BRITISH STANDARD

BS EN 169:2002

Personal eye-protection — Filters for welding and related techniques — Transmittance requirements and recommended use

The European Standard EN 169:2002 has the status of a British Standard

ICS 13.340.20

National foreword

This British Standard is the official English language version of EN 169:2002. It supersedes BS EN 169:1992 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PH/2, Eye protection, to Subcommittee PH/2/4, Welding, ultra violet 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;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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This British Standard, having been prepared under the direction of the Health and Environment Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 26 November 2002

Summary of pages

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Personal eye-protection - Filters for welding and related techniques - Transmittance requirements and recommended use

Protection individuelle de l'oeil - Filtres pour le soudage et les techniques connexes - Exigences relatives au facteur de transmission et utilisation recommandée

Persönlicher Augenschutz - Filter für das Schweißen und verwandte Techniken - Transmissionsanforderungen und empfohlene Anwendung

This European Standard was approved by CEN on 2 October 2002.

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 Management Centre 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 Management Centre has the same status as the official versions.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 169:2002) 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 May 2003, and conflicting national standards shall be withdrawn at the latest by May 2003.

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.

The annexes A and C are informative. Annex B is normative.

In the revision of this European Standard, and that of EN 379, which was performed concurrently, it was decided to remove from EN 379 welding filters with dual scale numbers and include them within this European Standard.

This document supersedes EN 169:1992.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to: 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 intended to protect operators performing work involving welding, braze-welding, air-arc gouging and plasma jet cutting. It also includes requirements for welding filters with dual scale numbers.

The other applicable requirements for these types of filters are given in EN 166. The requirements for the frames/mountings to which they are intended to be fitted are given in EN 175.

Guidance on the selection and use of these filters are given in Annex A.

The specifications for welding filters with switchable luminous transmittance are given in EN 379.

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, *Personal eye-protection – Vocabulary.*

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

EN 167:2001, *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 and the following apply.

3.1
welding filter with dual scale number
a protective filter with two different scale numbers (light and dark zones) which are divided into a maximum of three areas of the filter. The light zone is used for brief viewing when setting the electrode to the weld and igniting it. The dark zone is used for viewing the welding process

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 these filters comprises only the shade number corresponding to the filter, from 1,2 to 16 (see Table 1).

5 Requirements

5.1 General

The requirements of EN 166 apply to welding 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 in welding and related techniques are given in Table 1.

Table 1 – Transmittance requirements

Scale number	Maximum spectral transmittance in the ultraviolet $\tau(\lambda)$		Luminous transmittance τ_V		Maximum mean spectral transmittance in the infrared τ_A
	313 nm %	365 nm %	Maximum %	Minimum %	780 nm to 1 400 nm %
1,2	0,0003	50	100	74,4	69
1,4	0,0003	35	74,4	58,1	52
1,7	0,0003	22	58,1	43,2	40
2	0,0003	14	43,2	29,1	28
2,5	0,0003	6,4	29,1	17,8	15
3	0,0003	2,8	17,8	8,5	12
4	0,0003	0,95	8,5	3,2	6,4
5	0,0003	0,30	3,2	1,2	3,2
6	0,0003	0,10	1,2	0,44	1,7
7	0,0003	0,050	0,44	0,16	0,81
8	0,0003	0,025	0,16	0,061	0,43
9	0,0003	0,012	0,061	0,023	0,20
10	0,0003	0,006	0,023	0,0085	0,10
11	0,0003	0,0032	0,0085	0,0032	0,050
12	0,0003	0,0012	0,0032	0,0012	0,027
13	0,0003	0,00044	0,0012	0,00044	0,014
14	0,00016	0,00016	0,00044	0,00016	0,007
15	0,000061	0,000061	0,00016	0,000061	0,003
16	0,000023	0,000023	0,000061	0,000023	0,003

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 nm $\leq \lambda \leq$ 313 nm, the spectral transmittance shall not exceed the value permitted for 313 nm;

b) for 313 nm < $\lambda \leq$ 365 nm, the spectral transmittance shall not exceed the value permitted for 365 nm;

c) for 365 nm < $\lambda \leq$ 380 nm, the spectral transmittance shall not exceed the luminous transmittance τ_v;

d) for 380 nm < $\lambda \leq$ 480 nm, the spectral transmittance shall not exceed the value observed at 480 nm.

NOTE 1 Luminous transmittance values are based on the spectral distribution of illuminant A and on the CIE (1931) standard observer (2°) (see ISO/CIE 10526:1999 and ISO/CIE 10527:1991).

NOTE 2 The IR transmittance values are determined by integration of the spectral data.

5.3 Oculars with enhanced colour recognition (optional)

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

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

5.4 Oculars with enhanced reflectance in the infrared (optional)

Oculars which are claimed to have enhanced reflectance in the infrared shall have a mean spectral reflectance greater than 60 % within the wavelength range 780 nm to 2 000 nm when measured in accordance with EN 167:2001, clause 8.

5.5 Additional requirements for welding filters with dual scale number

5.5.1 Difference in scale number

The difference in scale number between the light and dark zones shall be no more than five.

5.5.2 Transmittance

5.5.2.1 The requirements of 5.5.2.2 and 5.5.2.3 shall be satisfied when the transmittances are measured in accordance with EN 167.

5.5.2.2 The minimum luminous transmittance in the light zone shall be 0,16 %.

5.5.2.3 The spectral transmittance in the ultraviolet and the mean transmittance in the infrared given in Table 1 and the additional requirements a) to d) in 5.2 required for the dark zone shall also apply to the light zone.

5.5.3 Dimensions

The dark zone shall be at least 25 mm vertical depth across the horizontal length.

Any region separating the light and dark zones shall not exceed 2 mm vertical depth across the horizontal length. This region shall provide at least the same protection against radiation as the dark zone.

Annex A
(informative)

Guidance on selection and use

A.1 General

For the personal protection of the operator the filter must be mounted in a suitable eye protector. Eye protector types are described in EN 175.

Many factors are involved in selecting the scale number of a protective filter which is suitable for welding or related techniques.

— **For gas welding and related techniques**, such as braze-welding, this European standard refers to the flow rate through the burners;

— **For arc welding, air-arc gouging, and plasma jet cutting**, the current is an essential factor in making an accurate choice possible.

In addition, for arc welding, the type of arc and the type of parent metal are also to be taken into consideration.

Other parameters have a significant influence, but it is difficult to evaluate their effect. These are, in particular:

— the position of the operator in relation to the flame or the arc. For example, depending on whether the operator leans over his work or adopts an arm's length position, a variation of at least one scale number can be necessary;

— local lighting;

— the human factor.

For these various reasons, this European Standard only gives those scale numbers which confirmed practical experience has shown to be valid in normal circumstances for the personal protection of operators with normal sight, carrying out work of a specified type.

The scale number of the filter to be used can be read from the tables, at the intersection of the column, corresponding to the gas flow rate or the current, and the line, specifying the work to be carried out.

The Tables A.1 to A.3 are valid for average working conditions, in which the distance from the welder's eye to the pool of molten metal is approximately 50 cm and the average illuminance is approximately 100 lx.

A.1.1 Scale numbers to be used for gas welding and braze welding

The scale numbers to be used for gas welding and braze welding are given in Table A.1.

Table A.1 – Scale numbers [a] to be used for gas welding and braze welding

Work	$q \leq 70$	$70 < q \leq 200$	$200 < q \leq 800$	$q > 800$
Welding and braze welding	4	5	6	7
NOTE q is the flow rate of acetylene, in litres per hour.				
[a] According to the conditions of use, the next greater or the next smaller scale number can be used.				

A.1.2 Scale numbers to be used for oxygen cutting

The scale numbers to be used for oxygen cutting following a line on the workpiece are given in Table A.2.

Table A.2 – Scale numbers [a] to be used for oxygen cutting

Work	$900 \leq q \leq 2000$	$2000 < q \leq 4000$	$4000 < q \leq 8000$
Oxygen cutting	5	6	7
NOTE q is the flow rate of oxygen, in litres per hour.			
[a] According to the conditions of use, the next greater or the next smaller scale number can be used.			

A.1.3 Scale numbers to be used for plasma jet cutting

The scale numbers to be used for plasma jet cutting following a line on the workpiece are given in Table A.3.

A.1.4 Scale numbers to be used for electric arc welding or air-arc gouging

The scale numbers to be used for electric arc welding or air-arc gouging are given in Table A.3.

The following abbreviations are used according to EN ISO 4063:

— covered electrode welding includes **MMA** (manual metal arc welding);

— the symbol **MAG** corresponds to metal arc welding with non-inert gas shield;

— the symbol **TIG** corresponds to tungsten inert gas;

— the symbol **MIG** corresponds to metal arc welding with inert gas shield;

— air-arc gouging corresponds to the use of a carbon electrode and a compressed air jet used to remove the molten metal).

Table A.3 – Recommended use of the different scale numbers for arc welding

Process	Current A																			
	1,5	6	10	15	30	40	60	70	100	125	150	175	200	225	250	300	350	400	450	500	600
Covered electrodes						8		9		10		11		12			13			14	
MAG							8		9		10		11		12			13			14
TIG			8			9		10		11			12			13					
MIG with heavy metals								9		10		11			12			13		14	
MIG with light alloys										10		11		12			13		14		
Air-arc gouging											10		11		12		13		14		15
Plasma jet cutting									9		10		11		12			13			
Micro- plasma arc welding		4		5		6		7		8		9		10		11		12			
	1,5	6	10	15	30	40	60	70	100	125	150	175	200	225	250	300	350	400	450	500	600

NOTE The term "heavy metals" applies to steels, alloy steels, copper and its alloys, etc.

A.1.5 Scale numbers of filters to be used by welders' assistants

It is necessary that welders' assistants and other persons in the region of welding operations be protected. Filters of scale number 1,2 to 4 should be used for this purpose. However, if the levels of risks require it, filters of higher scale numbers should be used. Especially when the welder's assistant would be at the same distance from the arc as the welder, both persons should use filters with the same scale numbers.

A.1.6 Filters with enhanced colour recognition

For welding processes in which colour recognition is important, the use of welding filters with enhanced colour recognition is recommended.

A.1.7 Filters with enhanced reflectance in the infrared

For welding processes, which generate considerable heat, the use of welding filters with enhanced reflectance in the infrared is recommended in order to increase the comfort of the wearer.

A.2 Remarks

A.2.1 For a scale number corresponding to the work conditions specified in Tables A.1, A.2 and A.3, the protection in the ultraviolet and infrared ranges is sufficient, Table 1 having been determined so that this should be the case. The use of a higher scale number would not necessarily provide better protection and would give in return disadvantages indicated in A.2.3.

A.2.2 If the use of filters selected from the tables produces a feeling of discomfort, the working environment and the eyesight of the operator should be examined.

A.2.3 It can be harmful to use filters with too high a scale number (too dark) as this would force the operator to move too close to the radiation source and to inhale harmful fumes.

A.2.4 For work carried out in the open air in strong natural light, it is possible to use a protective filter of one scale number higher.

Annex B
(normative)

Relative visual attenuation quotient for signal light recognition

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

This quotient Q is defined as:

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

where

τ_V is the luminous transmittance of the filter for CIE standard illuminant D 65 according to ISO/CIE 10526:1999

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

These are given by the equations:

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

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

where

$S_{\mathrm{A}\lambda}(\lambda)$ is the spectral distribution of radiation of CIE standard illuminant A (or 3 200 K light source for blue signal light). See: ISO/CIE 10526:1999

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

$V(\lambda)$ is the spectral luminous efficiency for daylight vision according to 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 ($S_{\mathrm{A}\lambda}(\lambda)$, $S_{\mathrm{D65}\lambda}(\lambda)$), of the illuminants, the spectral luminous efficiency $V(\lambda)$ of the eye and the spectral transmittance $\tau_S(\lambda)$ of the traffic signal lenses are given in clause B.2.

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

Table B.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 λ nm	$S_A(\lambda)\ V(\lambda)\ \tau_S(\lambda)$				$S_{D65}(\lambda)\ V(\lambda)$
	red	yellow	green	blue[a]	
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**

[a] For blue flashing light the spectral distribution for 3200 K is used instead of standard illuminant A.

Annex C
(informative)

Uncertainty of measurement and results interpretation

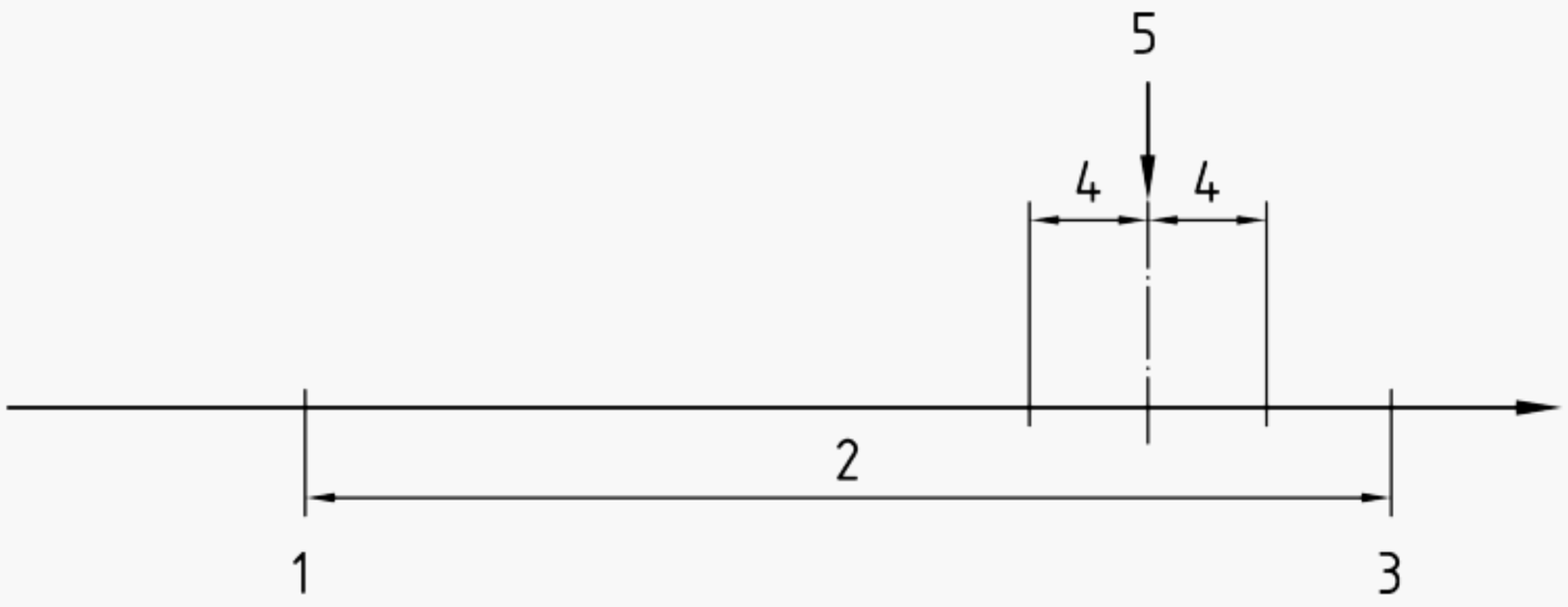
C.1 Test report and uncertainty of measurement

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:

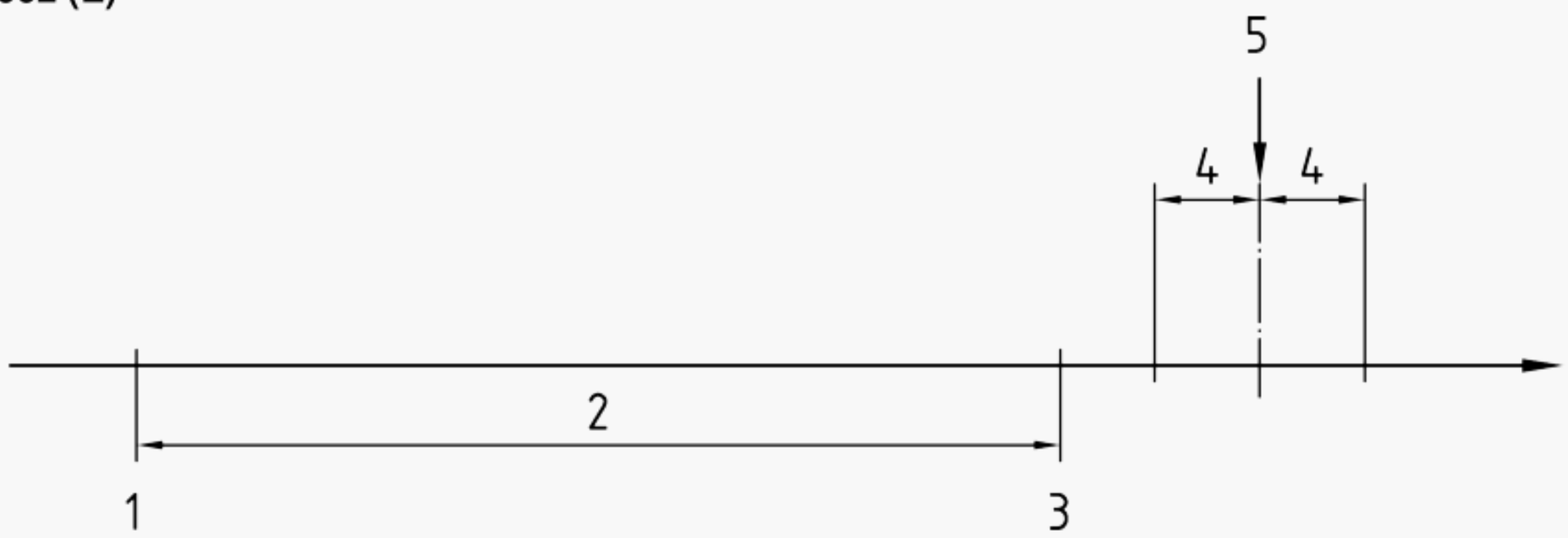
If the limit value for the particular test given in the standard, falls outside of the range of values calculated from the test data plus/minus the uncertainty U of measurement, then the result should be deemed to be a straightforward pass or fail (see Figures C.1 and C.2).



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

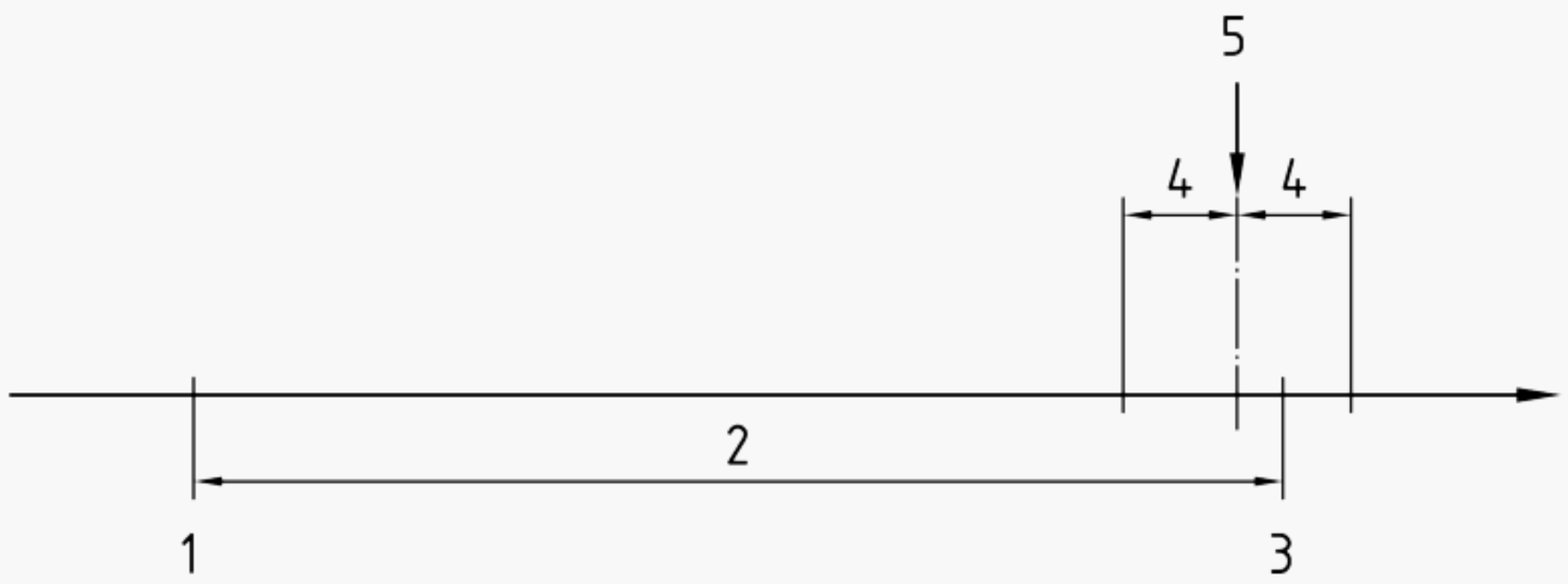


Key

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 passor 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 products 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

EU Directive 89/686/EEC, Annex II		Clause of this standard
1.1.1	Ergonomics	Annex B
1.1.2	Levels and classes of protection	
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	5.3
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-ionizing radiation	5, Annex B

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

Bibliography

[1] EN 175, *Personal eye-protection - Equipment for eye and face protection during welding and allied processes.*

[2] EN 379*, Specification for welding filters with switchable luminous transmittance and welding filters with dual luminous transmittance (ISO 4063:1998).*

[3] ISO 4063, *Welding and allied processes – Nomenclature of processes and reference numbers.*

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BRITISH STANDARD

BS EN
1015-4:1999

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

EUROPEAN STANDARD
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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.

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CEN

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

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

Ref. No. EN 1015-4:1998 E

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.

Contents

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 g $\pm$ 2 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 kg $\pm$ 0,015 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[1)];

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);

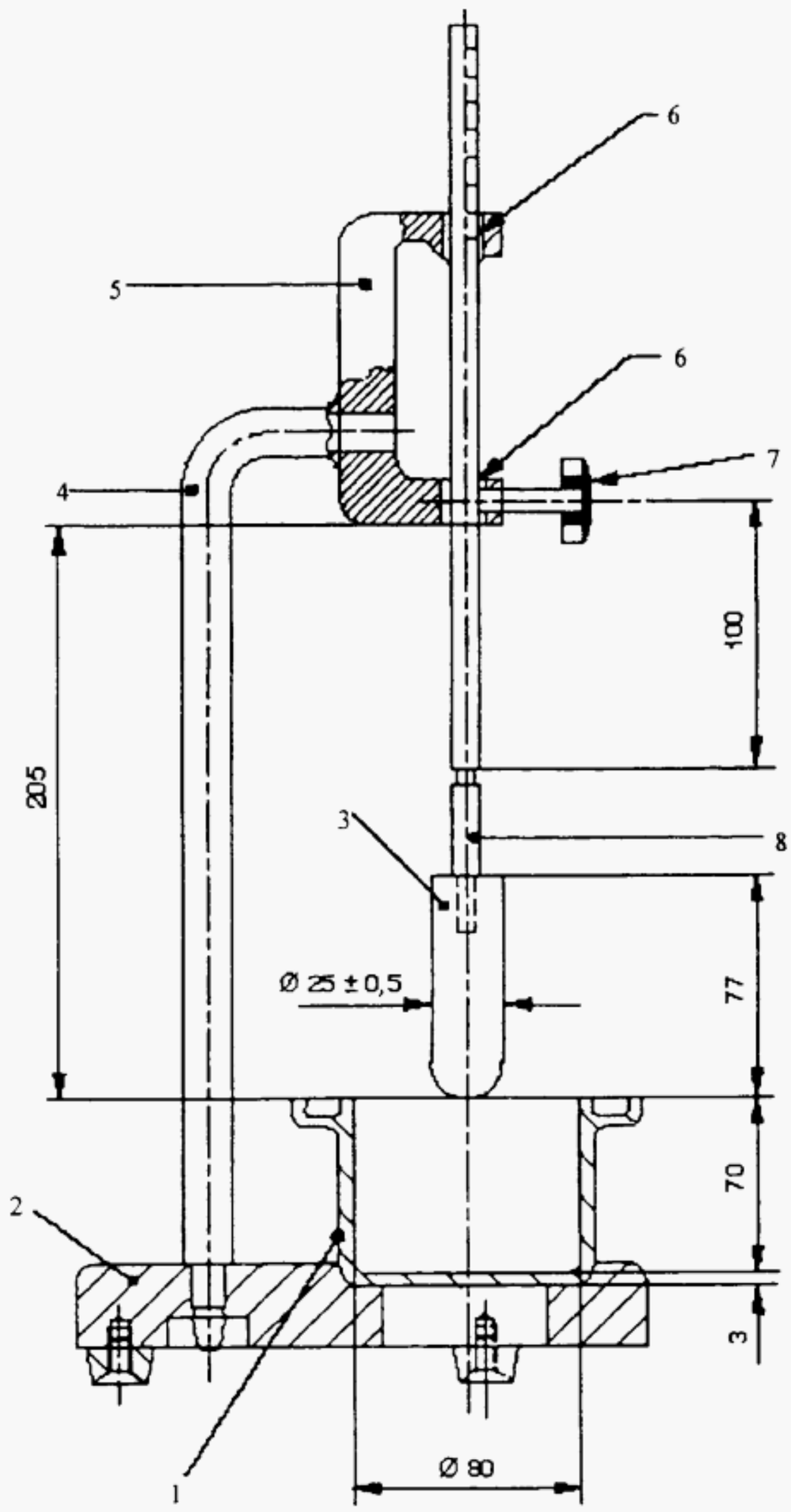
g) the date and time of testing;

h) test results (individual measurements and the plunger penetration values in mm for each test sample);

i) remarks, if any.

[1)] This information is contained on the certificate of sampling (see EN 1015-2).

Dimensions in millimetres



Key:					
1	Cylindrical vessel	2	Base plate	3	Plastics plunger
4	Frame	5	Clamp	6	Guide bush
7	Fixing screw	8	Penetration rod		

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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