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

BSI
British Standards

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 It supersedes BS EN 169:1992 which is withdrawn.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.

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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

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EN 169

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English version

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.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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

	Current A																				
Process	**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:

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

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

where

$S_{A\lambda}(\lambda)$ is the spectral distribution of radiation of CIE standard illuminant A (or 3 200 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 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 ($S_{A\lambda}(\lambda)$, $S_{D65\lambda}(\lambda)$), 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	$S_A(\lambda)\ V(\lambda)\ \tau_S(\lambda)$				$S_{D65}(\lambda)\ V(\lambda)$
nm	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

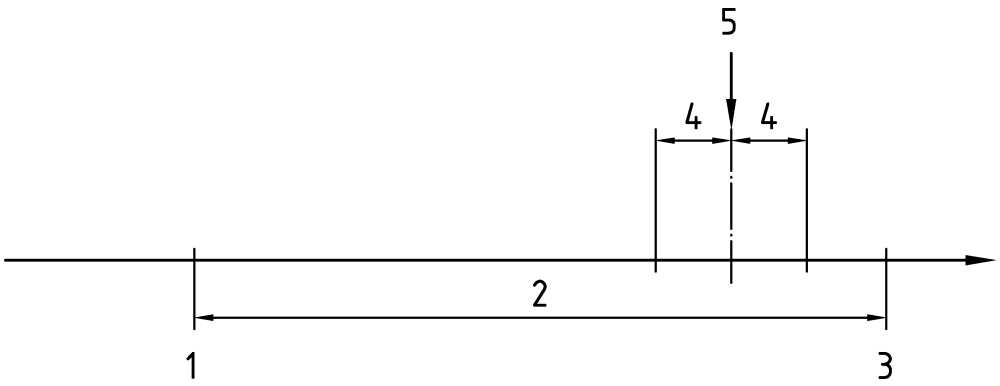
C.1 Test report and uncertainty of measurement

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:

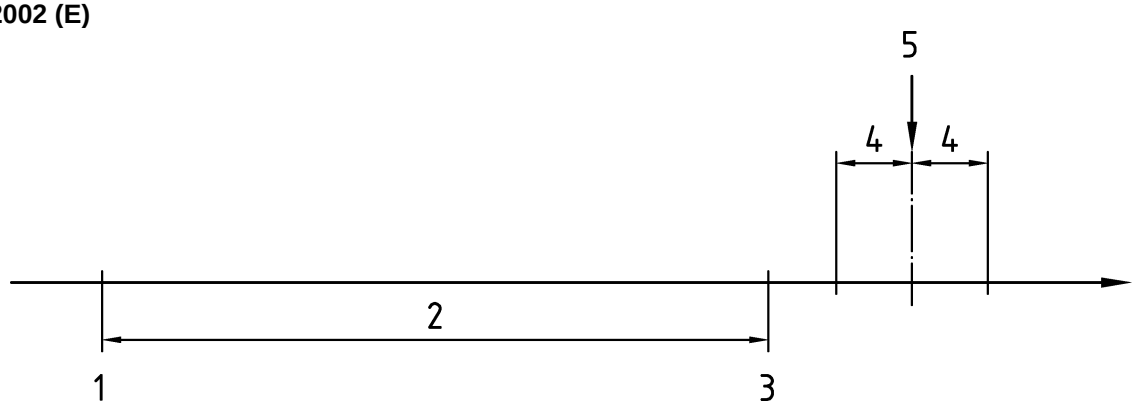
If the limit value for the particular test given in the standard, falls outside of the range of values calculated from the test data plus/minus the uncertainty U of measurement, then the result should be deemed to be a straightforward pass or fail (see Figures C.1 and C.2).



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

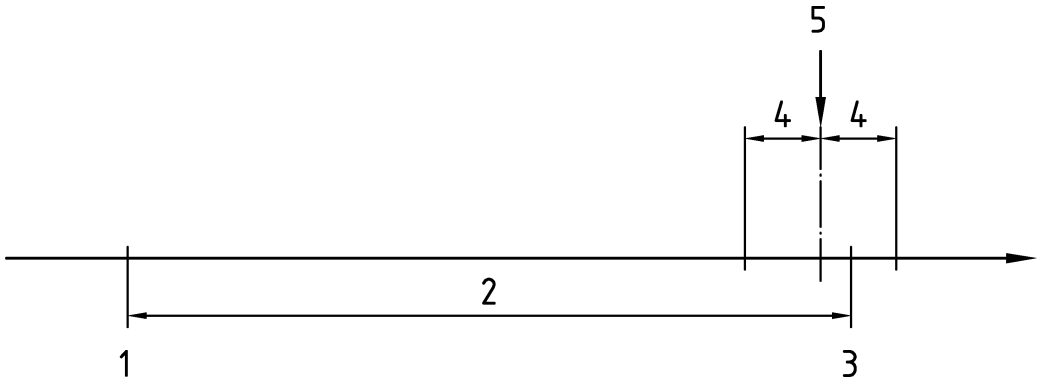


Key

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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