FINAL DRAFT International Standard

ISO/FDIS 11611

Protective clothing for use in welding and allied processes

Vêtements de protection utilisés pendant le soudage et les techniques connexes

ISO/TC **94**/SC **13**

Secretariat: **SNV**

Voting begins on:
2024-02-07

Voting terminates on:
2024-04-03

ISO/CEN PARALLEL PROCESSING

Reference number
ISO/FDIS 11611:2024(en)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had/had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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 ISO/TC 94, *Personal dafety — Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 162, *Protective clothing including hand and arm protection and lifejackets in collaboration,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 11611:2015) which has been technically revised.

The main changes are as follows:

a) an introduction has been included;

b) the clause on sampling requirements has been modified;

c) the clause for ageing due to washing (maximum number of cleaning procedures as indicated by the manufacturer) has been modified;

d) a new requirement for measuring the property value for rating and classification has been included;

e) the clause for the manufacturer's instructions and information has been modified;

f) a new Annex G for measuring property value for rating and classification has been included;

g) a procedure for sampling and testing the protective effect of fabrics, garments and gloves for use in welding against UV radiation (UV-A, UV-B, UV-C), taking into account representative manual welding processes, has been included;

h) Annex A comprising general explanations for UV protective characteristics of protective clothing for use in welding, has been included. All other annexes have been renumbered accordingly has been included;

i) Annex B has been complemented by a three-step UV protection classification system (Table B.2) for clothing for use in welding;

j) Annex C with the testing procedure for the protective effect against UV radiation emitted by welding processes, has been included;

k) Annex D with instructions for calculating the effectively transmitted total irradiance and the resulting maximum time of use related to the exposition limit value by using the determined worst-case UV transmission spectra of fabrics for welding protective garments, has been included;

l) Annex E with the spectral distribution and maximum effectively emitted total irradiance of the selected representative welding processes, has been included;

m) Annex F with the spectral weighing function $s_{\mathrm{eff}}(\lambda)$ for use in Annex D, has been included;

n) the previous Annex C has become Annex G;

o) the previous Annex D has become Annex H and has been revised;

p) Annex I with the summary of conducted Round Robin tests in the development of the UV transmission test procedure, has been included.

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.

Introduction

The purpose of this document is to provide minimum performance requirements for clothing for use in welding and allied processes.

For complete protection against exposure to heat and flame, it will be necessary to protect the head, face, hands, and/or feet with suitable personal protective equipment (PPE) and in some cases, appropriate respiratory protection might also be considered necessary.

Attention is drawn to ISO/TR 2801:2007[2], which sets out guidelines for selection, use, care, and maintenance of protective clothing against heat and flame.

Nothing in this document is intended to restrict any jurisdiction, purchaser, or manufacturer from exceeding these minimum requirements.

Protective clothing for use in welding and allied processes

1 Scope

This document specifies minimum safety requirements and test methods for protective clothing including hoods, aprons, sleeves, and gaiters that are designed to protect the wearer's body including head (hoods) and feet (gaiters) and that are to be worn during welding and allied processes with comparable risks. For the protection of the wearer's head and feet, this document is only applicable to hoods and gaiters. This document does not cover requirements for feet, hand, face, and/or eye protectors.

This type of protective clothing is intended to protect the wearer against the following hazards:

— spatter (small splashes of molten metal) in 2 risk levels, short contact time with flame, radiant heat from an electric arc used for welding and allied processes,

— harmful artificial optical radiation (UV-A, UV-B and especially UV-C) in 3 risk levels generated during welding and allied processes and

— minimizes the possibility of electrical shock by short-term, accidental contact with live electrical conductors at voltages up to approximately 100 V d. c. in normal conditions of welding. Sweat, soiling, or other contaminants can affect the level of protection provided against short-term accidental contact with live electric conductors at these voltages.

The main manual welding processes are exemplified and are classified into process groups according to the maximum effectively emitted total irradiance, which have been determined and evaluated by measurement[15] for these types of welding processes.

For adequate overall protection against the risks to which welders are likely to be exposed, personal protective equipment (PPE) covered by other standards should additionally be worn to protect the head, face, hands, and feet.

This document is not applicable for laser welding processes (coherent, monochromatic radiation sources).

Guidance for the selection of protective clothing for different welding activities is detailed in Annex B.

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 3376:2020, *Leather — Physical and mechanical tests — Determination of tensile strength and percentage elongation*

ISO 3377-1:2011, *Leather — Physical and mechanical tests — Determination of tear load — Part 1: Single edge tear*

ISO 4048:2018, *Leather — Chemical tests — Determination of matter soluble in dichloromethane and free fatty acid content*

ISO 5077:2007, *Textiles — Determination of dimensional change in washing and drying*

ISO 6942:2022, *Protective clothing — Protection against heat and fire — Method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat*

ISO 9150:1988, *Protective clothing — Determination of behaviour of materials on impact of small splashes of molten metal*

ISO 13688:2013, *Protective clothing — General requirements*

ISO 13934-1:2013, *Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method*

ISO 13935-2:2014, *Textiles — Seam tensile properties of fabrics and made-up textile articles — Part 2: Determination of maximum force to seam rupture using the grab method*

ISO 13937-2:2000, *Textiles — Tear properties of fabrics — Part 2: Determination of tear force of trouser-shaped test specimens (Single tear method)*

ISO 13938-1:2019, *Textiles — Bursting properties of fabrics — Part 1: Hydraulic method for determination of bursting strength and bursting distension*

ISO 13938-2:2019, *Textiles — Bursting properties of fabrics — Part 2: Pneumatic method for determination of bursting strength and bursting distension*

ISO 15025:2016, *Protective clothing — Protection against flame — Method of test for limited flame spread*

EN 1149-2:1997, *Protective clothing — Electrostatic properties — Part 2: Test method for measurement of the electrical resistance through a material (vertical resistance)*

EN 410:2011, *Glass in building – Determination of luminous and solar characteristics of glazing*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
ageing
changing of the product performance over time during use or storage

Note 1 to entry: Ageing is caused by a combination of several factors, such as the following:

— cleaning, maintenance, or disinfecting process;

— exposure to visible and/or ultraviolet radiation;

— exposure to high or low temperatures or to changing temperatures;

— exposure to chemicals including humidity;

— exposure to biological agents such as bacteria, fungi, insects, or other pests;

— exposure to mechanical action such as abrasion, flexing, pressure, and strain;

— exposure to contaminants such as dirt, oil, splashes of molten metal, etc.;

— exposure to wear and tear.

3.2
allied processes
processes having similar types and levels of risk as welding

EXAMPLE Cutting, arc air gouging, and hot spraying.

3.3
artificial optical radiation
optical radiation from artificial sources of light/radiation within a broad range of wave lengths over the total electromagnetic spectrum from deep ultraviolet (UV) to the visible spectrum (VIS), and far into the infrared (IR) range

Note 1 to entry: Classification is made into coherent radiation sources (narrowband 'monochromatic' radiation from lasers) and incoherent radiation (broadband 'polychromatic' radiation from all other artificial light sources, except for lasers.

3.4
cleaning
process by which an item of PPE is again made serviceable and/or hygienically wearable by removing any dirt or contamination

Note 1 to entry: A cleaning cycle is typically a washing plus drying or a dry cleaning treatment followed, if required, by ironing, or other finishing.

3.5
clothing assembly
series of garments arranged in the order as worn

Note 1 to entry: They may contain multilayer materials, material combinations or a series of separate garments in single layers.

3.6
component assembly
combination of all materials and hardware presented exactly as the finished garment construction

3.7
conditioning
keeping of the samples under standard conditions of temperature and relative humidity for a minimum period of time

3.8
gaiter
removable covering intended to protect the part of the leg below the knee which can also cover the upper surface of shoes

3.9
hardware
non-fabric items forming part of or optional extras in a garment

EXAMPLE Metal or plastic buttons or zippers and touch and close fasteners or hook and loop fasteners.

3.10
hole
opening, break, or discontinuity of any size in the original structure of the test specimen's fabric caused by application of the test flame

[SOURCE: ISO 15025:2016, 3.9]

3.11
hood
item of PPE made from material which covers the head and neck and can also cover the shoulders

3.12
innermost lining
innermost face of a *component assembly* (3.7) closest to the wearer's skin

Note 1 to entry: Where the innermost lining forms part of a material combination, the material combination is regarded as the innermost lining.

3.13
interlining
layer between the outermost layer and the *innermost lining* (3.12) in a multilayer garment

3.14
material
substances excluding *hardware* (3.9), of which an item of clothing is made

3.15
material assembly
combination of all *materials* (3.14) of a multi-layer garment presented exactly as the finished garment construction

3.16
material combination
material produced from a series of separate layers, fixed together during the garment manufacturing stage

3.17
multilayer material
material consisting of different layers intimately combined prior to the garment manufacturing stage

EXAMPLE The combining process includes weaving, quilting, coating, or gluing.

3.18
outer material
outermost *material* (3.14) of which the item of clothing is made

3.19
patch pocket
pocket located on the exterior of a protective garment, which is stitched as a patch over the outer layer of the protective garment

3.20
pre-treatment
standard way of preparing the samples before testing

Note 1 to entry: This can include e.g. a number of cleaning cycles, submitting the sample to heat, mechanical action, or any other relevant exposure and is completed by conditioning.

3.21
protective clothing
clothing which covers or replaces personal clothing and which is designed to provide protection for the wearer's upper and lower torso, neck, arms, and legs

3.22
protective garment
individual item of *protective clothing* (3.21) the wearing of which provides protection against specified hazards to the part of the body that it covers

EXAMPLE Protective coat, apron, trousers, *gaiters* (3.8), *hoods* (3.11), boiler suit, or coverall.

3.23
seam
any method of permanent fastening between two or more pieces of *material* (3.14)

3.23.1
side seam
seam (3.23) that runs laterally along the garment when it is placed flat on a surface, with the front uppermost

3.23.2
structural seam
seam (3.23) that is necessary for the integrity of the garment

3.24
sleeve
removable covering intended to protect part or all of the arm and the wrist in addition to sleeves in a jacket or overall

3.25
welding
process used in joining metal components involving local melting of metal

3.26
welding time
effective time during which the arc is burning during the *welding* (3.25) process ("active arc time") in which persons are within the operational range of the burning arc ("time of exposition")

4 General and design requirements

4.1 General

General requirements which are not specifically covered in this document shall be in accordance with ISO 13688:2013.

Welders' protective clothing shall be designed to prevent electrical conduction from the outside to the inside, e.g. by metal fasteners. Conformity shall be checked by visual inspection.

4.2 Protective clothing

Welders' protective suits shall completely cover the upper and lower torso, neck, arms to the wrist, and legs to the ankle. Suits shall consist of the following:

a) a single garment, e.g. a coverall or boiler suit;

b) a two-piece garment, consisting of a jacket and a pair of trousers.

Pleats in the exterior surface of the garment can act as trapping points for hot/molten materials. If pleats are present in the garment, the bottoms of the pleats shall incorporate a means whereby entrapment of molten metal can be prevented, for example by incorporating diagonal stitches or some other feature. Conformity shall be checked by visual inspection.

4.3 Size designation and fit

Garment sizes shall be in accordance with the requirements of ISO 13688:2013.

Where protection to the requirements of this document is provided by an outer two-piece suit, it shall be determined that, when correctly sized for the wearer, an overlap between the jacket and trousers remains when one standing wearer firstly fully extends both arms above the head and then bends over until the fingertips touch the ground.

Conformity shall be checked by visual inspection including an assessment of fit and physical measuring when the appropriate size of clothing is donned by a wearer.

In addition, the wrists, lower arms, and ankles shall also remain covered in an_upright and raised arms overhead position. This shall also apply to one-piece suits.

4.4 Additional protective garments

Welder's protective garments can be designed to provide extra protection against heat and flame aspects, harmful UV radiation and electrical shock for specific areas of the body when worn in addition to a suit according to 4.2, e.g. neck curtain, hoods, sleeves, apron, and gaiters. Aprons shall cover the front body of the user at least from side seam to side seam.

In the case of hoods, manufacturers shall identify the specific visor(s) to be incorporated into the hood.

Performance testing of additional protective garments shall be carried out on the assembly, comprising the suit plus the additional protective garment. Additional protective garments such as sleeves, apron, and gaiters shall cover the intended areas when worn with a suit of appropriate size and the additional item alone shall also meet the requirements of this document.

4.5 Pockets and flap closures

Where garments are constructed with pockets, the pockets shall be constructed to the following design:

a) pockets with external openings, including patch pockets shall be made of material(s) conforming to 6.7 and 6.8;

b) external opening pockets including pass-through openings shall have a covering flap except for

   — side pockets below the waist which do not extend more than 10° forward of the side seam,

   — a single rule pocket with an opening not greater than 75 mm placed behind the side seam on one or both legs and measured flat, and

c) all flaps shall be at least 20 mm wider than the opening (at least 10 mm on each side) to prevent the flap from being tucked into the pocket. They shall be stitched down on each side or capable of covering the pocket opening by fastening. Flap materials shall conform to 6.7 and 6.8.

Conformity shall be checked by visual inspection and physical measurement.

4.6 Closures and seams

Closures shall be designed with a protective cover flap on the outside of the garment. The maximum distance between buttonholes/press studs shall be 150 mm. If zippers are used, they shall be designed in such a way that they completely close the opening and the slide fastener shall be designed to lock when completely closed. Cuffs can be provided with closures to reduce their width. The closure and any fold which it creates shall point downwards when the garment is worn. Cuffs shall not have turn-ups. Neck openings shall be provided with closures.

Trousers or one-piece suits shall not have turn-ups. They can have side slits which shall have a means of closure and the slit and closure shall be covered.

Conformity shall be checked by visual inspection.

4.7 Hardware

Hardware penetrating the outer material of a welders' protective garment or garment assembly shall not be exposed to the innermost surface of the garment or the garment assembly.

Conformity shall be checked by visual inspection.

5 Sampling and pre-treatment

5.1 Sampling

5.1.1 General

The samples shall be taken from fabrics and/or other materials being representative for the component assembly or of the garment or from the finished garment.

The samples for testing the UV protection during welding operations shall be taken in accordance with 5.1.2.

NOTE The sampling process in 5.1.2 ensures that the variation of the fabric is taken into account.