

# Personal eye-protection — Ultraviolet filters — Transmittance requirements and recommended use

The European Standard EN 170:2002 has the status of a  
British Standard

ICS 13.340.20

# National foreword

This British Standard is the official English language version of EN 170:2002. It supersedes BS EN 170:1992 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PH/2, Eye protection, to Subcommittee PH/2/4, Welding, ultraviolet and infrared filters, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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English version

## Personal eye-protection - Ultraviolet filters - Transmittance requirements and recommended use

Protection individuelle de l'oeil - Filtres pour l'ultraviolet -  
Exigences relatives au facteur de transmission et utilisation  
recommandée

Persönlicher Augenschutz - Ultraviolettschutzfilter -  
Transmissionsanforderungen und empfohlene Anwendung

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## Foreword

This document (EN 170:2002) has been prepared by Technical Committee CEN /TC 85, "Eye-protective equipment", the secretariat of which is held by AFNOR.

**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of an identical text or by endorsement, at the latest by April 2003, and conflicting national standards shall be withdrawn at the latest by April 2003.

This document supersedes EN 170:1992.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this document.

In this European Standard, Annex A is normative and Annexes B and C are informative.

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

## 1 Scope

This European Standard specifies the scale numbers and transmittance requirements for filters for protection against ultraviolet radiation.

The other applicable requirements for these types of filters and the frames/mountings to which they are intended to be fitted are given in EN 166.

Guidance on the selection and use of these filters are given in annex B.

**NOTE** The protective filters specified in this standard are not suitable for the direct viewing of bright light sources like Xenon high-pressure arc lamps or for the direct or indirect observation of an electric welding arc. For this purpose a welding filter as specified in EN 169 and with a scale number appropriate to the source being observed should be 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 (including amendments).

EN 165:1995, *Personal eye-protection – Vocabulary*.

EN 166, *Personal eye-protection – Specifications*.

EN 167, *Personal eye-protection – Optical test methods*.

ISO/CIE 10526:1999, *CIE Standard illuminants for colorimetry*.

ISO/CIE 10527:1991, *CIE Standard colorimetric observers*.

## 3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 165:1995 apply.

## 4 Designation and identification

The complete table of numbering of filters is given in EN 166.

The marking of oculars and frame is described in EN 166.

The scale number of ultraviolet filters comprises the code number 2 and the shade number corresponding to the filter, from 1,2 to 5 (see Table 1).

## 5 Requirements

### 5.1 General

The requirements of EN 166 apply to ultraviolet filters. Only those requirements that are different from or supplement the EN 166 specifications are given in this European standard.

### 5.2 Transmittance requirements

The definitions of transmittances are given in EN 165.

The determination of luminous transmittance is described in EN 167.

The transmittance requirements for filters used for protection against ultraviolet radiation are given in Table 1.

**Table 1 – Transmittance requirements**

Scale number	Maximum spectral transmittance in the ultraviolet $\tau(\lambda)$		Luminous transmittance $\tau_v$		Transmittance in the infrared spectral range
	313 nm %	365 nm %	maximum %	minimum %	
2-1,2	0,0003	10	100	74,4	no specification
2-1,4	0,0003	9	74,4	58,1	
2-1,7	0,0003	7	58,1	43,2	
2-2	0,0003	5	43,2	29,1	
2-2,5	0,0003	3	29,1	17,8	
2-3	0,0003	2	17,8	8,5	
2-4	0,0003	0,8	8,5	3,2	
2-5	0,0003	0,3	3,2	1,2	

Minimum and maximum values of luminous transmittance may be exceeded by taking into account the limits of relative uncertainty given in EN 167.

Additional requirements:

- a) for  $210 \text{ nm} \leq \lambda \leq 313 \text{ nm}$  the spectral transmittance shall not exceed the value specified for 313 nm;
- b) for  $313 \text{ nm} < \lambda \leq 365 \text{ nm}$  the spectral transmittance shall not exceed the value specified for 365 nm;
- c) for  $365 \text{ nm} < \lambda \leq 405 \text{ nm}$  the spectral transmittance shall not exceed the luminous transmittance;

NOTE Luminous transmittance values are based on the spectral distribution of CIE illuminant A and on the CIE (1931) standard observer ( $2^\circ$ ) (see ISO/CIE 10526:1999 and ISO/CIE 10527:1991).

### 5.3 Ocular with enhanced colour recognition (optional)

Between 500 nm and 650 nm the spectral transmittance shall be not less than 0,2  $\tau_v$ .

The relative visual attenuation quotient  $Q$ , for signal lights red, yellow, green and blue shall be not less than 0,8.

## Annex A (normative)

### Relative visual attenuation quotient for signal light recognition

#### A.1 Definition of relative visual attenuation quotient for signal light recognition

This quotient  $Q$  is defined as:

$$Q = \frac{\tau_{sign}}{\tau_v}$$

where

$\tau_v$  is the luminous transmittance of the filter for CIE standard illuminant D 65. See ISO/CIE 10526:1999

$\tau_{sign}$  is the luminous transmittance of the filter for the spectral power distribution of the traffic signal light.

These are given by the equations:

$$\tau_v = \frac{\int_{380 \text{ nm}}^{780 \text{ nm}} \tau_F(\lambda) \cdot V(\lambda) \cdot S_{D65\lambda}(\lambda) \cdot d\lambda}{\int_{380 \text{ nm}}^{780 \text{ nm}} V(\lambda) \cdot S_{D65\lambda}(\lambda) \cdot d\lambda}$$

$$\tau_{sign} = \frac{\int_{380 \text{ nm}}^{780 \text{ nm}} \tau_F(\lambda) \cdot \tau_s(\lambda) \cdot V(\lambda) \cdot S_{A\lambda}(\lambda) \cdot d\lambda}{\int_{380 \text{ nm}}^{780 \text{ nm}} \tau_s(\lambda) \cdot V(\lambda) \cdot S_{A\lambda}(\lambda) \cdot d\lambda}$$

where

$S_{A\lambda}(\lambda)$  is the spectral distribution of radiation of CIE standard illuminant A (or 3200 K light source for blue signal light). See: ISO/CIE 10526:1999

$S_{D65\lambda}(\lambda)$  is the spectral distribution of radiation of CIE standard illuminant D65. See ISO/CIE 10526:1999

$V(\lambda)$  is the spectral luminous efficiency for daylight vision. See ISO/CIE 10 527:1991

$\tau_S(\lambda)$  is the spectral transmittance of the traffic signal lens;

$\tau_F(\lambda)$  is the spectral transmittance of the filter.

The spectral values of the products of the spectral distributions ( $S_{A\lambda}(\lambda)$ ,  $S_{D65\lambda}(\lambda)$ ), of the illuminants, the spectral luminous efficiency  $V(\lambda)$  of the eye and the spectral transmittance  $\tau(\lambda)$  of the traffic signal lenses are given in A.2.



## A.2 Spectral functions for the calculation of luminous transmittance and relative visual attenuation quotients

**Table A.1 :Product of the spectral distribution of radiation of the signal lights and standard illuminant D65 as specified in ISO/CIE 10526:1999 and the spectral luminous efficiency of the average human eye for daylight vision as specified in ISO/CIE 10527:1991**

Wavelength $\lambda$ nm	$S_A(\lambda) V(\lambda) \tau_S(\lambda)$				$S_{D65}(\lambda) V(\lambda)$
	red	yellow	green	blue <sup>a</sup>	
380	0	0	0	0,0001	0
390	0	0	0	0,0008	0,0005
400	0	0	0,0014	0,0042	0,0031
410	0	0	0,0047	0,0194	0,0104
420	0	0	0,0171	0,0887	0,0354
430	0	0	0,0569	0,3528	0,0952
440	0	0	0,1284	0,8671	0,2283
450	0	0	0,2522	1,5961	0,4207
460	0	0	0,4852	2,6380	0,6688
470	0	0	0,9021	4,0405	0,9894
480	0	0	1,6718	5,9025	1,5245
490	0	0	2,9976	7,8862	2,1415
500	0	0	5,3553	10,1566	3,3438
510	0	0	9,0832	13,0560	5,1311
520	0	0,1817	13,0180	12,8363	7,0412
530	0	0,9515	14,9085	9,6637	8,7851
540	0	3,2794	14,7624	7,2061	9,4248
550	0	7,5187	12,4687	5,7806	9,7922
560	0	10,7342	9,4061	3,2543	9,4156
570	0	12,0536	6,3281	1,3975	8,6754
580	0,4289	12,2634	3,8967	0,8489	7,8870
590	6,6289	11,6601	2,1640	1,0155	6,3540
600	18,2382	10,5217	1,1276	1,0020	5,3740
610	20,3826	8,9654	0,6194	0,6396	4,2648
620	17,6544	7,2549	0,2965	0,3253	3,1619
630	13,2919	5,3532	0,0481	0,3358	2,0889
640	9,3843	3,7352	0	0,9695	1,3861
650	6,0698	2,4064	0	2,2454	0,8100
660	3,6464	1,4418	0	1,3599	0,4629
670	2,0058	0,7892	0	0,6308	0,2492
680	1,1149	0,4376	0	1,2166	0,1260
690	0,5590	0,2191	0	1,1493	0,0541
700	0,2902	0,1137	0	0,7120	0,0278
710	0,1533	0,0601	0	0,3918	0,0148
720	0,0742	0,0290	0	0,2055	0,0058
730	0,0386	0,0152	0	0,1049	0,0033
740	0,0232	0,0089	0	0,0516	0,0014
750	0,0077	0,0030	0	0,0254	0,0006
760	0,0045	0,0017	0	0,0129	0,0004
770	0,0022	0,0009	0	0,0065	0
780	0,0010	0,0004	0	0,0033	0
Sum	100	100	100	100	100

<sup>a</sup> For blue flashing light the spectral distribution for 3200 K is used instead of standard illuminant A.

## **Annex B** (informative)

### **Guidance on selection and use**

**B.1** For the personal protection of the operator the filter must be mounted in a suitable eye protector. Eye protector types are described in EN 166.

**B.2** For protection against ultraviolet radiation, filters should be selected from those classified in Table B.1. These filters can have a yellowish tinge which can modify colour perception.

**B.3** For processes in which colour recognition is important, the use of UV filters with enhanced colour recognition is recommended.

**B.4** Filters according to this standard are not suitable for direct viewing of bright light sources like Xenon high-pressure arc lamps or welding arcs. For this purpose welding filter according to EN 169 should be used.

**B.5** The guidelines given in Table B.1 (typical applications) are not applicable to persons with photophobia or to those under medical treatment that can increase the sensitivity of the eyes to optical radiation.

Table B.1 – Designation, properties and typical applications

Scale number	Colour perception	Typical applications	Typical sources <sup>a</sup>
2-1,2 2-1,4 2-1,7	May be impaired, unless marked 2C-shade	For use with sources which emit predominantly ultra violet radiation at wavelengths shorter than 313 nm and when glare is not an important factor. This covers the UVC and most of the UVB bands <sup>b</sup> .	Low-pressure mercury lamps such as lamps used to stimulate fluorescence or “black lights”, actinic lamps and germicidal lamps.
2-2 2-2,5			Medium pressure mercury lamps such as photochemical lamps.
2-3 2-4	May be impaired, unless marked 2C-shade	For use with sources which emit intense radiation in both the UV and visible spectral regions and therefore require the attenuation of visible radiation.	High-pressure mercury lamps and metal halide lamps such as sun lamps for solaria.
2-5			Pulsed lamp systems. High and very high-pressure mercury lamps such as sun lamps for solaria.
<sup>a</sup> The examples given are for general guidance.			
<sup>b</sup> The wavelengths of these bands are as recommended by CIE (that is, 280 nm to 315 nm for UVB and 100 nm to 280 nm for UVC).			

Annex C  
(informative)

Uncertainty of measurement and results interpretation

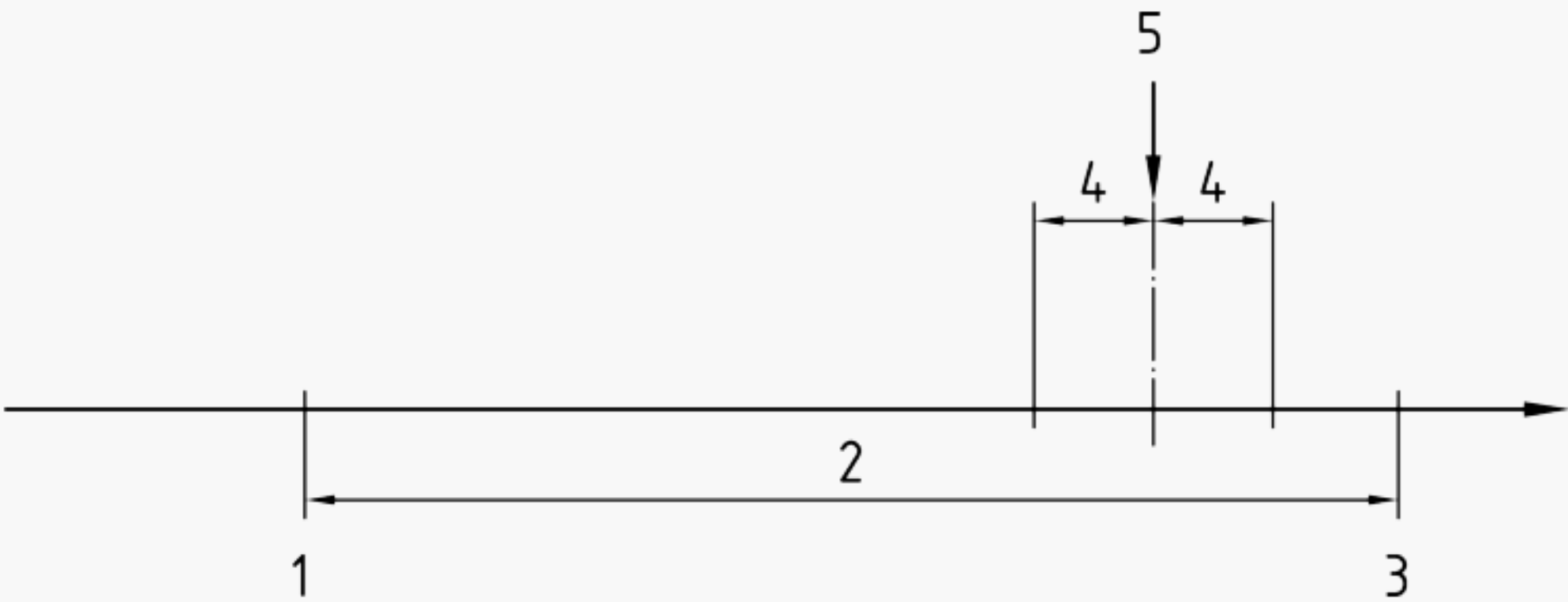
C.1 Test report and uncertainty of measurement

For each of the required measurements performed in accordance with this standard, a corresponding estimate of the uncertainty of measurement should be evaluated.

This estimate of uncertainty should be applied and stated when reporting test results, in order to enable the user of the test report to assess the reliability of the data.

The following protocol with regard to uncertainty of measurement should be applied to test results:

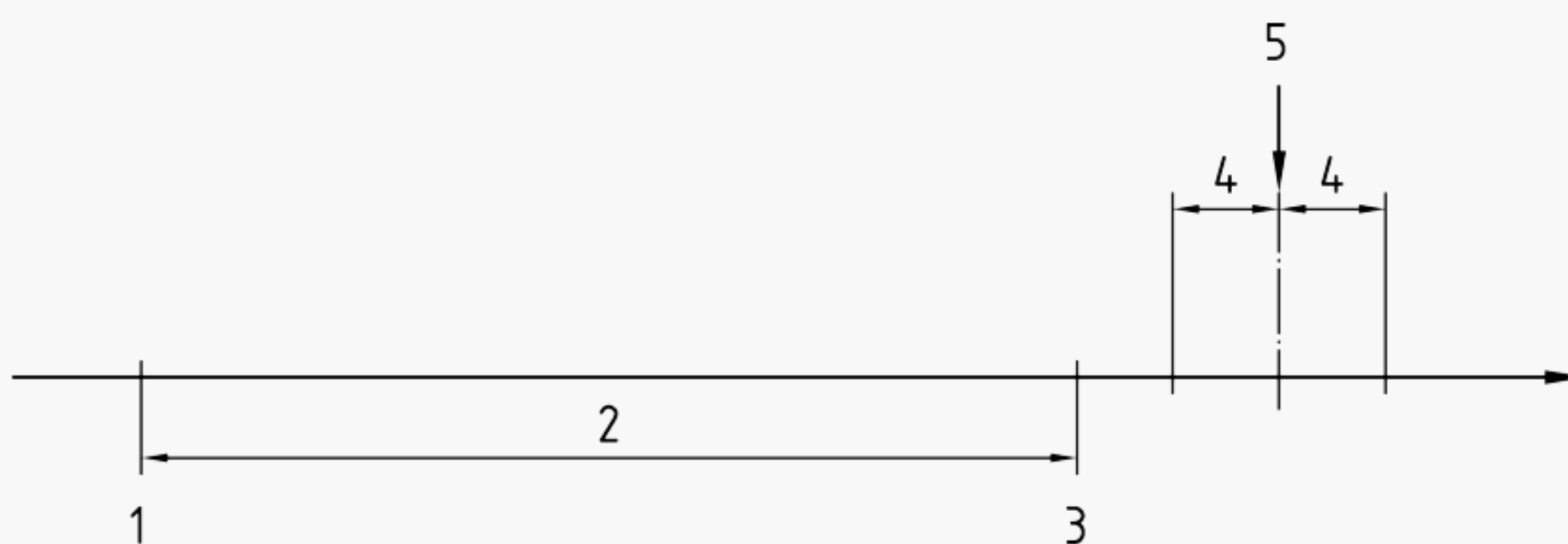
If the limit value for the particular test given in the standard, falls outside of the range of values calculated from the test data plus/minus the uncertainty  $U$  of measurement, then the result should be deemed to be a straightforward pass or fail (see Figures C.1 and C.2).



- Key
- 1 Lower specification limit (LSL)
  - 2 Specification zone
  - 3 Upper specification Limit (USL)
  - 4  $U$
  - 5 Result of a measurement

Figure C.1 — Result pass

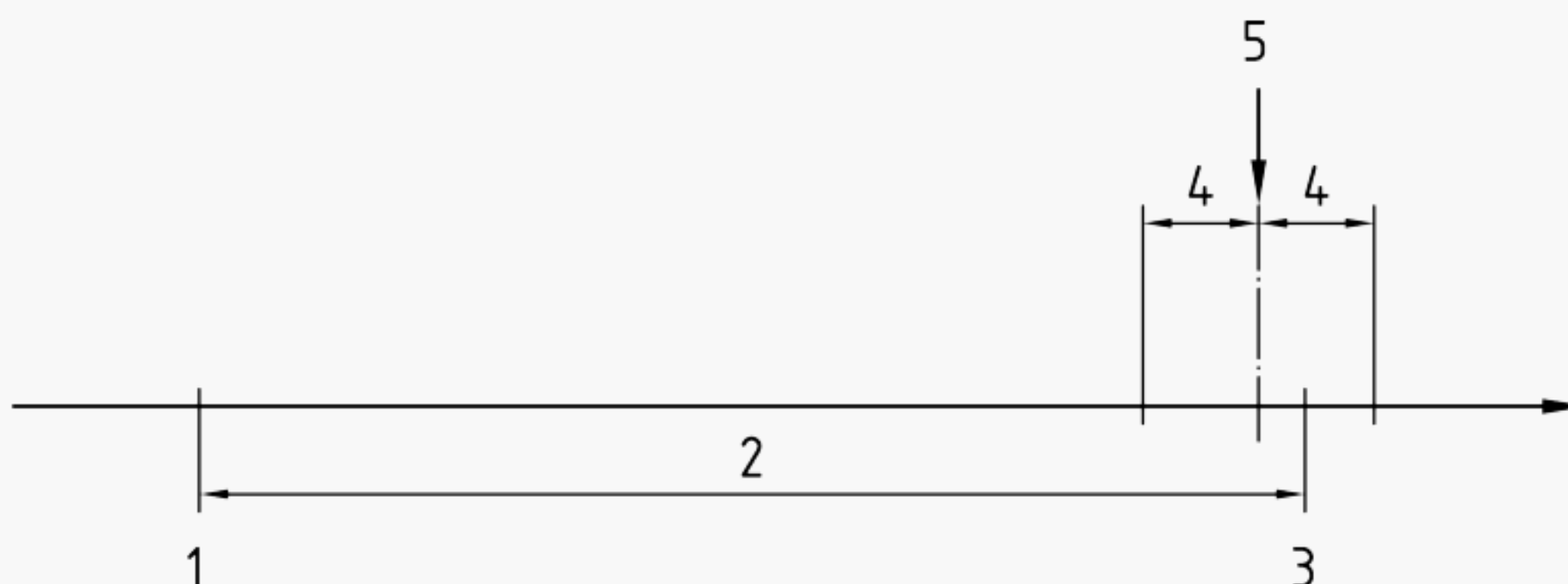


**Key**

- 1 Lower specification limit (LSL)
- 2 Specification zone
- 3 Upper specification Limit (USL)
- 4  $U$
- 5 Result of a measurement

**Figure C.2 — Result fail**

If the limit value for the particular test given in the standard, falls within the range of values calculated from the test data plus/minus the uncertainty  $U$  of measurement, then the assessment of pass or fail should be determined on the basis of safety, that is considering the safest conditions for the user of the PPE (see Figure C.3).

**Key**

- 1 Lower specification limit (LSL)
- 2 Specification zone
- 3 Upper specification Limit (USL)
- 4  $U$
- 5 Result of a measurement

**Figure C.3 — Result fail**

## Annex ZA (informative)

### Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive 89/686/EEC.

**WARNING:** Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

The following clauses of this standard are likely to support requirements of Directive 89/686/EEC, Annex II :

**Table ZA.1 - Relationship between this standard and Directive 89/686/EEC**

Directive 89/686/EEC, Annex II		Clauses
1.1.1	Ergonomics	Scope, annex B
1.1.2.1	Highest level of protection possible	5
1.1.2.2.	Classes of protection appropriate to different levels of risk	5, annex B
1.2	Innocuousness of PPE	
1.2.1	Absence of risks and other inherent nuisance factors	Scope
1.2.1.1	Suitable constituent materials	Scope
1.2.1.2	Satisfactory surface condition of all PPE parts in contact with the user	Scope
1.2.1.3	Maximum user impediment	Scope
1.3	Comfort and efficiency	
1.3.1	Adaptation to users morphology	Not relevant
1.3.2	Lightness and design strength	Scope
1.3.3	Compatibility of different classes or types of PPE designed for simultaneous use	Not relevant
1.4	Information supplied by the manufacturer	Scope
2.3	PPE for the face, eyes and respiratory tracts	5.2
2.4	PPE subject to ageing	Scope
2.12	PPE bearing one or more identification or recognition marks directly or indirectly relating to health and safety	4
3.9.1	Non-ionising radiation	5, annex B

Compliance with the clauses of this standard provides one means of conforming to the specific essential requirements of the Directive concerned and associated EFTA regulations.

## Bibliography

EN 169, *Personal eye-protection – Filters for welding and related techniques – Transmittance requirements and recommended use.*

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# Methods of test for mortar for masonry —

## Part 4: Determination of consistence of fresh mortar (by plunger penetration)

The European Standard EN 1015-4:1998 has the status of a  
British Standard

ICS 91.100.10

ICS 91.100.10

Descriptors: masonry work, mortars: materials, tests, penetration tests, determination, consistency

English version

## Methods of test for mortar for masonry — Part 4: Determination of consistence of fresh mortar (by plunger penetration)

Méthodes d'essai des mortiers pour maçonnerie —  
Partie 4: Détermination de la consistance des  
mortiers frais (par pénétration du piston)

Prüfverfahren für Mörtel für Mauerwerk —  
Teil 4: Bestimmung der Konsistenz von Frischmörtel  
(mit Eindringgerät)

This European Standard was approved by CEN on 4 September 1998.

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**

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**Central Secretariat: rue de Stassart 36, B-1050 Brussels**



Foreword

This European Standard has been prepared by Technical Committee CEN/TC 125, Masonry, the Secretariat of which is held by BSI.

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 April 1999, and conflicting national standards shall be withdrawn at the latest by September 2000.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and includes the performance requirements referred to in the Eurocode for masonry structures.

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

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## Introduction

Fresh mortar is brought to a defined level of consistence as measured using the plunger penetration rod prior to the assessment of those properties which are used to characterize it.

Consistence is a measure of the fluidity and/or wetness of the fresh mortar and gives a measure of the deformability of the fresh mortar when subjected to a certain type of stress. The consistence however is not directly associated with the manner in which the fresh mortar handles when used by a craftsman.

Normally there will be a linear correlation between the plunger penetration value, measured according to this test method, and the flow value measured in accordance with prEN 1015-3, for the same type of mortar with increasing water content, but the slope will differ with different types of mortars.

## 1 Scope

This European Standard specifies a method for determining the consistence of freshly mixed mortars (in the following briefly referred to as fresh mortars) including those containing mineral binders and both dense and lightweight aggregates, which is by means of the plunger penetration value.

## 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 1015-2, *Methods of test for mortar for masonry — Part 2: Bulk sampling of mortars and preparation of test mortars*.

## 3 Principle

The plunger penetration value of a defined sample of fresh mortar is measured by the vertical penetration of a defined plunger rod which has been allowed to fall freely through a given height into the fresh mortar sample.

## 4 Apparatus

**4.1 Plunger apparatus**, conforming to Figure 1, and consisting of the following parts:

*Plunger stand*, with the base plate (A), frame, clamp with guide bushes (B) and fixing screw (C).

*Cylindrical vessel*, (D) secured centrally in a positioning recess.

*Penetration rod*, (E) with an upper scale and having a plastics plunger (F) of circular cross-section at the base and with a hemispherical lower end of the same diameter. The total mass of the penetration rod and plunger is  $90 \text{ g} \pm 2 \text{ g}$ . The penetration rod is fixed in an initial position 100 mm above the mortar surface, measured from the lower, hemispherical end of the plunger.

**4.2 Tamper**, consisting of a rigid, non-absorptive rod of circular cross-section, approximately 40 mm in diameter and approximately 200 mm long. The tamping face is flat and at right angles to the length of the tamper. The mass of the tamper is  $0,250 \text{ kg} \pm 0,015 \text{ kg}$ .

**4.3 Trowel**.

**4.4 Palette knife**.

## 5 Sampling, preparation and storage of test samples

The fresh mortar for this test shall have a minimum volume of 1,5 l and shall be obtained by reduction of the bulk test sample (see EN 1015-2) using a sample divider or by quartering.

Ready to use mortars (factory-made wet mortars which are retarded), and pre-batched air-lime/sand wet mortars when not gauged with hydraulic binders, shall be tested within their specified workable life.

Mortars that are made from dry constituents and water shall be mixed in accordance with EN 1015-2 unless otherwise specified.

The length of mixing period shall be measured from the moment all the constituents are introduced into the mixer.

Before testing, the batch shall be gently stirred by hand using a trowel (4.3) or palette knife (4.4) in 5 to 10 seconds to counteract any false setting etc., but without any additional mixing of the batch.

Any deviation from the mixing procedure shall be noted.

Two test samples shall be tested.

## 6 Procedure

Using the fixing screw [4.1(C)], secure the penetration rod [4.1(E)] in its initial position. Wipe the plunger [4.1(F)] clean with a damp cloth and dry before use.

Fill the vessel [4.1(D)] with mortar in two layers, each layer being compacted by 10 short strokes of the tamper (4.2), to ensure uniform filling of the vessel. Skim off the excess mortar with a palette knife leaving the mortar surface plane and level with the top rim of the vessel. Do not trowel further.

Place the filled vessel on the base plate [4.1(A)] and release the fixing screw, allowing the plunger to fall freely, starting from its initial position.

Determine the penetration of the plunger into the mortar by reading the scale on the lower side of the upper guide bush [4.1(B)] to the nearest mm.

## 7 Calculation and expression of results

Calculate the mean value of the plunger penetration from the individual values for each mortar test sample, to the nearest mm. If the two individual values deviate from their mean value by less than 10 % use this mean value as the plunger penetration value of the mortar. If the two individual plunger penetration values deviate from their mean value by more than 10 %, repeat the test using further mortar from the reduced bulk test sample (see clause 5) and if the results deviate from their mean value by less than 10 % use the mean value from the repeat test as the plunger penetration value of the mortar. If the results differ by more than 10 % consider the measurements unsatisfactory and take fresh test samples from the bulk test sample or laboratory prepared mortar and repeat the test.

## 8 Test report

The test report shall include the following information:

- a) the number, title and date of issue of this European Standard;
- b) the place, date and time of taking the bulk test sample<sup>1)</sup>;
- NOTE This is the sample taken from the bulk supply that is to be used for all of the tests in EN 1015.
- c) the method used for taking the bulk test sample (if known) and the name of the organization that took it;
- d) the type, origin and designation of the mortar by reference to the relevant part of prEN 998;
- e) preparation (mixing, casting) and storage (curing) conditions;
- f) the date and time of preparing test samples for test (i.e. date and time of any mixing, casting, moulding, or demoulding procedure, if appropriate);
- g) the date and time of testing;
- h) test results (individual measurements and the plunger penetration values in mm for each test sample);
- i) remarks, if any.

<sup>1)</sup> This information is contained on the certificate of sampling (see EN 1015-2).

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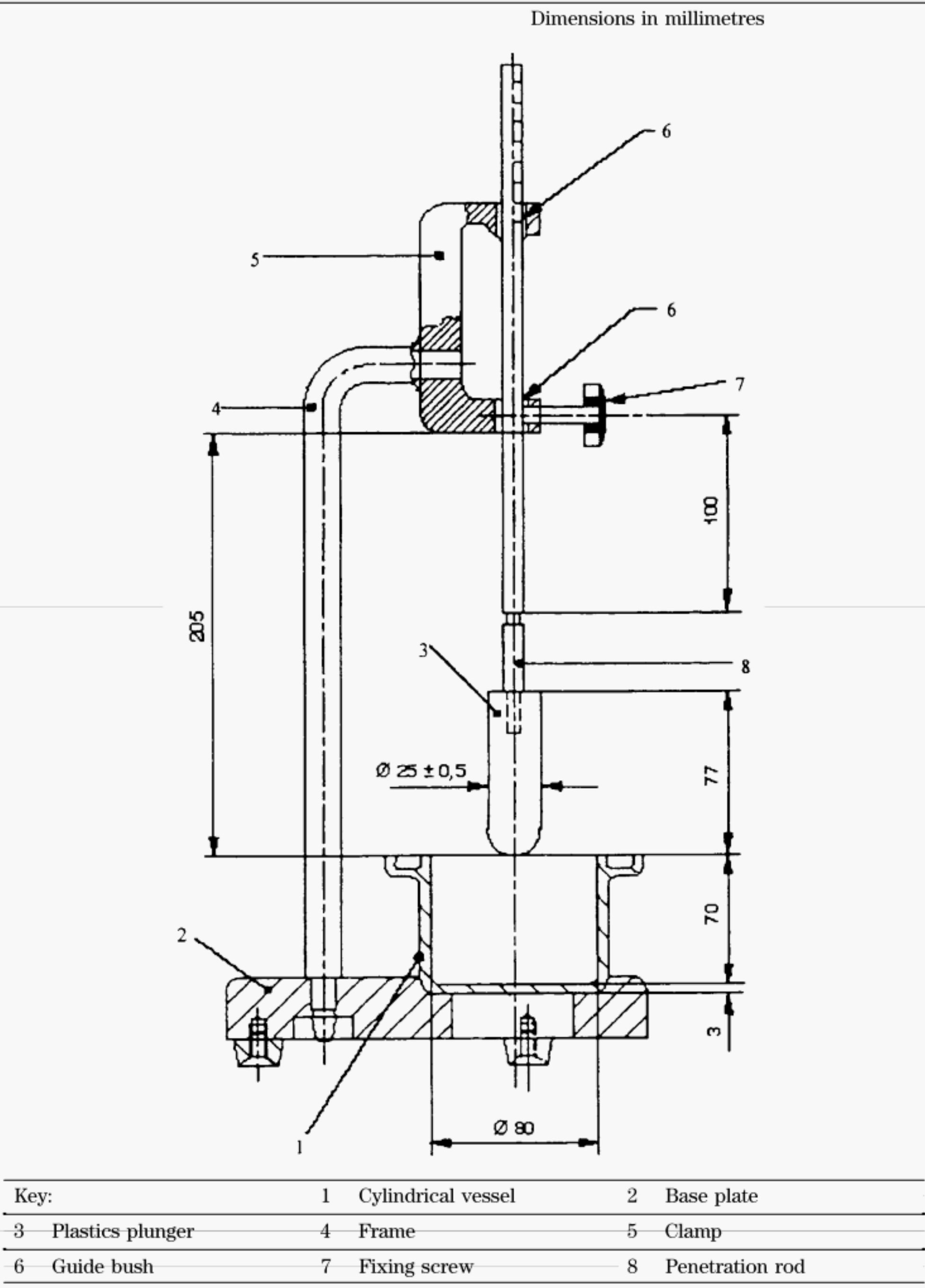


Figure 1 — Plunger test apparatus

Annex A (informative)

Bibliography

The following informative reference is made in this standard:  
prEN 1015-3, *Methods of test for mortar for masonry — Part 3: Determination of consistence of fresh mortar (by flow table)*.



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