cement mortar. The method applies to common cements and to other cements and materials, the standards for which call up this method. It may not apply to other cement types that have, for example, a very short initial setting time.

The method is used for assessing whether the compressive strength of a cement is in conformity with its specification and for validation testing of a CEN Standard sand, EN 196-1, or alternative compaction equipment.

The Standard describes the reference equipment and procedure and allows alternative compaction equipment and procedures to be used provided that they have been validated in accordance with the appropriate provisions in this Standard. In the event of a dispute, only the reference equipment and procedure are used.

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.



EN 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements*

EN 196-7, *Methods of testing cement — Part 7: Methods of taking and preparing samples of cement*



ISO 565:1990, *Test sieves — Woven metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

ISO 1101:1983, *Technical drawings — geometrical tolerancing — Tolerancing of form, orientation, location and run-out — generalities, definitions, symbols, indications on drawings*

ISO 1302:1992, *Technical drawings — Method of indicating surface texture*

ISO 2591-1:1988, *Test sieving — Part 1: Methods using test sieves of woven wire cloth and perforated metal plate*

ISO 3310-1:1990, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

ISO 4200:1991, *Plain end steel tubes, welded and seamless — General tables of dimensions and masses per unit length*

## 3 Principle

The method comprises the determination of the compressive, and optionally the flexural, strength of prismatic test specimens 40 mm × 40 mm × 160 mm in size.

These specimens are cast from a batch of plastic mortar containing one part by mass of cement, three parts by mass of CEN Standard sand and one half part of water (water/cement ratio 0,50). CEN Standard sands from various sources and countries may be used provided that they have been shown to give cement strength results which do not differ significantly from those obtained using the CEN Reference sand (see clause 11).

In the reference procedure the mortar is prepared by mechanical mixing and is compacted in a mould using a jolting apparatus. Alternative compaction equipment and procedures may be used provided that they have been shown to give cement strength results which do not differ significantly from those obtained using the reference jolting apparatus and procedure (see clause 11 and annex A).

The specimens are stored in the mould in a moist atmosphere for 24 h and, after demoulding, specimens are stored under water until strength testing.

At the required age, the specimens are taken from their wet storage, broken in flexure into halves and each half tested for strength in compression.

# 4 Laboratory and equipment

## 4.1 Laboratory

The laboratory where preparation of specimens takes place shall be maintained at a temperature of (20 ± 2) °C and a relative humidity of not less than 50 %.



The moist air room or the large cabinet for storage of the specimens in the mould shall be maintained at a temperature of (20,0 ± 1,0) °C and a relative humidity of not less than 90 %.



The storage containers, fitted with gratings, for curing the specimens in water shall be of material which does not react with cement. The temperature of the water shall be maintained at (20,0 ± 1,0) °C.



The temperature and relative humidity of the air in the laboratory and the temperature of the water in the storage containers shall be recorded at least once a day during working hours. The temperature and relative humidity of the moist air room or cabinet shall be recorded at least every 4 h.

Cement, CEN Standard sand, water and apparatus used to make and test specimens shall be at a temperature of (20 ± 2) °C.

Where temperature ranges are given, the target temperature at which the controls are set shall be the middle value of the range.

## 4.2 General requirements for the equipment

The tolerances shown in Figures 1 to 5 are important for correct operation of the equipment in the testing procedure. When regular control measurements show that the tolerances are not met, the equipment shall be rejected, adjusted or repaired. Records of control measurements shall be kept.

Acceptance measurements on new equipment shall cover mass, volume, and dimensions to the extent that these are indicated in this European Standard paying particular attention to those critical dimensions for which tolerances are specified.

In those cases where the material of the equipment can influence the results, the material is specified and shall be used.

The approximate dimensions shown in the figures are provided as guidance to equipment manufacturers or operators. Dimensions which include tolerances are obligatory.

## 4.3 Test sieves

Wire cloth test sieves conforming to ISO 2591-1 and ISO 3310-1 shall be of the sizes from ISO 565 given in Table 1 (series R 20).

**Table 1 — Aperture of test sieves**

| **Square mesh size** (mm) | | | | | |
|---|---|---|---|---|---|
| 2,00 | 1,60 | 1,00 | 0,50 | 0,16 | 0,08 |

## 4.4 Mixer

The mixer shall consist essentially of:

a) a stainless steel bowl with a capacity of about 5 litres of the typical shape and size shown in Figure 1, provided with means by which it can be fixed securely to the mixer frame during mixing and by which the height of the bowl in relation to the blade and, to some extent, the gap between blade and bowl can be finely adjusted and fixed;

b) a stainless steel blade of the typical shape, size and tolerances shown in Figure 1, revolving about its own axis as it is driven in a planetary movement around the axis of the bowl at controlled speeds by an electric motor. The two directions of rotation shall be opposite and the ratio between the two speeds shall not be a whole number.



Where more than one mixer is used, blades and bowls shall form sets which shall always be used together.



The gap between blade and bowl shown in Figure 1 shall be checked regularly. The gap of (3 ± 1) mm refers to the situation when the blade in the empty bowl is brought as close as possible to the wall. Simple tolerance gauges ('feeler gauges') are useful where direct measurement is difficult.

The mixer shall operate at the speeds given in Table 2 when mixing the mortar.

**Table 2 — Speeds of mixer blade**

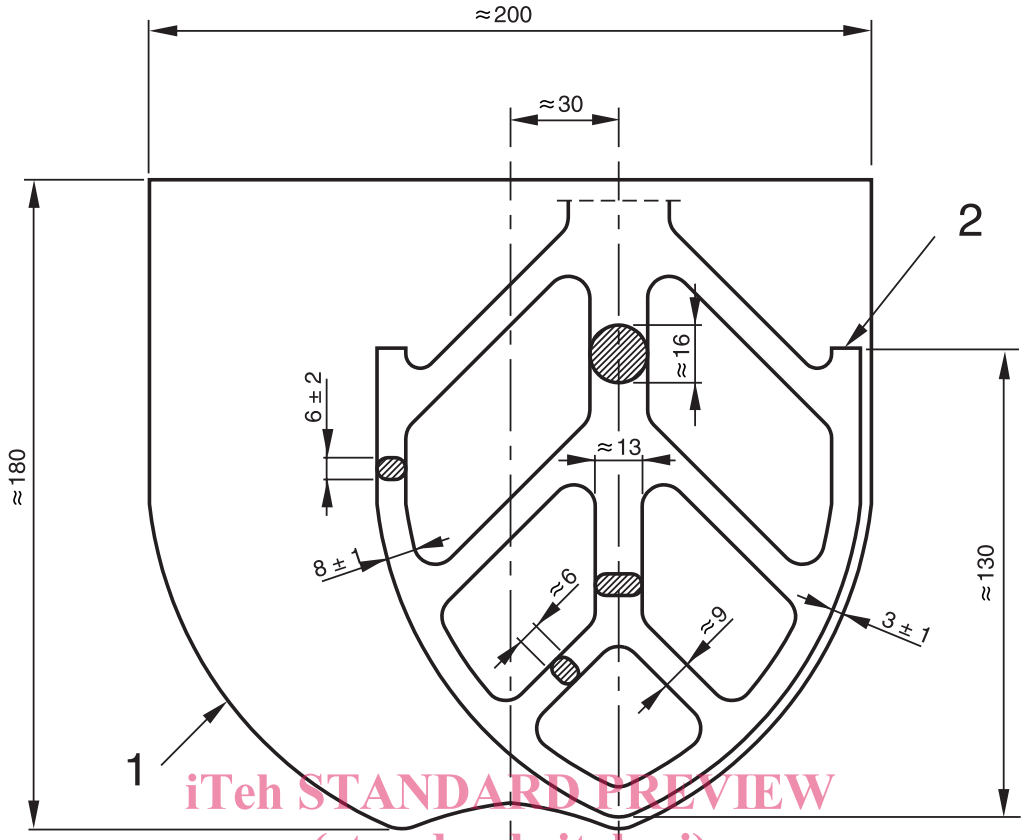
| | **Rotation**<br>min $^{-1}$ | **Planetary movement**<br>min $^{-1}$ |
|---|---|---|
| Low speed | 140 ± 5 | 62 ± 5 |
| High speed | 285 ± 10 | 125 ± 10 |

## 4.5 Moulds

The mould shall consist of three horizontal compartments so that three prismatic specimens 40 mm × 40 mm in cross section and 160 mm in length can be prepared simultaneously.

A typical design is shown in Figure 2.

The mould shall be made of steel with walls at least 10 mm thick. Each internal side face of the mould shall be case hardened to a Vickers hardness of at least HV 200, as supplied.






Key:



1. Bowl 2. Blade

Dimensions in mm

**Figure 1 — Typical bowl and blade**

NOTE 1 A minimum Vickers hardness value of HV 400 is recommended.

The mould shall be constructed in such a manner as to facilitate the removal of moulded specimens without damage. Each mould shall be provided with a machined steel or cast iron baseplate. The mould, when assembled, shall be positively and rigidly held together and fixed to the baseplate.

The assembly shall be such that there is no distortion or visible leakage during operation. The baseplate shall make adequate contact with the table of the compacting apparatus and be rigid enough not to induce secondary vibrations.

NOTE 2 Moulds and jolting apparatus from different manufacturers may have unrelated external dimensions and masses, so their compatibility needs to be ensured by the purchaser.

Each part of the mould shall be stamped with identifying marks to facilitate assembly and to ensure conformity to the specified tolerances. Similar parts of separate mould assemblies shall not be interchanged.

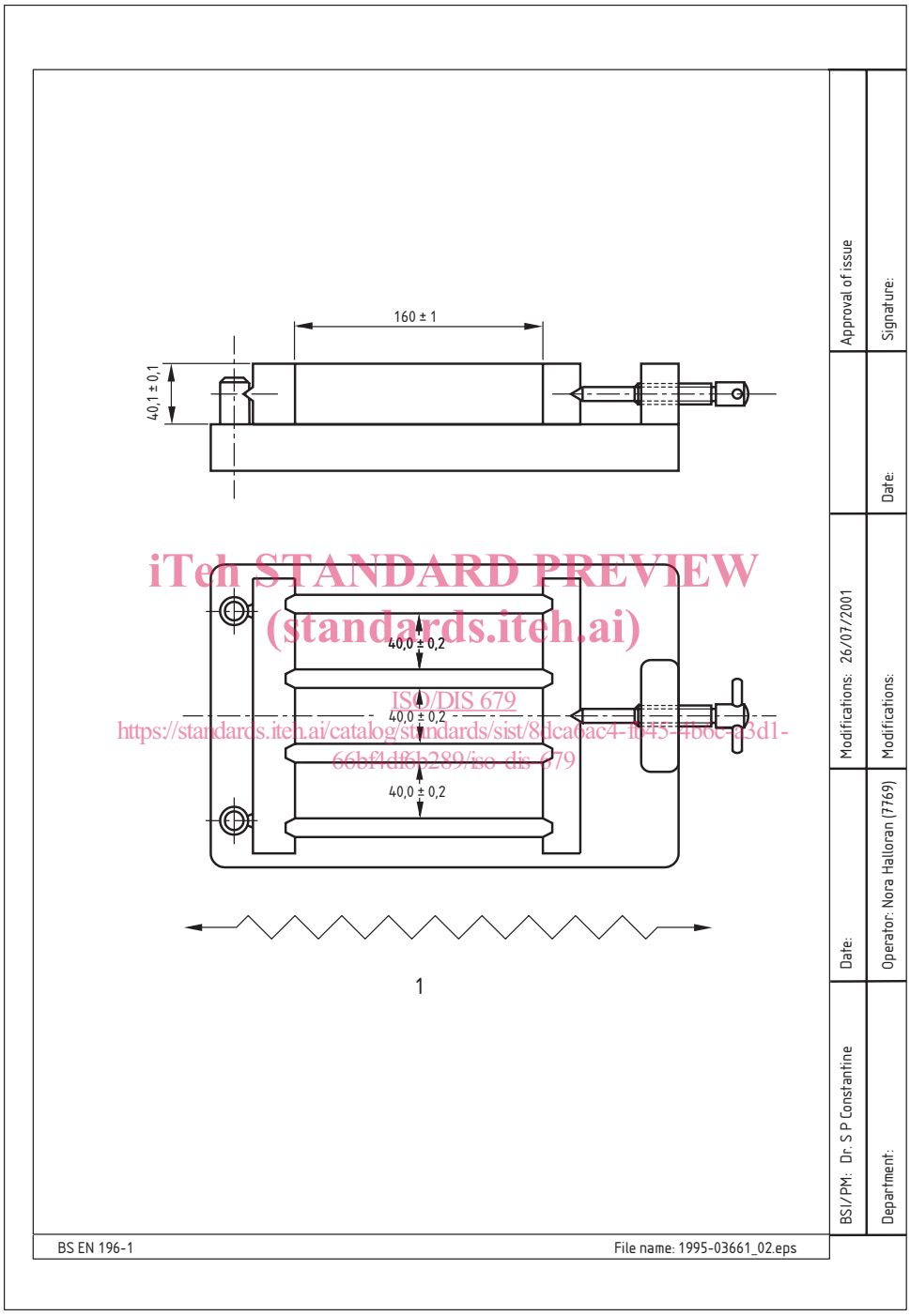
The assembled mould shall conform to the following requirements.

a) The internal dimensions and tolerances of each mould compartment shall be as follows:

length: (160 ± 1) mm;

width: (40,0 ± 0,2) mm;

depth: (40,1 ± 0,1) mm.






Key:
1. Striking off direction with sawing motion

Dimensions in mm

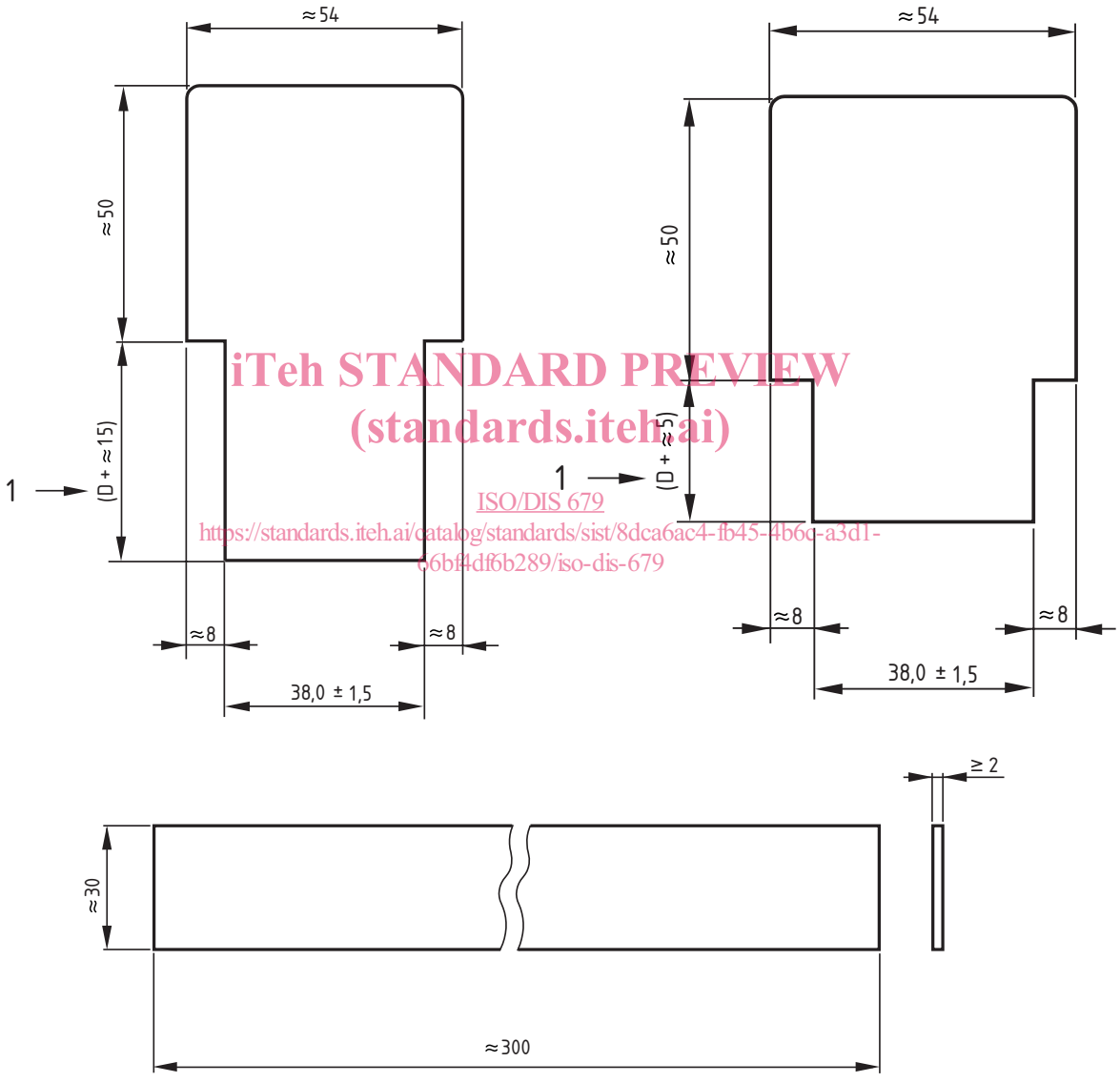
**Figure 2 — Typical mould**

b) The flatness tolerance (see ISO 1101, 14.2) over the whole of each internal side face shall be not greater than 0,03 mm.

c) The perpendicularity tolerance (see ISO 1101, 14.8) for each internal face with respect to the bottom surface of the mould and the adjacent internal face as datum faces shall be not greater than 0,2 mm.

d) The surface texture (see ISO 1302) of each internal side face shall be not rougher than N8, as supplied.

Moulds shall be replaced when any one of the specified tolerances is exceeded. The mass of the mould shall accord with the requirement for the combined mass in 4.6.






Key:

(a). Large spreader (b) Small spreader (c) Straightedge

1. D = Height of hopper Dimensions in mm

**Figure 3 — Typical spreaders and metal straightedge**

In assembling the cleaned mould ready for use, a suitable sealing material shall be used to coat the outer joints of the mould. A thin film of mould oil shall be applied to the internal faces of the mould.

NOTE 3 Some oils have been found to affect the setting of cement; mineral-based oils have been found to be suitable.

To facilitate the filling of the mould a tightly fitting metal hopper with vertical walls 20 mm to 40 mm in height shall be provided. When viewed in plan, the hopper walls shall overlap the internal walls of the mould by not more than 1 mm. The outer walls of the hopper shall be provided with a means of location to ensure correct positioning over the mould.

For spreading and striking off the mortar two spreaders and a metal straightedge of the type shown in Figure 3 shall be provided.

## 4.6 Jolting apparatus

The jolting apparatus (a typical design is shown in Figure 4) shall conform to the following requirements.

The apparatus shall consist of a rectangular table rigidly connected by two light arms to a pivot at nominally 800 mm from the centre of the table. The table shall incorporate at the centre of its lower face a projecting lug with a rounded face. Beneath the projecting lug shall be a small stop with a plane upper surface. In the rest position, the common normal through the point of contact of the lug and the stop shall be vertical. When the lug rests on the stop, the top face of the table shall be horizontal so that the level of any of the four corners does not deviate from the mean level by more than 1,0 mm. The table shall have dimensions equal to or greater than those of the mould baseplate, and a plane machined upper surface. Clamps shall be provided for firm attachment of the mould to the table.



The combined mass of the table, including arms, empty mould, hopper and clamps shall be (20,0 ± 0,5) kg.



The arms connecting the table assembly to the pivot shall be rigid and constructed of round tubing with an outside diameter lying in the range 17 mm to 22 mm selected from tube sizes given in ISO 4200. The total mass of the two arms, including any cross bracing, shall be (2,25 ± 0,25) kg. The pivot bearings shall be of the ball or roller type and protected from ingress of grit or dust. The horizontal displacement of the centre of the table as caused by the play of the pivot shall not exceed 1,0 mm.

The lug and the stop shall be made of through-hardened steel of at least HV 500 Vickers hardness value. The curvature of the lug shall be about 0,01 $mm^{-1}$.

In operation, the table is raised by a cam and allowed to fall freely from a height of (15,0 ± 0,3) mm before the lug strikes the stop.

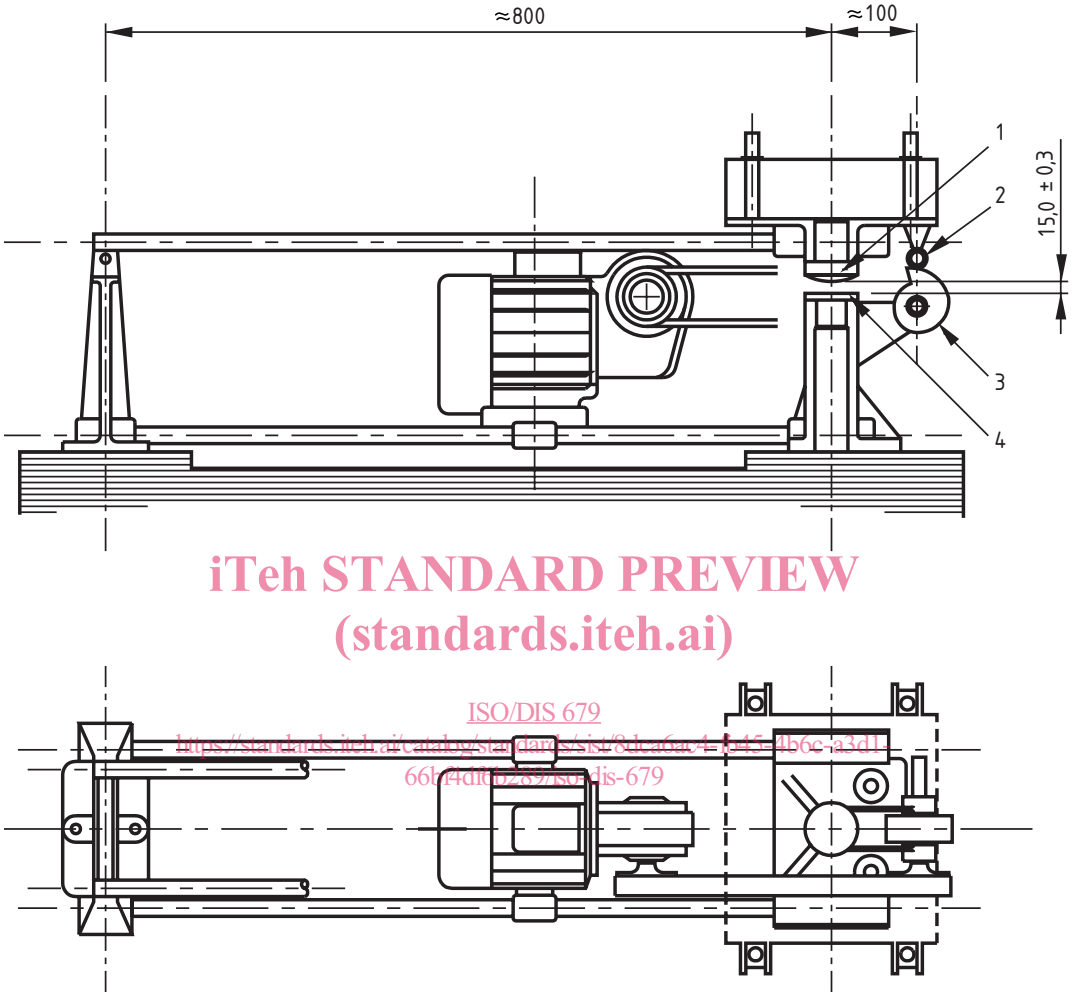
The cam shall be made of through hardened steel of at least HV 400 Vickers hardness value and its shaft shall be mounted in ball bearings of such construction that the free fall is always (15,0 ± 0,3) mm. The cam follower shall be of a construction which ensures minimal wear of the cam. The cam shall be driven by an electric motor of about 250 W through a reduction gear at a uniform speed of one revolution per second. A control mechanism and a counter shall be provided which ensures that one period of jolting of (60 ± 3) s comprises exactly 60 jolts.

The position of the mould on the table shall be such that the longitudinal dimension of the compartments is in line with the direction of the arms and perpendicular to the axis of rotation of the cam. Suitable reference marks shall be provided to facilitate the positioning of the mould in such a way that the centre of the central compartment is directly above the point of impact.

The apparatus shall be firmly mounted on a concrete block of mass of about 600 kg and volume of about 0,25 $m^3$ and of dimensions giving a suitable working height for the mould. The entire base of

the concrete block shall stand on an elastic pad, e.g. natural rubber, having a suitable isolation efficiency preventing external vibrations from affecting the compaction.

The base of the apparatus shall be fixed level to the concrete base by anchor bolts and a thin layer of mortar shall be placed between the base of the apparatus and the concrete base to ensure overall and vibration free contact.






Key:

1. Lug 2. Cam follower 3. Cam 4. Stop

Dimensions in mm

**Figure 4 — Typical jolting apparatus**

## 4.7 Flexural strength testing apparatus

NOTE The provision of this apparatus is optional. If only the compressive strength is to be measured, means for breaking the test prisms into halves are used as described in clause 9.

The flexural strength can be measured by using a flexural strength testing machine or by using a suitable device in a compression testing machine. In either case the apparatus shall conform to the following requirements: