INTERNATIONAL STANDARD

ISO 1920-2

Second edition
2016-11-01

Testing of concrete —

Part 2: Properties of fresh concrete

Essais du béton —

Partie 2: Caractéristiques du béton frais

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 1, *Test methods for concrete*.

This second edition cancels and replaces the first edition (ISO 1920-2:2005), which has been technically revised with the following changes:

a) 4.3.5, list a) has been updated;

b) 4.7.3.3, the required minimum dimensions 800 mm × 800 mm have been added;

c) Figure 11, footnote [a] was added;

d) 6.4.4, Note was added;

e) Bibliography list has been updated.

A list of all parts in the ISO 1920 series can be found on the ISO website.

Introduction

International Standards are widely adopted at the regional or national level and applied by manufacturers, trade organizations, purchasers, consumers, testing laboratories, authorities and other interested parties. Since these documents generally reflect the best experience of industry, researchers, consumers and regulators worldwide and cover common needs in a variety of countries, they constitute one of the important bases for the removal of technical barriers to trade. However, full adoption may not be practicable in all cases for reasons, such as regional or national security, protection of human health or safety, or protection of the environment, or because of fundamental climatic, geographical or technological problems. As a consequence, the corresponding technical deviations to ISO standards are permitted where required by national or regional legislation or industry convention when adopting an International Standard.

Where such national deviations are required, it is important that they are clearly identified and the reasons for the deviations stated. Depending of on the method of adoption of the International Standard, the deviations will be noted in the national introduction, in the preface or foreword (for small numbers) or as a national annex (for large numbers). See ISO/IEC Guide 21-1 for more information.

ISO/TC 71/SC 1 has identified those items in this document that may be the subject of national or regional deviations. The items are indicated in the text by the phrase "…except where the national annex to this document requires…".

Testing of concrete —

Part 2:
Properties of fresh concrete

Caution — When cement is mixed with water, alkali is released. When sampling, prevent skin contact with wet cement or concrete by wearing suitable protective clothing (gloves, footwear, safety glasses). If wet cement or concrete enters the eye, immediately wash it out thoroughly with clean water and seek medical treatment without delay. Wash wet concrete off the skin immediately.

Caution — The use of vibrating equipment, such as vibration tables, can cause damage to joints and loss of sensation due to nerve damage. Moulds, density containers, etc. should be clamped to the table and not held in position using one's hands while they are being vibrated.

1 Scope

This document specifies procedures for testing fresh concrete. It specifies the following test methods: determination of consistence (slump test, Vebe test, degree of compactability, flow-table test for high-fluidity concrete, and the slump-flow test), determination of fresh density and determination of air content by the pressure-gauge method and by the water-column method.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1101, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 1920-1, *Testing of concrete — Part 1: Sampling of fresh concrete*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
fresh density
mass of a quantity of fully compacted fresh concrete divided by its volume

Note 1 to entry: The fresh density is expressed in kilograms per cubic metre.

4 Determination of consistence

4.1 General

The consistence of the concrete is determined by one of the methods described below:

— slump test (see 4.3);

— Vebe test (see 4.4);

— degree of compactability (see 4.5);

— flow-table test (see 4.6);

— slump-flow test for high-fluidity concrete (see 4.7).

These methods are not applicable to foamed concrete, no-fines concrete, or where the maximum aggregate size exceeds 40 mm.

4.2 Sampling

Samples for the tests shall be obtained in accordance with ISO 1920-1. Each sample shall be remixed before carrying out the tests.

4.3 Slump test

4.3.1 Principle

The fresh concrete is compacted into a mould in the shape of a frustum of a cone. When the cone is withdrawn upwards, the distance the concrete has slumped provides a measure of the consistence of the concrete.

The slump test is applicable to a range of consistence of concrete that corresponds to slumps of between 10 mm and 210 mm. Outside this range, the measurement of slump may be unsuitable and other methods of determining the consistence should be considered.

If the slump continues to change over a period of 1 min after remoulding, this test is not suitable.

NOTE For high-fluidity concrete, the slump-flow test described in 4.7 is a more appropriate test.

4.3.2 Apparatus

Note the calibration requirements associated with each apparatus.

4.3.2.1 Mould, suitable of forming the test specimen, made of a metal not readily attacked by cement paste and not thinner than 1,5 mm.

The mould may be made either with or without a seam. The interior of the mould shall be smooth and free from projections such as protruding rivets and shall be free from dents. The mould shall be in the form of hollow frustum of a cone and shall have the following internal dimensions:

— diameter of base: 200 mm ± 2 mm;

— diameter of top: 100 mm ± 2 mm;

— height: 300 mm ± 2 mm.

The base and the top shall be open and parallel to each other and at right angles to the axis of the cone. The mould shall be provided, on the upper portion, with two handles at two-thirds of the height, and at the bottom with fixing clamps or foot pieces to hold it steady. A mould that can be clamped to the base

is acceptable, provided the clamping arrangement can be fully released without movement of the mould or interference with the slumping concrete.

The mould shall be visually checked prior to each use to assure that it is clean and is not damaged or dented. The cone shall be checked annually to ensure that its dimensions and conditions remain within tolerances.

4.3.2.2 Tamping rod, straight, made of steel, having a circular cross-section with a diameter of 16 mm ± 1 mm, 600 mm ± 5 mm in length, and with rounded ends. The rod may be extended with a handle of plastic conduit, provided that the overall length does not exceed 1 000 mm.

The tamping rod shall be checked annually to ensure that its dimensions and conditions remain within tolerances.

4.3.2.3 Funnel (optional), made of a non-absorbent material not readily attacked by cement paste.

The funnel shall consist of two co-axial conical frustums having a common diameter of 100 mm, the ends being of greater diameter, one frustum to act as a filling funnel and the other as a collar to enable the funnel to be located on the outer surface of the mould.

The funnel shall be checked annually to ensure that its dimensions and conditions remain within tolerances.

4.3.2.4 Rule, graduated from 0 mm to 300 mm, at intervals not exceeding 5 mm, with the zero point being at the extreme end of the rule.

4.3.2.5 Base plate/surface, rigid, flat, non-absorbent and smooth plate or other surface on which to place the mould.

4.3.2.6 Shovel, with a square blade.

4.3.2.7 Remixing tray, of rigid construction and made from a non-absorbent material not readily attacked by cement paste.

It shall be of appropriate dimensions such that the concrete can be thoroughly remixed, using the square-bladed shovel.

4.3.2.8 Scoop, with a width of approximately 100 mm.

4.3.2.9 Timer or other similar **timing device**, to allow time measurement to 1 s.

The watch shall be properly calibrated at the time of test.

4.3.2.10 Moist cloth.

4.3.3 Procedure

Dampen the mould and the base plate. Wipe any excessive water from the surfaces, using an absorbent cloth. Place the mould on the horizontal base plate/surface. During filling, clamp or hold the mould firmly in place by standing on the two foot pieces.

Immediately after obtaining the sample in accordance with 4.2, fill the mould in three layers, each approximately one-third of the height of the mould when compacted. When adding the concrete, ensure that it is distributed symmetrically around the mould. Tamp each layer with 25 strokes of the tamping rod. Uniformly distribute the strokes over the cross-section of each layer. For the bottom layer, this will necessitate inclining the rod slightly and positioning approximately half the strokes spirally toward the centre. Tamp the second layer and the top layer each throughout its depth, so that the strokes just

penetrate into the underlying layer. In filling and tamping the top layer, heap the concrete above the mould before tamping is started.

When the specified tamping procedure could cause segregation of the sample, the number of tamping strokes may be reduced to an extent that segregation can be avoided.

If the tamping operation of the top layer results in subsidence of the concrete below the top edge of the mould, add more concrete to keep an excess above the top of the mould at all times. Also ensure that the addition of concrete to the top layer does not provide extra compaction of the concrete. After the top layer has been tamped, scrape off the surface of the concrete level with the top of the mould by means of a sawing and rolling motion of the tamping rod.

Remove spilled concrete from the base plate/surface. Remove the mould in 3,5 s ± 1,5 s by a steady upward lift with no lateral or torsional motion being imparted to the concrete. The lifting time may be shortened when required by the national annex.

The entire operation from the start of the filling to the removal of the mould shall be carried out without interruption and shall be completed within 180 s.

Immediately after removal of the mould, determine the slump, *h*, by measuring the difference between the height of the mould and that of the highest point of the slumped test sample (see Figure 1), except where the national annex to this document requires the measurement of the difference between the height of the mould and the centre point or the average height of the slumped concrete. Measure to the nearest 10 mm, except where the national annex to this document requires the measurement to the nearest 5 mm.

4.3.4 Test result

The test is valid only if it yields a true slump, this being a slump in which the concrete remains substantially intact and symmetrical as shown in Figure 2 a). If a specimen shears, as shown in Figure 2 b), take another sample and repeat the procedure.

Record the true slump, *h*, as shown in Figure 1 to the nearest 10 mm, or 5 mm when required by the national annex.

If two consecutive tests show a portion of the concrete shearing off from the mass of the test specimen, report the test as being invalid as the concrete lacks the necessary plasticity and cohesiveness for the slump test to be suitable.

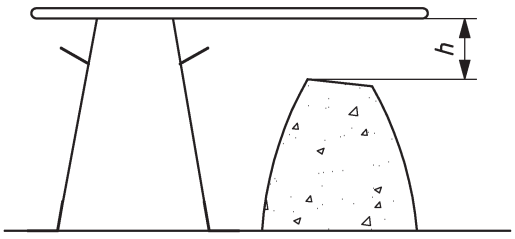
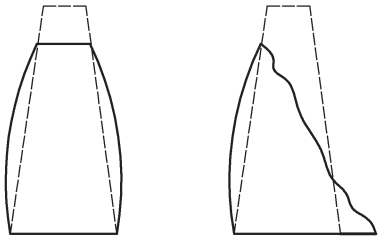


Figure 1 — Slump measurement



a) True slump **b) Shear**

Figure 2 — Forms of slump

4.3.5 Test report

In addition to the information required in Clause 7, the test report shall include the following:

a) the slump, measured to a nearest 10 mm (or 5 mm when required by the national annex), and its measuring point: highest, centre or average, if there is a true slump, or;

b) a notation that the test gave a sheared slump;

c) identification of specimen;

d) time and date of testing.

4.4 Vebe test

4.4.1 Principle

The fresh concrete is compacted into a slump mould. The mould is lifted clear of the concrete and a transparent disc is swung over the top of the concrete and carefully lowered until it comes in contact with the concrete. The slump of the concrete is recorded. The vibrating table is started and the time taken for the lower surface of the transparent disc to be fully in contact with concrete is measured.

If the Vebe time is less than 5 s or more than 30 s, the use of this test method to determine consistence may be unsuitable and other methods should be considered for this purpose.

4.4.2 Apparatus

Note the calibration requirements associated with each apparatus.

4.4.2.1 Consistometer (Vebe meter), consisting of the following items and as shown in Figure 3:

a) **container** (Figure 3, item 1), cylindrical in shape, having an internal diameter of 240 mm ± 5 mm and a height of 200 mm ± 2 mm, and made of a metal not readily attacked by cement paste. The thickness of the wall shall be 3 mm and that of the base, 7,5 mm.

The container shall be watertight and of sufficient rigidity to retain its shape under rough usage. It shall be fitted with handles and protected from corrosion. The container shall be provided with suitable foot pieces to enable it to be securely clamped to the top of the vibrating table (Figure 3, item 7) by means of wing nuts (Figure 3, item 8).

b) **mould** (Figure 3, item 2), as described in 4.3.2.1, except that the fixing clamps or foot pieces are not required.

The mould shall be visually checked prior to each use to assure that it is clean and is not damaged or dented.

c) **disc** (Figure 3, item 3), transparent, horizontal, attached to a rod (Figure 3, item 9) that slides vertically through a guide sleeve (Figure 3, item 5) mounted on a swivel arm (Figure 3, item 13) and which can be fixed in position by a screw (Figure 3, item 15).

The swivel arm also supports a funnel (Figure 3, item 4), the bottom of which coincides with the top of the conical mould when the latter is positioned concentrically in the container. The swivel arm is located by a holder (Figure 3, item 12) and can be fixed in position by a set-screw (Figure 3, item 6). When in the appropriate position, the axes of the rod and of the funnel shall be coincident with the axis of the container.

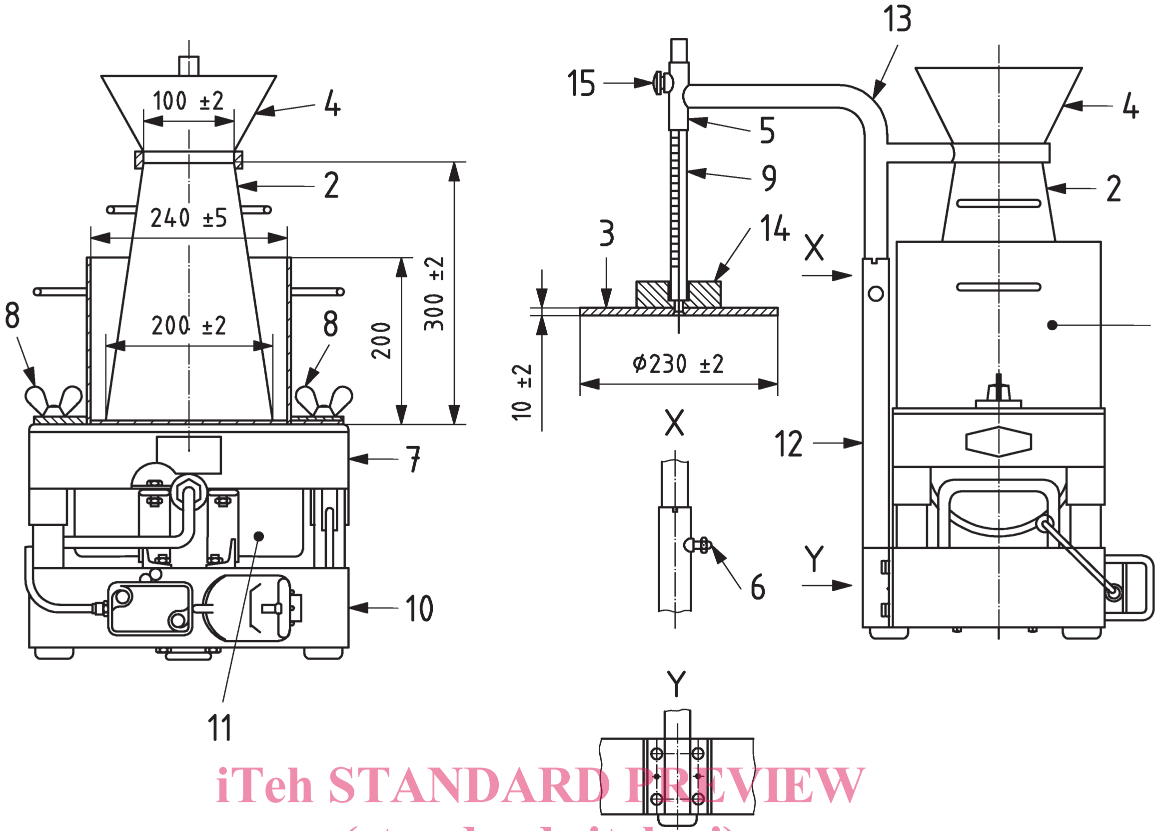
The transparent disc shall be 230 mm ± 2 mm in diameter and 10 mm ± 2 mm in thickness. A weight (Figure 3, item 14) placed directly above the disc shall be provided such that the moving assembly consisting of the rod, the disc and the weight has a mass of 2 750g ± 50 g. The rod shall be provided with a scale graduated to at least 5 mm intervals to record the slump of the concrete.

d) **vibrating table** (Figure 3, item 7), 380 mm ± 3 mm in length and 260 mm ± 3 mm in width, supported on four rubber shock absorbers.

A vibrator unit (Figure 3, item 11), carried on a base (Figure 3, item 10) resting on three rubber feet, shall be securely fixed beneath it. The vibrator shall operate at a frequency of 55 Hz ± 5,5 Hz and the vertical amplitude of the vibration of the table with the empty container on top of it shall be approximately 0,5 mm ± 0,02 mm.

The vibrating table shall be checked annually to ensure that the frequency and vertical amplitude remain within tolerances.

All the elements of the vibration table shall be checked annually to ensure that their dimensions remain within tolerances.



Key

1 container
2 mould
3 transparent disc
4 funnel
5 guide sleeve
6 set-screw
7 vibrating table
8 wing nuts
9 rod
10 base for vibrator
11 vibrator unit
12 holder
13 swivel arm
14 weight
15 screw

Figure 3 — Consistometer (Vebe meter)

4.4.2.2 Tamping rod, straight, made of steel or other suitable metal, of circular cross-section, having a diameter of 16 mm ± 1 mm, 600 mm ± 5 mm in length, and with rounded ends.

4.4.2.3 Stopwatch or clock, capable of recording time to an accuracy of 0,5 s.

4.4.2.4 Remixing container, of rigid construction, made from a non-absorbent material not readily attacked by cement paste.

4.4.2.5 Scoop, with a width of approximately 100 mm.

4.4.2.6 Moist cloth.

4.4.3 Procedure

Place the Vebe meter (consistometer) on a rigid horizontal base free from extraneous vibration and shock. Make sure that the container (Figure 3, item 1) is firmly fixed to the vibrating table (Figure 3, item 7) by means of the wing nuts (Figure 3, item 8). Dampen the mould (Figure 3, item 2) and place it in the container. Swing the funnel (Figure 3, item 4) into position over the mould and lower the funnel on the mould. Tighten the screw (Figure 3, item 6) so that the mould cannot rise from the bottom of the container.

During the subsequent operations, ensure that the mould (Figure 3, item 2) does not rise or move until it is raised and do not allow any concrete to fall into the container (Figure 3, item 1).

From the sample of concrete obtained in accordance with 4.2, immediately fill the mould in three layers, each approximately one-third of the height of the mould when compacted. Tamp each layer with 25 strokes of the tamping rod. Uniformly distribute the strokes over the cross-section of each layer. For the bottom layer, this will necessitate inclining the rod slightly and positioning approximately half the strokes spirally toward the centre. Tamp the second layer and the top layer each throughout its depth, so that the strokes just penetrate into the underlying layer. In filling and tamping the top layer, heap the concrete above the mould before tamping is started.

If necessary, add further concrete to maintain an excess above the top of the mould throughout the tamping operation. After the top layer has been tamped, loosen the screw (Figure 3, item 6), raise and swing the funnel (Figure 3, item 4) through 90° and tighten the screw (Figure 3, item 6).

Scrape off the concrete level with the top of the mould with a sawing and rolling motion of the tamping rod. Remove the mould (Figure 3, item 2) from the concrete by raising it carefully in a vertical direction, using the handles. The operation of raising the mould shall be performed in 2 s to 5 s by a steady upward lift with no lateral or torsional motion being imparted to the concrete.

If the concrete shears [as shown in Figure 4 b)], collapses [as shown in Figure 4 c)], or slumps to the extent that it touches the wall of the container (Figure 3, item 1), this information shall be recorded.

If the concrete has not slumped into contact with the wall of the container (Figure 3, item 1) and a true slump, as shown in Figure 4 a) has been obtained, the fact shall be recorded.

Swing the transparent disc (Figure 3, item 3) over the top of the concrete, tighten the screw (Figure 3, item 6), loosen the screw (Figure 3, item 15) and very carefully lower the disc until it just comes in contact with the concrete.

When the disc (Figure 3, item 3) just touches the highest point of the concrete without disturbing it, tighten the screw (Figure 3, item 15). When there is a true slump, the value of the slump shall be read from the scale (Figure 3, item 9) and the value recorded.

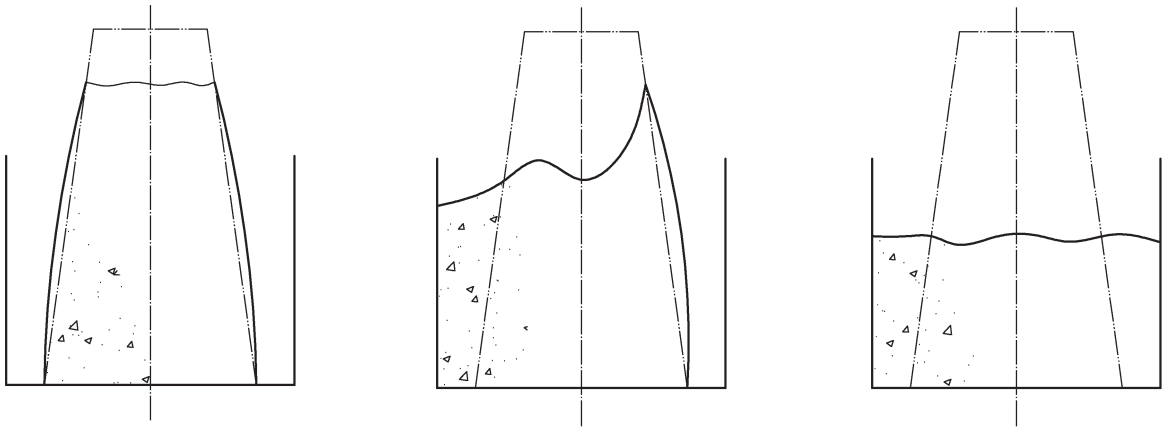
The screw (Figure 3, item 15) shall be loosened to allow the disc (Figure 3, item 3) to follow the concrete as it settles under the subsequent vibration. Simultaneously, start the vibration of the table and the timer. Observe through the transparent disc (Figure 3, item 3) how the concrete is being remoulded. As soon as the lower surface of the disc is fully in contact with cement grout, stop the timer and switch off the vibrating table. Record the time taken to the nearest second.

Complete the procedure within a period of 5 min from the start of filling.

The consistence of a concrete mix changes with time due to hydration of the cement and, possibly, loss of moisture. Tests on different samples should, therefore, be carried out at a constant time interval after mixing if strictly comparable results are to be obtained.

4.4.4 Test result

Record the time read from the stopwatch to the nearest second. This is the Vebe time expressing the consistence of the concrete under test.



a) True slump b) Shear c) Collapse

Figure 4 — Forms of slump

4.4.5 Test report

In addition to the information required in Clause 7, the test report shall include the following:

a) type of slump: true slump/collapse/shear;

b) when there is a true slump, the measured slump, to nearest 10 mm;

c) time from completion of mixing of the concrete until the time of removal of the mould;

d) vebe time, in seconds;

e) identification of specimen;

f) time and date of testing.

4.5 Degree of compactability test

4.5.1 Principle

The fresh concrete is carefully placed with a trowel in a container avoiding any compaction while filling. When the container is full, the top surface is scraped off level with the top of the container. The concrete is compacted and the distance from the surface of the compacted concrete to the upper edge of the container is used to determine the degree of compactability.

If the degree of compactability is less than 1,04 or more than 1,46, the concrete has a consistence for which the degree of compactability test is not suitable.

4.5.2 Apparatus

4.5.2.1 Container, with parallel sides and a general shape as shown in Figure 6, made of metal not readily attacked by cement paste and having the following internal dimensions:

— base: 200 mm ± 2 mm × 200 mm ± 2 mm;

— height: 400 mm ± 2 mm;

— the thickness of the base and walls shall be at least 1,5 mm.