

Building lime

Part 2. Test methods

The European Standard EN 459-2 : 1994 has the status of a British Standard

UDC 691.51 : 666.92 : 620.1

Cooperating organizations

The European Committee for Standardization (CEN), under whose supervision this European Standard was prepared, comprises the national standards organizations of the following countries:

Austria	Oesterreichisches Normungsinstitut
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United Kingdom	British Standards Institution

This British Standard, having been prepared under the direction of Technical Committee B/516, was published under the authority of the Standards Board and comes into effect on 15 March 1995

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National foreword

This British Standard has been prepared under the direction of Technical Committee B/516, Cement and lime. It is the English language version of EN 459-2 : 1994 *Building lime — Part 2: Test methods* published by the European Committee for Standardization (CEN) and was prepared by Technical Committee CEN/TC 51 'Cement and building limes'. EN 459-2 was approved on 1994-11-24 and under the CEN rules has to be implemented as a British Standard and conflicting test methods in BS 890 and BS 6463 withdrawn. The UK gave a positive vote to the final draft.

The tests described in this standard are required by the European Prestandard specification for building limes, ENV 459-1, published as DD ENV 459-1. However, the existing British Standard specification for building limes, BS 890, is permitted to continue for at least the next three years until the European Prestandard achieves full European Standard (EN) status. CEN rules require that when a European Standard which contains test methods is published any conflicting test methods given in national standards are to be withdrawn. In order to meet this requirement, BS 890 is being revised to enable the test methods given in BS EN 459-2 to be used. Until this revision is published, BS 890 : 1972 and its associated test methods will continue to be the definitive British Standard specification for building lime in the UK.

In those cases where BS EN 459-2 does not provide tests for properties which have in the past been of value to manufacturers and users, they may be found in BS 6463, or in BS 890 where indicated, as follows.

a) Chemical methods:

- 1) total silica;
- 2) soluble silica (BS 890);
- 3) iron (III) oxide;
- 4) alumina;
- 5) manganese dioxide;
- 6) copper;
- 7) fluoride;
- 8) matter insoluble in acetic acid;
- 9) acetic acid soluble heavy metals;
- 10) acetic acid soluble barium;
- 11) water soluble salts;
- 12) neutralization value;
- 13) residue insoluble in sucrose.

b) Physical methods:

- 1) residue on slaking;
- 2) preparation of lime putty of standard consistence;
- 3) particle size of hydrated lime by air jet sieving;
- 4) particle density;
- 5) surface area by air permeability;
- 6) workability of lime putty;
- 7) separation of water from lime putty on standing.

NOTE. BS 890 and BS 6463 are in course of revision.

Technical Committee CEN/TC 51 endeavoured to harmonize, where possible, the test methods adopted for building limes and those for masonry cements. This has been largely achieved as far as test equipment is concerned but differences in the materials being tested have resulted in differences in the test procedures adopted.

BS EN 459-2 includes the following methods which are not included in BS 890 or BS 6463:

- setting times;
- preparation of standard mortar;
- penetration into mortar;
- water retention of mortar;
- air content of mortar.

Where BS 6463 and BS EN 459-2 include tests for the same property, some methods are generally similar but others differ significantly as follows:

i) generally similar:

- lime plus magnesia content;
- magnesia content;
- available lime;
- SO₃ content;
- soundness (BS 6463);
- free water content.

ii) significantly different:

- carbon dioxide content;
- loss on ignition;
- strength;
- fineness by sieving;
- soundness (BS 890);
- bulk density;
- yield.

BS 6463 includes a number of updated methods of test for limes which were, however, never called up by BS 890 : 1972. These methods are compared with those in BS 890 and with those that now supersede them in BS EN 459-2 in table NA.1 of annex NA. The tests remaining in BS 6463, after those conflicting with BS EN 459-2 have been deleted, are being consolidated into a new edition.

DD ENV 459-1 defines in **3.15** hydraulic limes prepared in two different ways. When it is required to determine whether a product described as a natural hydraulic lime contains Portland cement, the method described in national annex NB should be used.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

ICS 91.100.10

Descriptors: Construction materials, lime, tests, chemical analysis, physical tests, compressive strength, stability, setting time, determination of content, elastic limit

English version

Building lime — Part 2: Test methods

Chaux de construction —
Partie 2: Méthodes d'essai

Baukalk —
Teil 2: Prüfverfahren

This European Standard was approved by CEN on 1994-11-24. 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.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists 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 Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 51, Cement and building limes, the secretariat of which is held by IBN.

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 by May 1995, and conflicting national standards shall be withdrawn at the latest by May 1995.

The European Standard EN 459 for building lime consists of the following parts:

Part 1. *Definitions, specifications and conformity criteria*

Part 2. *Test methods*

The existing standards from the EN 196 series were used as a basis for EN 459-2. However, because of the chemical and physical properties of building limes, other test methods than those used for cement and masonry cement are necessary and have been incorporated into this European Standard.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

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0 Introduction

For the European Standard for building lime EN 459-2 the objective has been to adopt as many European standardized methods as possible and where this has not been possible to use other appropriate proven methods.

Unless otherwise stated, tolerances are in accordance with ISO 2768-1.

All measurements are in millimetres.

1 Scope

This European Standard describes the test methods for all building limes covered by ENV 459-1.

This European Standard describes reference test methods and in some cases alternative test methods. In the event of a dispute, only the reference method is used.

If methods other than the following are used it is necessary to show that they give results equivalent to those given by the reference methods.

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 196-1 : 1994	<i>Methods of testing cement — Part 1: Determination of strength</i>
EN 196-2	<i>Methods of testing cement — Part 2: Chemical analysis of cement</i>
EN 196-3 : 1994	<i>Methods of testing cement — Part 3: Determination of setting time and soundness</i>
EN 196-6 : 1989	<i>Methods of testing cement — Part 6: Determination of fineness</i>
EN 196-7	<i>Methods of testing cement — Part 7: Methods of taking and preparing samples of cement</i>
EN 196-21 : 1989	<i>Methods of testing cement — Part 21: Determination of the chloride, carbon dioxide and alkali content of cement</i>

ENV 459-1 : 1994	<i>Building lime — Part 1: Definitions, specifications and conformity criteria</i>
EN 932-1 ¹⁾	<i>Tests for general properties of aggregates — Part 1: Methods for sampling</i>
EN 10003-1 ¹⁾	<i>Metallic materials, hardness test, Brinell — Part 1: Test methods</i>
EN 10088-2 ¹⁾	<i>Stainless steel — Part 2: Technical delivery conditions for sheet/plate and strip for general purposes</i>
ISO 383 : 1976	<i>Laboratory glassware — Interchangeable conical ground joints</i>
ISO 2768-1 : 1989	<i>ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits</i>
ASTM C 230-83	<i>Standard specification for flow table for use in tests of hydraulic cement</i>

3 Sampling

3.1 General

Sampling shall be carried out in accordance with the requirements of EN 196-7 amended as in 3.1 to 3.4 for application to building limes.

EN 196-7 deals exclusively with the sampling of powdered materials. All powdered limes shall be sampled in accordance with the procedures given in EN 196-7 taking into account the need to minimize moisture and carbon dioxide absorption. The homogenization efficiency shall be verified by the CaO content.

3.2 Sampling of powdered material

The spot sample size shall be (20 ± 5) kg. Before carrying out chemical analyses, the sample shall be reduced in mass by means of a sample divider and/or by quartering to produce a sub-sample of 1 kg. Any coarse material in this sample shall be reduced in size to finer than 0,3 mm before chemical analysis is carried out.

3.3 Sampling of granular material

The spot sample size shall be (20 ± 5) kg. Sample granular material in accordance with the procedures given in EN 932-1¹⁾ for aggregates, again taking care to avoid moisture and carbon dioxide absorption.

Crush and grind the sample and reduce its mass to produce a 1 kg sub-sample of material finer than 0,3 mm where the sample is to be used for chemical analysis.

¹⁾At present at the draft stage.

3.4 Sampling lime putties

The spot sample size shall be $(10 \pm 5) \text{ dm}^3$.

Where lime putties are sampled, the increments shall be blended thoroughly by using an electric stirrer of adequate capacity.

4 Chemical analysis

4.1 General

For analysis, use reagents of analytical grade and distilled water or deionized water.

4.2 Calcium and magnesium oxide (CaO + MgO)

Determine the (CaO + MgO) content using the method given in EN 196-2.

4.3 Magnesium oxide (MgO)

Determine the (MgO) content using the method given in EN 196-2.

4.4 Carbon dioxide (CO₂)

4.4.1 Selection of method

Determine the (CO₂) content using the reference method given in EN 196-21 as a reference method. An alternative (volumetric) method may be used as described in 4.4.2.

4.4.2 Volumetric determination of carbon dioxide (alternative method)

4.4.2.1 Principle

The carbon dioxide contained in the lime in the form of carbonates is given off by reaction with hydrochloric acid and determined volumetrically.

4.4.2.2 Apparatus

The apparatus is shown in figure 1.

4.4.2.3 Reagents

- a) *Copper sulfate*, CuSO₄.
- b) *Concentrated hydrochloric acid*, HCl ($\rho = 1,18 \text{ to } 1,19 \text{ g/cm}^3$).
- c) *Dilute hydrochloric acid*, 1 + 1 (1 part of concentrated hydrochloric acid and 1 part of water by volume).
- d) *Methyl red solution*, dissolve 0,2 g of methyl red in water and make up to 100 ml.
- e) *Sealing liquid*, Add 20 g of sodium sulfate and 5 ml of concentrated sulfuric acid to distilled water and make up to 100 ml and colour with a few drops of methyl red solution. The sealing liquid shall be saturated with CO₂.
- f) *Potassium hydroxide solution*, containing 50 % of mass of KOH.
- g) *Calcium carbonate*, CaCO₃ dried to constant mass at 250 °C.

4.4.2.4 Procedure

The mass of the cement sample used depends on the expected CO₂ content and shall be chosen approximately as follows:

- 2 g for $0 \% \leq \text{CO}_2 \leq 2 \%$;
- 1 g for $2 \% < \text{CO}_2 \leq 5 \%$;
- 0,5 g for $5 \% < \text{CO}_2 \leq 10 \%$;
- 0,3 g for $10 \% < \text{CO}_2 \leq 15 \%$;
- 0,1 g for $40 \% \leq \text{CO}_2 \leq 50 \%$.

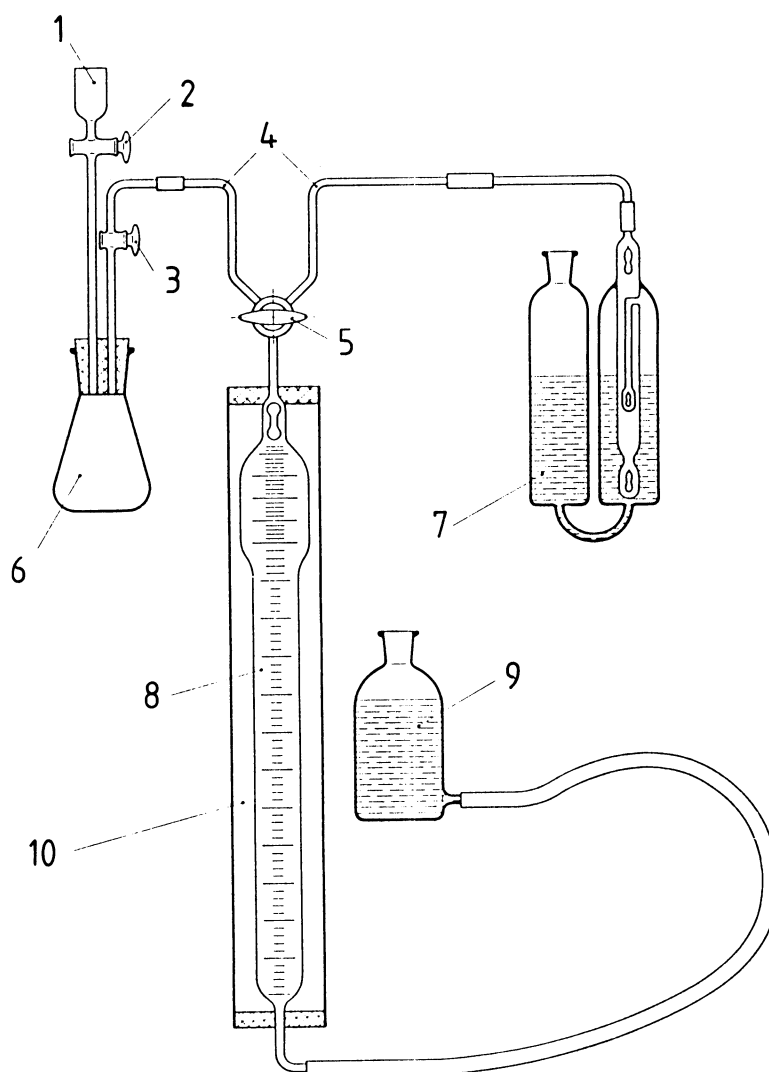
Weigh out the sample accurately to 0,1 mg into the decomposition flask, add a spatula-tip of copper sulfate to bond any hydrogen sulfide formed and suspend in a little water.

Connect the flask to the apparatus with the aid of the double-bored stopper. A funnel and the feed tube to the measuring burette pass through the stopper. Open the stopcocks in these two lines. Bring the three-way tap to the position such that it connects the flask and measuring burette with one another. Fill the burette with sealing liquid up to the three-way tap by raising the levelling bottle. Now close stopcock 1 and fill the funnel with dilute hydrochloric acid (1 + 1). Add dilute hydrochloric acid (1 + 1) to the flask through the dropping funnel until the flask is half full. Stopcock 1 being closed, a little acid remains as sealing liquid in the funnel.

Allow the mixture to react for a few minutes in the cold and then heat it to the boiling point and boil for about another 3 min. Fill the flask completely with dilute hydrochloric acid (1 + 1) up to stopcock 2 with the aid of the dropping funnel in order to transfer the remaining gas mixture into the burette. Take care that no dilute hydrochloric acid also flows over. Close the burette with the three-way tap. After about 5 min, bring the sealing liquid in the burette and in the levelling bottle to the same level and read off the gas volume V_1 .

Turn the three-way tap to connect the measuring burette with the absorption vessel and wash out the air/CO₂ mixture collected. For this, raise the levelling bottle so that all the gas is forced through the potassium hydroxide solution in the absorption vessel. The CO₂ is thereby absorbed. Repeat the absorption operation about seven or eight times until, finally, the measuring burette contains only the residual gas. Close the three-way tap, bring the sealing liquid in the burette and in the levelling vessel to the same level and read off the volume V_2 .

The difference in volume ($V_1 - V_2$) corresponds to the carbon dioxide content of the sample.



- 1 Dropping funnel
- 2 Stopcock 1
- 3 Stopcock 2
- 4 Capillary tubes
- 5 Three-way tap
- 6 Decomposition flask with a volume of 50 ml
- 7 Absorption vessel containing potassium hydroxide solution
- 8 Burette
- 9 Levelling vessel with sealing liquid
- 10 Jacketed tube filled with water

Figure 1. Kleine apparatus for determination of carbon dioxide

4.4.2.5 Evaluation

Calculate the carbon dioxide content as the content by mass of CO₂, in percent, from the equation:

$$C = 0,053 F_1 \frac{(V_1 - V_2) \times P}{T \times m_1} \quad (1)$$

where

- C is the carbon dioxide content by mass, in percent;
- F_1 is the correction factor in accordance with 4.4.2.6;
- V_1 is the volume of the gas before absorption, in millilitres;
- V_2 is the volume of the gas after absorption, in millilitres;
- P is the corrected barometer reading, in pascals $\times 100$;
- T is the measurement temperature, in kelvins;
- m_1 is the mass of the sample, in grams.

If the calibration and determination are carried out directly after one another, the temperature and atmospheric pressure need not be taken into consideration. For this case, equation (1) is simplified to:

$$C = \frac{4,397 (V_1 - V_2) \text{ of measurement}}{(V_3 - V_4) \text{ of calibration} \times m_1} \quad (2)$$

if 0,100 g of CaCO₃ is weighed out for the calibration.

4.4.2.6 Calibration of the apparatus

Weigh 0,1000 g of calcium carbonate, dried to constant mass at 250 °C, to an accuracy of 0,1 mg into the decomposition flask. Carry out the determination as described in 4.4.2.4.

The volume difference ($V_3 - V_4$) corresponds to the carbon dioxide content of the calibration material. Calculate the correction factor F_1 of the absorption apparatus from the following relationship, obtained by rearranging equation (1):

$$F_1 = \frac{82,96 \times T}{(V_3 - V_4) \times P} \quad (3)$$

The meanings of the symbols correspond to those given in 4.4.2.5.

The factor shall be in the range 1,00 to 1,04, otherwise the apparatus is to be checked for tightness and proper functioning and the calibration repeated.

4.5 Loss on ignition

Determine the loss on ignition using the method given in EN 196-2.

4.6 Sulfate (SO₃)

Determine the sulfate content using the method given in EN 196-2. Express the result as the content by mass of SO₃ in percent.

4.7 Available lime

4.7.1 General

Use the method given in 4.7.2 for air lime and the method given in 4.7.3 for hydraulic lime.

4.7.2 Determination of available lime content of air limes

4.7.2.1 Principle

The available (unbound) lime (calcium oxide and calcium hydroxide) is dissolved in a solution of sucrose and titrated with hydrochloric acid, phenolphthalein being used as an indicator.

To avoid the gravelling of highly reactive limes ($t_u < 2$ min, according to 5.10.5) on slaking which could lead to incomplete dissolution of the available lime, such limes should be wetted with 1 ml of methanol before suspension.

4.7.2.2 Reagents

- a) *Water*.
- b) *Sucrose*, refined sugar, commercially available.
- c) *Methanol*, CH₃OH.
- d) *Hydrochloric acid*, 1 mol/l (standard solution).
- e) *Phenolphthalein indicator*. Dissolve 0,5 g of phenolphthalein in 50 ml of ethanol and dilute to 100 ml with water.

4.7.2.3 Procedure

Place 50 ml of water in a 300 ml conical flask. Transfer 1 g of a lime sample weighed to an accuracy of 0,001 g to the flask and swirl to suspend. Add 10 g of sucrose, stopper the flask and keep the suspension in motion for 12 min to 15 min (magnetic stirrer, vibrating table or similar apparatus). Then filter through two fine filter papers. Wash the flask with six 25 ml portions of cold water and titrate the filtrate or an aliquot part with the hydrochloric acid using phenolphthalein as indicator.

4.7.2.4 Expression of results

Calculate the available lime content from the equation:

$$K_a = \frac{2,804 V_5}{m_2} \quad (4)$$

where

- K_a is the available lime content by mass, in percent;
- V_5 is the volume of HCl used, in millilitres;
- m_2 is the mass of the sample, in grams.

4.7.3 Determination of available lime content of hydraulic lime

4.7.3.1 Principle

The available (unbound) lime (calcium oxide and calcium hydroxide) is extracted by means of ethyl-acetoacetate and the extract titrated with hydrochloric acid, bromophenol blue being used as an indicator.

4.7.3.2 Reagents

- Ethyl-acetoacetate*, $\text{CH}_3\text{COCH}_2\text{COOC}_2\text{H}_5$, for synthesis.
- 2-propanol*, $(\text{CH}_3)_2\text{CHOH}$;
- Concentrated hydrochloric acid*, HCl , see 4.4.2.3 b).
- Dilute hydrochloric acid*, 0,1 mol/l (standard solution).
- Sodium hydroxide on support*, NaOH , for elementary analysis.
- Ethanol*, $\text{C}_2\text{H}_5\text{OH}$.
- Bromophenol blue indicator*, tetrabromophenol sulfonphthalein.
- Bromophenol blue solution*. Dissolve 0,1 g bromophenol blue in ethanol and make up the solution to 100 ml with the same.
- 1-butanol*, 2-methyl-1-propanol.

4.7.3.3 Procedure

Place 12 ml ethyl-acetoacetate and 80 ml 1-butanol in a 250 ml Erlenmeyer flask with a joint conforming to ISO 383 : 1976, nominal diameter of the joint 29,2 mm, length 32 mm. Add approximately 1 g of the sample, dried out of contact with the air (vacuum-drying oven) at $(105 \pm 5)^\circ\text{C}$, ground to analytical fineness and weighed to the nearest 0,1 mg, to the mixture and shake. Bring the mixture to the boil while stirring (e.g. with a magnetic stirrer) and then reflux. The lower end of the reflux condenser is fitted with a joint conforming to ISO 383 : 1976, nominal diameter of the joint 29,2 mm, length 32 mm, while a tube made of sodium hydroxide on a support at its upper end provides protection against carbon dioxide penetrating from the air.

Stop the extraction after 15 min. Cool the extract briefly and siphon it off into a 250 ml suction bottle through a glass filter funnel when lukewarm. Insert a filter paper for slow filtration speed (approximate pore size $2,0\ \mu\text{m}$ to $2,2\ \mu\text{m}$) and a filter paper for a medium filtration speed (approximate pore size $6,5\ \mu\text{m}$) into the filter funnel. (Do not cut the filter paper by hand.) Moisten the filters with the ethyl-acetoacetate prior to filtration. If the filtrate is cloudy, carry out a second filtration with the same filter combination. Wash the flask and residue with a maximum of 50 ml 2-propanol. It is not necessary to transfer the last remnants of the residue to the filter funnel.

Add 3 to 4 drops of bromophenol blue solution to the filtrate and titrate with the 0,1 mol/l hydrochloric acid until the colour changes to yellow.

4.7.3.4 Expression of results

Calculate the available lime content from the equation:

$$K_a = 2,804 \times \frac{V_6 \times F_2}{m_3} \quad (5)$$

where

- K_a is the available lime content by mass, in percent;
 V_6 is the volume of HCl used, in millilitres;
 F_2 is the factor of the dilute hydrochloric acid;
 m_3 is the mass of the sample, in grams.

5 Physical tests

5.1 Compressive strength

5.1.1 General

Determine the compressive strength in accordance with EN 196-1, 'hydraulic lime' being substituted where 'cement' is mentioned.

However, the modifications given in 5.1.2 shall apply.

5.1.2 Modifications to EN 196-1

5.1.2.1 Composition of mortar

A water/binder ratio of 0,50, as specified in EN 196-1, shall apply only to Hydraulic Limes 5 (HL 5).

For HL 2 and HL 3,5 the water/binder ratio shall be 0,55 (each batch for three specimens to be prepared using (248 ± 1) g water).

Hydraulic limes with bulk densities not more than $0,60\ \text{kg/dm}^3$, which are to be tested for compressive strength, shall be mixed with a water/binder ratio of 0,60 (each batch for three specimens to be prepared using (270 ± 1) g water).

5.1.2.2 Compaction of specimens

Compaction by means of the vibrating table shall be the reference method (5.1.2.2.1).

The method specified in EN 196-1 (jolting apparatus) is an alternative method.

Other alternative methods of compaction may be used provided that the absolute difference between the mean values of the 28 day compressive strength (based on at least ten test results) does not exceed $1,5\ \text{N/mm}^2$ in parallel tests with three different Hydraulic Limes HL 5.

5.1.2.2.1 Vibrating table

The vibrating table (see figure 2) shall conform to the following requirements:

- a) method of operation: magnetic vibrator;
- b) type of oscillation: sinusoidal;
- c) nominal frequency: 50 Hz;
- d) oscillating mass (including empty moulds): $(35 \pm 0,1)$ kg;
- e) oscillating plate: the working surface shall be ground to give an even surface. Minimum size $(B \times T)$ 400 mm $\times$ 300 mm consisting of either:
 - a single layer of austenitic stainless steel³⁾, (minimum thickness 10 mm); or
 - a double layer of metal (minimum thickness 20 mm), the top layer made of austenitic stainless steel³⁾ with a minimum thickness of 1 mm being bonded permanently to the bottom layer by means of a frictional and interlocking connection.
- f) holder for moulds: fixing attachment suitable for moulds 40 mm $\times$ 40 mm $\times$ 160 mm including the mounted hopper;
- g) mass of table: ≥ 100 kg.

With the aid of the adjusting screws attached to its lower surface, the vibrating table shall be set up in such a way that the working surface of the oscillating plate deviates from the horizontal plane by not more than 1 mm/m.

The oscillating plate shall produce uniaxial vertical vibrations only. The peak-to-peak amplitude measured at the centre separating walls and the outer corners of the empty mould shall be $(0,75 \pm 0,10)$ mm. The amplitude shall be continuously displayed.

The table shall be equipped with guides or similar devices to hold the mould in the centre of the working surface.

It shall be possible to secure the mould and the hopper mounted on it firmly in position by means of a fixing attachment.

The duration of vibration shall be set to the nearest second with an automatic timer.

5.1.2.2.2 Compaction procedure

Cast the specimens immediately after the preparation of the mortar.

Compact the mortar on the vibrating table.

The mould shall be mounted firmly on the vibrating table. After the vibrator has been switched on, fill the compartments of the mould with two layers of mortar within a maximum of 45 s, proceeding as follows.

Working from right to left, place the first layer of mortar into the compartments of the mould within 15 s so that the compartments are approximately half-full.

After an interval of 15 s, during which the vibrator remains switched on, place the second layer in the mould within the following 15 s, again working from right to left. Use the total amount of mortar specified in 5.1.2.1. The vibrator shall switch off automatically after (120 ± 1) s.

Lift the mould off the vibrating table as gently as possible and remove the hopper. Remove the excess mortar immediately afterwards using a straightedge (EN 196-1 : 1994, figure 3) held almost vertically and moved slowly with a transverse sawing motion (EN 196-1 : 1994, figure 2) once in each direction. Smooth the surface of the specimen using the same straightedge held almost level.

5.1.2.3 Storage of specimens after demoulding

Store the demoulded specimens in a large cabinet (conforming to 4.1 of EN 196-1 : 1994) maintained continuously at a temperature of (20 ± 1) °C and a relative humidity of not less than 90 %, observing the tolerances in respect of time specified in EN 196-1 : 1994, until such time as the compressive strength test is carried out.

5.1.2.4 Rate of increase in compressive load

Increase the compressive load at a rate of (400 ± 40) N/s.

5.1.2.5 Reproducibility

Reproducibility is expressed as the standard deviation (s_R) of the results of the determination of compressive strength obtained by different well-experienced laboratories and may be expected to be

s_R at 7 d: $0,5 \text{ N/mm}^2$

s_R at 28 d: $1,0 \text{ N/mm}^2$

NOTE.

s_R at 7 d - Standard deviation of the results of the determination of compressive strength obtained by different competent laboratories for 7 day old specimens.

s_R at 28 d - Standard deviation of the results of the determination of compressive strength obtained by different competent laboratories for 28 day old specimens.

³⁾ E.g. steel type X 8 CrNiS 18-9 (1.4503) according to EN 10088-2 (see footnote 1).