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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



78/1367/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: IEC 63232-1-2 ED1	
DATE OF CIRCULATION: 2021-08-27	CLOSING DATE FOR COMMENTS: 2021-11-19
SUPERSEDES DOCUMENTS: 78/1235/NP, 78/1241/RVN	

IEC TC 78 : LIVE WORKING	
SECRETARIAT: France	SECRETARY: Mrs Sophie Chabin
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	

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TITLE:

Live working – Hand protective devices against the thermal hazards of an electric arc – Part 1-2: Test methods – Method 2: Determination of arc protection class of hand protective devices by using a constrained and directed arc (box test)

NOTE FROM TC/SC OFFICERS:

This document has been prepared by PT 63232.

The CD of Part 1-2 and the NP for IEC 63232-2 LIVE WORKING – HAND PROTECTIVE DEVICES AGAINST THE THERMAL HAZARDS OF AN ELECTRIC ARC - Part 2: Requirements are circulating in parallel.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**LIVE WORKING – HAND PROTECTIVE DEVICES
AGAINST THE THERMAL HAZARDS OF AN ELECTRIC ARC –****Part 1-2: Test methods –
Method 2: Determination of arc protection class of hand protective
devices by using a constrained and directed arc (box test)**

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- IEC 63232-1-2 has been prepared by the project team PT 63232: Electric arc performance of hand protection equipment – test standard of IEC technical committee 78: LIVE WORKING. It is an International Standard.
- This is the first edition.
- The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/NP	XX/XX/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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The National Committees are requested to note that for this publication the stability date is XXXX.

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

Part 1-2: Test methods – Method 2: Determination of arc protection class of hand protective devices by using a constrained and directed arc (box test)

1 Scope

This part of IEC 63232 specifies procedures to test *hand protective devices* intended for use with 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 *hand protective devices* in four 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 63232-1-1, using an open arc for testing.

This standard covers the thermal effects of an electric arc. Other effects 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.

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

EN 420:2003 + A1: 2009, *Protective gloves – General requirements and test methods*

¹ ATPV = arc thermal performance value.

² ELIM= Energy Limit

³ EBT=Energy Broken Threshold

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in [external document reference] and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

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)

Note 1 to entry: Arc current is expressed in kiloamperes (kA).

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 to entry: Arc duration is expressed in milliseconds (ms).

3.1.3

arc energy

W_{arc}

<electric arc testing> electrical energy supplied to the arc and converted in the arc

Note 1 to entry: Arc energy is calculated as 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 kilojoules (kJ).

3.1.4

arc gap

distance between the arc electrodes

Note to entry: Arc gap is expressed in millimetres (mm).

3.1.5

arc protection class (APC)

class of *arc thermal protection* of a hand protective device tested in accordance with the box test

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

Note 2 to entry: Tested hand protective device show arc thermal protection at minimum up to the class energy level. In general, the actual exposure energy limit up to which the hand protective device provides protection is higher.

Note 3 to entry: In this standard we have four arc protection classes APC 1 and APC 2 are tested at 300mm, APC 1/150 and APC 2/150 additionally defined to indicate testing at 150 mm.

3.1.6

arc voltage

voltage across the arc

Note 1 to entry: Arc voltage is expressed in volts (V).

3.1.7**burning time****afterflame time**

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

Note to entry: burning time/afterflame time is expressed in seconds (s).

3.1.8**calorimeter**

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

3.1.9**charring**

material response evidenced by formation of carbonaceous residue as the result of pyrolysis or incomplete combustion

3.1.10**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}).

3.1.11**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; used for verification

Note to entry: Direct exposure incident energy is expressed in kilojoules per metre squared kJ/m² (cal/cm²) 4.

3.1.12**dripping**

material response evidenced by formation of droplets that fall from the material of the product.

3.1.13**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 to entry has been added to refer specifically to live working and arc testing.]

3.1.14**embrittlement**

material response evidenced by formation of a brittle residue as the result of pyrolysis or incomplete combustion

3.1.15**exposure time**

total test time interval of observation and measurement

4) Correlation: 1 cal/cm² = 41,840 kJ/m²; 1 kJ/m² = 0,023 9006 cal/cm².

280 Note to entry: Exposure time is expressed in seconds (s).

281 **3.1.16**

282 **hand protective device**

283 **protective glove**

284 item of personal protective equipment (PPE), e.g., protective gloves, that protects the hand or
285 a part of the hand against injury, and is worn to supplement other protective equipment (e.g.
286 protective clothing, face shield, etc.) and can also be used to protect the forearm or the entire
287 arm

288 **3.1.17**

289 **hand protective device assembly**

290 **assembly of gloves**

291 *hand protective device* consisting of two or more *hand protective devices* worn together, which
292 may individually cover different parts of the wearer's hands and forearms and/or which may be
293 worn fully or partially on top of each other (e.g., combination of a liner glove, a rubber insulating
294 glove and a protector glove, etc.) and which have been designed in such a way as to fit together

295 Note 1 to entry: The arc protection class of a hand protective device assembly cannot be determined from the arc
296 protection class of the individual devices but can only be determined by testing of hand protective device assembly
297 specimens.

298 **3.1.18**

299 **heat flux**

300 *<electric arc testing>* thermal intensity transmitted by an *electric arc* indicated by the amount of
301 energy transmitted per unit surface area and time

302 Note 1 to entry: Heat flux is expressed in kilowatts per square metre kW/m².

303 **3.1.19**

304 **hole formation**

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

306 Note 1 to entry: *<in box testing> Shrink-open* is also an instance of *hole formation*.

307 **3.1.20**

308 **ignition**

309 initiation of flaming and combustion

310 **3.1.21**

311 **incident energy**

312 E_i

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

314 Note 1 to entry: Stoll curve differential is expressed in kJ/m² or kW·s/m² (cal/cm²).

315 **3.1.22**

316 **material**

317 substance(s) of which a product is made

318 Note 1 to entry: A product can consist of single or multiple layers.

319 **3.1.23**

320 **material response**

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

324 **3.1.24**

325 **melting**

326 *material response* evidenced by softening and deformation

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

3.1.25**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 kiloamperes (kA).

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.

3.1.26**sensor**

assembly with a *calorimeter* and a non-conductive heat-resistant *material* in which the *calorimeter* is mounted

3.1.27**shrinkage**

material response evidenced by reduction in specimen size

3.1.28**shrink-open**

<electric arc testing> material response caused by excessive shrinkage with the result that the test specimen dislodges exposing any part of the calorimeter of the test stand.

Note 1 to entry: <in box testing> *shrink-open* is also considered *hole formation*.

3.1.29**Stoll curve**

empirical model used to predict the onset of second-degree skin burn injury from thermal energy exposure

Note 1 to entry: The Stoll curve defines a relationship between the absorbed energy rate and the human skin tolerance time.

Note 2 to entry: The Stoll curve is defined in the paper: A Method and Rating System for Evaluation of Thermal Protection. Aerospace Medicine, 1969, Vol. 40, pp. 1232-1238 by A.M. Stoll and M.A. Chianta.⁵

3.1.30**Stoll curve differential****SCD**

The maximum or minimum difference between a curve of transmitted energy and the Stoll curve in the time interval from 1 s up to 30 s after the beginning of the arc (time zero); the SCD will be positive and its value will be the maximum difference between the two curves, if the curve of transmitted energy is at any moment during the 29 s equal or above the Stoll curve; the SCD will be negative and its absolute value will be the minimum difference between the two curves, if the curve of transmitted energy is always during the 29 s below the Stoll curve.

Note 1 to entry: Stoll curve differential is expressed in kJ/m² or kW·s/m² (cal/cm²).

3.1.31**test current** **I_{class}**

prospective short-circuit current of the electric test circuit (predicted current), rms value (symmetrical AC component)

Note 1 to entry: Test current is expressed in kiloamperes (kA).

⁵ A Method and Rating System for Evaluation of Thermal Protection. Aerospace Medicine, 1969, Vol. 40, pp. 1232-1238 by A.M. Stoll and M.A. Chianta.