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Health and safety in welding and allied processes — Transparent welding curtains, strips and screens for arc welding processes

Hygiène et sécurité en soudage et techniques connexes — Rideaux, lanières et écrans transparents pour les procédés de soudage à l'arc

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Foreword

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

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

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

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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

This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 9, *Health and safety*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 25980:2014), which has been technically revised.

The main changes are as follows:

— hazard level G has been removed;

— requirements regarding luminous and effective blue-light transmittance have been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html.

Health and safety in welding and allied processes — Transparent welding curtains, strips and screens for arc welding processes

1 Scope

This document specifies safety requirements for transparent welding curtains, strips and screens to be used in workplaces where arc welding is taking place. They are intended to provide protection against harmful levels of optical radiation and spatter for workers who are in the vicinity of arc welding processes but not involved in the welding itself. They are intended to reduce the discomfort glare from the arc but also allow sufficient luminous transmittance to permit a view into the workspace behind.

The transparent welding curtains can also be used in other applications as long as the UV- and blue-light emissions are less than in arc welding and the transmitted infrared irradiance is below applicable exposure limits. They are designed to be used at a distance from the arc of at least 1 m.

Welding curtains, strips and screens specified in this document are not intended to replace welding filters. For intentional viewing of welding arcs, other means of protection are used, see ISO 16321-1 and ISO 16321-2.

This document is not applicable to protection against laser radiation, for which ISO 19818-1 applies.

2 Normative references

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

ISO 4007:2018, *Personal protective equipment — Eye and face protection — Vocabulary*

ISO/CIE 11664-1, *Colorimetry — Part 1: CIE standard colorimetric observers*

ISO/CIE 11664-2, *Colorimetry — Part 2: CIE standard illuminants*

ISO 18526-2:2020, *Eye and face protection — Test methods — Part 2: Physical optical properties*

ISO 18526-3:2020, *Eye and face protection — Test methods — Part 3: Physical and mechanical properties*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4007 and the following apply.

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

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

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

3.1
transparent
characteristic of welding curtains, strips and screens that permit visibility of the working place without implying to be glass clear

3.2
effective ultraviolet transmittance
τ_{UV}
normalized value of the spectral transmittance averaged between 200 nm and 400 nm weighted by the relative spectral effectiveness function for ultraviolet

Note 1 to entry: The effective ultraviolet transmittance is usually expressed as a percentage and calculated using Formula (1).

3.3
effective blue-light transmittance
τ_{B}
normalized value of the spectral transmittance averaged between 300 nm and 700 nm weighted by the relative spectral effectiveness function for blue light

Note 1 to entry: The effective blue-light transmittance is usually expressed as a percentage and calculated using Formula (2).

3.4
luminous transmittance
τ_{V}
ratio of the luminous flux transmitted to the incident luminous flux for a specified illuminant and photopic vision

Note 1 to entry: The luminous transmittance is usually expressed as a percentage and calculated using Formula (3).

[SOURCE: ISO 4007:2018, 3.10.1.32, modified — Note 1 to entry revised, Note 2 to entry removed.]

4 Requirements

4.1 Transmittance

4.1.1 Infrared transmittance

This document does not provide infrared transmittance requirements. The intensity of the infrared radiation from the welding arc at a distance of more than 1 m is too low to represent a hazard.

Annex A provides information on the basis of the transmittance requirements of this document.

4.1.2 Effective ultraviolet transmittance

When tested in accordance with 5.1.2, the weighted effective ultraviolet transmittance, τ_{UV}, in the wavelength range between 200 nm and 400 nm shall be less than 0,002 %.

NOTE Measurement of spectral transmittance at wavelengths below 250 nm creates measurement problems with noise. Most plastic materials (e.g. PVC and PC) have a very high attenuation and provide sufficient protection at wavelengths < 250 nm.

4.1.3 Effective blue-light transmittance

When tested in accordance with 5.1.3, the weighted effective blue-light transmittance, τ_{B}, in the wavelength range between 300 nm to 700 nm shall be less than 1,0 %.

4.1.4 Luminous transmittance

When tested in accordance with 5.1.4, the classification based on the luminous transmittance can be expressed in the grades according to Table 1. Annex B provides information on the selection of curtain and grade.

Table 1 — Luminous transmittance

Grade	Luminous transmittance $\tau_{v,D65}$ %	
	Minimum	Maximum
Light	29,0	100,0
Medium	8,5	29,0
Dark	1,0	8,5
Extra dark[a]	0,02	1,0
NOTE The maximum values are taken as equal to or less than and the minimum values are taken as greater than.		
[a] Extra dark is normally intended for separation of adjacent operations.		

4.2 Resistance to ultraviolet radiation

To ensure that the required protection is maintained and the discomfort glare protection is not markedly altered after exposure to UV radiation, the curtain shall be exposed to a xenon arc that has similar spectral characteristics to welding arcs.

After exposure to UV radiation due to the test specified in 5.2, the curtain shall remain in conformity with 4.1.2 and 4.1.3 and the relative change in luminous transmittance shall not be greater than ± 20 %.

4.3 Resistance to flame spread

When tested in accordance with 5.3.3, the welding curtain, strip or screen material is considered to be satisfactory if for all three samples:

— the flame does not reach the test mark with the burner in position;

— the flame self-extinguishes after removal of the burner;

— the material does not continue to glow for more than 3,0 s after removal of the burner.

4.4 Seam and eyelet strength

If eyelets are used and when welding curtains with thickness < 0,5 mm are tested in accordance with 5.4, there shall be no tearing of any seam or eyelet and/or removal of any eyelet.

5 Test and calculation methods

5.1 Transmittance

5.1.1 General

After preparation, the test specimens shall be maintained at a temperature of (23 ± 5) °C and relative humidity of less than 70 % for a minimum of 16 h before testing.

The methods for measuring spectral transmittance according to ISO 18526-2:2020, Clause 6 shall be applied.

5.1.2 Effective ultraviolet transmittance

τ_{UV} (%) is calculated using Formula (1):

$$\tau_{UV} = 100 \times \frac{\int_{200\,nm}^{400\,nm} \tau(\lambda) \cdot S(\lambda) \cdot d\lambda}{\int_{200\,nm}^{400\,nm} S(\lambda) \cdot d\lambda} \quad (1)$$

where

$\tau(\lambda)$ is the spectral transmittance in the range 200 nm to 400 nm;

$S(\lambda)$ is the spectral efficiency for UV radiation;

λ is the wavelength in nm.

5.1.3 Effective blue-light transmittance

τ_B (%) is calculated using Formula (2):

$$\tau_B = 100 \times \frac{\int_{300\,nm}^{700\,nm} \tau(\lambda) \cdot B(\lambda) \cdot d\lambda}{\int_{300\,nm}^{700\,nm} B(\lambda) \cdot d\lambda} \quad (2)$$

where

$\tau(\lambda)$ is the spectral transmittance in the range 300 nm to 700 nm;

$B(\lambda)$ is the blue-light hazard function;

λ is the wavelength in nm.

5.1.4 Luminous transmittance

For the purposes of this document, CIE illuminant D65, $\tau_{v,D65}$ (%), is used and calculated using Formula (3).

$$\tau_{v,D65} = 100 \times \frac{\int_{380\,nm}^{780\,nm} \tau(\lambda) \cdot S_{D65}(\lambda) \cdot V(\lambda) \cdot d\lambda}{\int_{380\,nm}^{780\,nm} S_{D65}(\lambda) \cdot V(\lambda) \cdot d\lambda} \quad (3)$$

where

$\tau(\lambda)$ is the spectral transmittance in the range 380 nm to 780 nm;

$V(\lambda)$ is the CIE 2° spectral luminous efficiency function for photopic vision in accordance with ISO/CIE 11664-1;

$S_{D65}(\lambda)$ is the spectral distribution of the incident radiation of CIE standard Illuminant D65 in accordance with ISO/CIE 11664-2;

λ is the wavelength in nm.

NOTE The values of the product $S_{D65}(\lambda) \cdot V(\lambda)$ are given in ISO 4007:2018, Table A.3 and can be interpolated when necessary.

5.2 Resistance to ultraviolet radiation

To ensure the stability of the spectral absorption properties of the curtain, a sample shall be tested in accordance with ISO 18526-3:2020, 6.8.3 in a xenon arc test chamber for an exposure time of (100,0 ± 0,2) h. The spectral transmittance is then tested to ensure that the curtain still meets the attenuation requirements of 4.1.2 and 4.1.3. Record the relative change in luminous transmittance as a percentage.

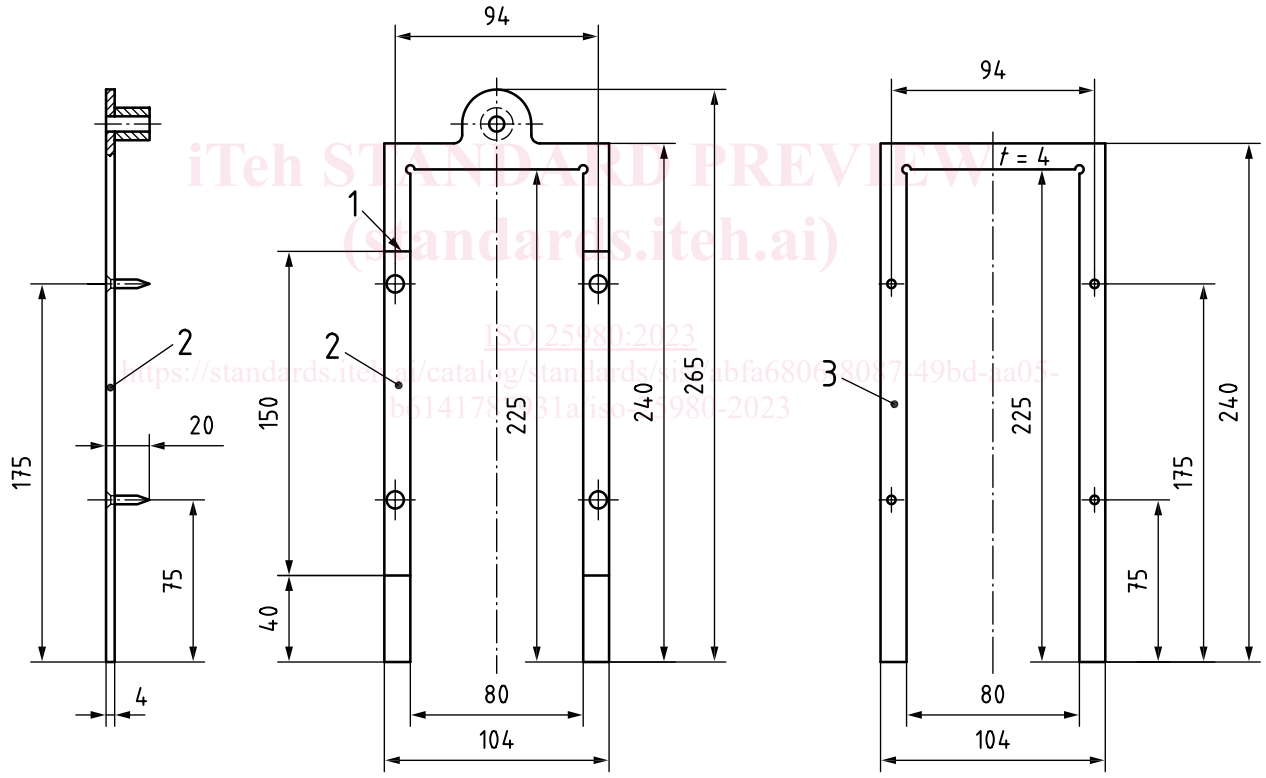
5.3 Resistance to flame spread

5.3.1 Test apparatus

The following apparatus is required:

5.3.1.1 Sample holder, made of rigid metal or non-flammable material with the construction and dimensions shown in Figure 1. The test marks are on the front of part 1 and the locating pins project from the rear of part 1, see Figure 2.

Dimensions in millimetres



Key

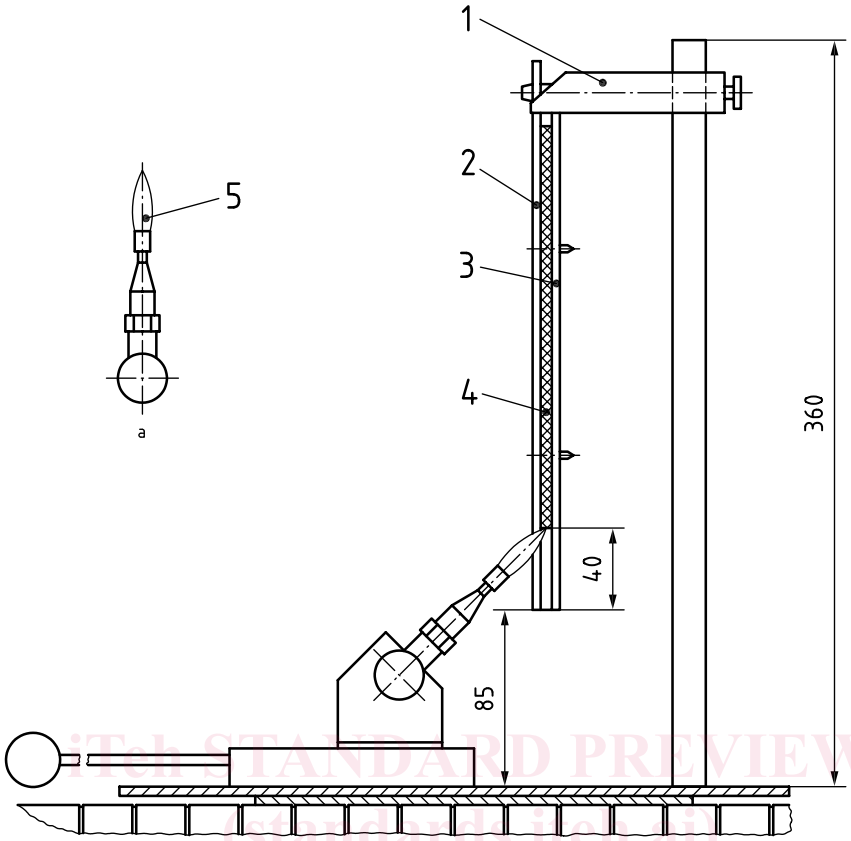
1 test mark
2 sample holder part I
3 sample holder part II
t thickness of sample holder

NOTE All dimensions have tolerances of ± 0,5 mm.

Figure 1 — Sample holder

5.3.1.2 Propane burner, having a nominal visible flame height of 20 mm when put in an upright position (see Figure 2).

Dimensions in millimetres



Key

1 mounting device
2 sample holder part I
3 sample holder part II
4 sample
5 flame
a Position of the burner when setting the flame height.

NOTE All dimensions have tolerances of ± 0,5 mm.

Figure 2 — Burner and testing setup

5.3.2 Test specimens

There shall be three samples cut from the welding curtain, (190 ± 5) mm long and (90 ± 2) mm wide.

5.3.3 Test procedure

a) Testing shall be carried out at (23 ± 5) °C and a relative humidity of less than 70 % in a draught-free environment.

b) Clamp the sample between the two parts of the sample holder (see Figure 2). The lower end of the sample shall be (40 ± 2) mm above the lower end of the sample holder.

c) Suspend the sample and holder as shown in Figure 2.

d) Set the burner upright and allow to burn for at least 60 s.

e) Turn the burner by an angle of 45°.

f) Direct the burner at the bottom of the sample so that the tip of the flame hits the sample in the geometric centre of the lower edge.

g) After 15 s remove the burner and observe whether or not the flame self-extinguishes and the material has ceased to glow within 3,0 s.

h) Carry out a visual inspection to see if the flame has reached the test mark 150 mm above the lower end of the sample.

5.3.4 Test report

Report whether:

a) the flame does not reach the test mark with the burner in position;

b) the flame self-extinguishes after removal of the burner;

c) the material does not continue to glow for more than 3,0 s after removal of the burner.

5.4 Seam and eyelet strength

5.4.1 Test apparatus

The following apparatus is required:

5.4.1.1 Bench stand with an attached horizontal clamp to hold sheet material 100^{+4}_{-6} mm wide evenly in its jaws, allowing the material to hang down freely. The stand shall have a metallic hook of circular cross-section of nominal 6 mm diameter to attach the sheet material by an eyelet. The stand shall allow a sample to hang freely by at least 600 mm.

5.4.1.2 Minimum weight of 7 kg attached to a metallic hook of circular cross-section of nominal 6 mm diameter.

5.4.1.3 Clamp as in item a) but not attached to the stand, with a hole allowing the weight to be hung from the clamp using the attached hook as in item b).

5.4.2 Test specimens

5.4.2.1 Specimen 1

The dimensions of the test specimen shall be 100^{+4}_{-6} mm along the side containing the eyelet under test (if any) and parallel to the seam under test (if any). The other dimension is not critical and should be between 150 mm and 200 mm. If the sample has no eyelet it should be provided with a punched hole with a diameter of 10^{+1}_{-1} mm and 25^{+1}_{-1} mm short of the sides.

5.4.2.2 Specimen 2

The dimensions of the test specimen shall be between 200 mm and 350 mm along the side containing two eyelets under test (if any). The eyelets should be 25^{+1}_{-1} mm short of the cutting edge and parallel to the seam under test (if any). The other dimension is not critical and should be between 100 mm and 200 mm, measured from the underside of the seam. If the sample has no eyelets it should be provided with two punched holes with a diameter of 10^{+1}_{-1} mm and 25^{+1}_{-1} mm short of three sides.