



BSI Standards Publication

Live working — Protective clothing against the thermal hazards of an electric arc

Part 1-2: Test methods — Method 2:
Determination of arc protection class
of material and clothing by using a
constrained and directed arc (box test)

National foreword

This British Standard is the UK implementation of EN 61482-1-2:2014. It is identical to IEC 61482-1-2:2014. It supersedes BS EN 61482-1-2:2007, which will be withdrawn on 13 November 2017.

The UK participation in its preparation was entrusted to Technical Committee PEL/78, Tools for live working.

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

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English Version

Live working - Protective clothing against the thermal hazards of
an electric arc - Part 1-2: Test methods - Method 2:
Determination of arc protection class of material and clothing by
using a constrained and directed arc (box test)
(IEC 61482-1-2:2014)

Travaux sous tension - Vêtements de protection contre les
dangers thermiques d'un arc électrique - Partie 1-2: Méthodes
d'essai - Méthode 2: Détermination de la classe de protection
contre l'arc de matériaux et de vêtements au moyen d'un arc
dirigé et contraint (enceinte d'essai)
(CEI 61482-1-2:2014)

Arbeiten unter Spannung - Schutzkleidung gegen die
thermischen Gefahren eines elektrischen Lichtbogens -
Teil 1-2: Prüfverfahren - Verfahren 2: Bestimmung der
Lichtbogen-Schutzklasse des Materials und der Kleidung unter
Verwendung eines gerichteten Prüflichtbogens (Box-Test)
(IEC 61482-1-2:2014)

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Foreword

The text of document 78/1053/FDIS, future edition 2 of IEC 61482-1-2, prepared by IEC/TC 78 "Live working" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61482-1-2:2014.

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This document supersedes EN 61482-1-2:2007.

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The text of the International Standard IEC 61482-1-2:2014 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61482-1-1	NOTE	Harmonized as EN 61482-1-1.
ISO 3175-2	NOTE	Harmonized as EN ISO 3175-2.
ISO 6330	NOTE	Harmonized as EN ISO 6330.
ISO 13688:2013	NOTE	Harmonized as EN ISO 13688:2013 (not modified).
ISO 15797	NOTE	Harmonized as EN ISO 15797.

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 9151	1995	Protective clothing against heat and flame - Determination of heat transmission on exposure to flame	-	-

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LIVE WORKING – PROTECTIVE CLOTHING AGAINST THE THERMAL HAZARDS OF AN ELECTRIC ARC –

Part 1-2: Test methods –

Method 2: Determination of arc protection class of material and clothing by using a constrained and directed arc (box test)

1 Scope

This part of IEC 61482 specifies procedures to test *material* and *garments* intended for use in heat and flame-resistant *clothing* for workers if there is an electric arc hazard. A directed and constrained *electric arc* in a test circuit is used to classify *material* and *clothing* in two defined *arc protection classes*.

This International Standard is not dedicated toward measuring the arc rating values (ATPV¹, ELIM² or EBT³). Procedures determining these arc rating values are prescribed in IEC 61482-1-1, using an open arc for testing.

Other effects than the thermal effects of an electric arc like noise, light emissions, pressure rise, hot oil, electric shock, the consequences of physical and mental shock or toxic influences are not covered by this standard.

Protective clothing for work intentionally using an *electric arc*, e.g. arc welding, plasma torch, is not covered by this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9151:1995, *Protective clothing against heat and flame – Determination of heat transmission on exposure to flame*

3 Terms, definitions and symbols

For the purposes of this document, the following terms, definitions and symbols apply.

3.1 Terms and definitions

3.1.1

arc current

I_{arc}

current actually flowing in the electric test circuit during *arc duration* (through the arc)

¹ ATPV = *arc thermal performance value*.

² ELIM = *incident energy limit*

³ EBT = *breakopen energy threshold*

Note 1 to entry: *Arc current* is expressed in kA rms.

Note 2 to entry: The *arc current* flowing during *arc duration* fluctuates due to the non-linear arc impedance stochastically varying with time.

3.1.2

arc duration

time duration of the arc

Note 1 to entry: *Arc duration* is expressed in ms.

3.1.3

arc energy

W_{arc}

electrical energy supplied to the arc and converted in the arc

Note 1 to entry: *Arc energy* is the sum of the instantaneous *arc voltage* values multiplied by the instantaneous *arc current* values multiplied by the incremental time values during the *arc duration*.

Note 2 to entry: *Arc energy* is expressed in kJ or kW·s.

3.1.4

arc gap

distance between the arc electrodes

Note 1 to entry: *Arc gap* is expressed in mm.

3.1.5

arc protection class

category of *arc thermal protection* of *material* and *protective clothing* tested in the box test (class 1 or class 2)

Note 1 to entry: The *arc protection class* is characterized by the test energy level of arc exposure (*arc energy* and *incident energy*).

Note 2 to entry: Tested *material* and *protective clothing* show *arc thermal protection* at minimum up to the class energy level. In general the actual exposure energy limit up to which the *material* and *protective clothing* provide protection is higher.

3.1.6

arc thermal protection

degree of thermal protection offered against *electric arc* under specific arc testing conditions

Note 1 to entry: For *materials*, the arc thermal performance is obtained from the measurement of the *transmitted energy* and by evaluation of other thermal parameters (*burning time*, *hole formation*, *melting*).

Note 2 to entry: For *garments*, the arc thermal performance is obtained by evaluation of thermal parameters (*burning time*, *hole formation*, *melting*) and of the functioning of fasteners and accessories.

3.1.7

arc voltage

voltage across the arc

Note 1 to entry: *Arc voltage* is expressed in V.

3.1.8

burning time

after flame time

time for which a flaming of the test specimen is visible after the end of the electric arc duration

Note 1 to entry: *Burning time* is expressed in s.

3.1.9**calorimeter**

assembly of a copper disc with attached thermocouple used for measuring the heat flux and incident energy

3.1.10**charring**

formation of carbonaceous residue as the result of pyrolysis or incomplete combustion

3.1.11**clothing**

assembly of *garments* worn by workers

3.1.12**delta peak temperature**

ΔT_p

difference between the maximum temperature and the initial temperature of the *sensor* during the test *exposure time*

Note 1 to entry: *Delta peak temperature* is expressed in °C.

Note 2 to entry: The symbol ΔT_p is used without index when testing with *material*; an additional index "0" is used when testing without *material* for calibration (ΔT_{p0}).

3.1.13**direct exposure incident energy**

E_{i0}

heat energy or *incident energy* emitted by the *electric arc* and received at a *calorimeter* directly exposed to the arc without *material* influence

Note 1 to entry: *Direct exposure incident energy* is used for calibration.

Note 2 to entry: *Direct exposure incident energy* is expressed in kJ/m² or kW·s/m² (cal/cm²)⁴.

3.1.14**dripping**

material response evidenced by flowing of the fibre polymer

3.1.15**electric arc**

self-maintained gas conduction for which most of the charge carriers are electrons supplied by primary-electron emission

Note 1 to entry: During live working, the *electric arc* is generated by gas ionisation arising from an unintentional electrical conducting connection or breakdown between live parts or a live part and the earth path of an electrical installation or an electrical device. During testing, the *electric arc* is initiated by the blowing of a fuse wire.

[SOURCE: IEC 60050-121:1998, 121-13-12, modified – the Note 1 to entry has been added to refer specifically to live working and arc testing.]

3.1.16**embrittlement**

formation of a brittle residue as the result of pyrolysis or incomplete combustion

3.1.17**exposure time**

total test time interval of observation and measurement

⁴ Correlation: 1 cal/cm² = 41,868 kJ/m²; 1 kJ/m² = 0,023 885 cal/cm².

Note 1 to entry: *Exposure time* is expressed in s.

3.1.18

garment

single item of *clothing* which may consist of single or multiple layers

3.1.19

heat flux

thermal intensity of an *electric arc* indicated by the amount of energy transmitted per unit area and time

Note 1 to entry: *Heat flux* is expressed in kW/m².

3.1.20

hole formation

existence of openings in the test specimen *material* with minimum 5 mm in any direction

3.1.21

ignition

initiation of flaming and combustion

3.1.22

incident energy

E_i

heat energy (total heat) received at a unit surface area as a result of an electric arc

Note 1 to entry: *Incident energy* is measured as a proportional peak temperature rise ΔT_p of a *calorimeter sensor*.

Note 2 to entry: *Incident energy* is expressed in kJ/m² or kW·s/m² (cal/cm²).

3.1.23

material

fabric or other substances of which the *garment* is made

Note 1 to entry: The *material* may consist of single or multiple layers.

3.1.24

material response

reaction of the *material* to an *electric arc* characterized by *burning time* (after flame), *ignition*, *hole formation*, *melting*, *dripping*, *charring*, *embrittlement*, *shrinkage* and *transmitted energy*

3.1.25

melting

material response evidenced by softening and deformation

Note 1 to entry: *Materials* which melt are normally polymer(s).

3.1.26

prospective short-circuit current

predicted current flowing when the arc electrodes are connected by a conductor of negligible impedance (short-circuit of supply)

Note 1 to entry: *Prospective short-circuit current* is expressed in kA rms.

Note 2 to entry: There is in general a difference between the actual *arc current* I_{arc} and the *test current* I_{class} as defined. The actual *arc current* flowing during the *arc duration* is smaller and fluctuates due to the non-linear arc impedance stochastically varying with time. Reproducible test conditions may only be defined by means of the *prospective short-circuit current* to be expected in case of impedance-less connected arc electrodes. This *prospective short-circuit current* is, by the way, also a parameter which describes the practically interesting points in the electrical systems or installations where arc exposure has to be considered.