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Part 6-1: Multiple function equipment - Transfer switching equipment

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Responsible Committee Secretary: **Mr Simon Bounds (BSI)**Direct tel: **0208 996 7281**E-mail: simon.bounds@bsigroup.com

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.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

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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.	

PROJECT NUMBER: IEC 60947-6-1 ED4	
DATE OF CIRCULATION: 2025-02-07	CLOSING DATE FOR VOTING: 2025-05-02
SUPERSEDES DOCUMENTS: 121A/594/CD, 121A/606B/CC	

IEC SC 121A : LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR	
SECRETARIAT: France	SECRETARY: Mr Michaël LAHEURTE
OF INTEREST TO THE FOLLOWING COMMITTEES: SC 23K, SC 121B	HORIZONTAL FUNCTION(S):
ASPECTS CONCERNED: Electromagnetic Compatibility, Safety	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING Attention IEC-CENELEC parallel voting The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE: Low-voltage switchgear and controlgear – Part 6-1: Multiple function equipment - Transfer switching equipment
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PROPOSED STABILITY DATE: 2029

NOTE FROM TC/SC OFFICERS: SC121A officers are supporting the circulation of CDV for IEC 60947-6-1 ED4. Experts are kindly asked to refer to line numbers when commenting the document.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 6-1: Multiple function equipment –
Transfer switching equipment**

FOREWORD

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International Standard IEC 60947-6-1 has been prepared by sub-committee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

This third edition cancels and replaces the second edition published in 2005, and its Amendment 1:2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- clarification of scope and object;
- clarification of terms and definitions;
- removal of unnecessary definitions;
- modification of characteristics;

- modification of utilization categories definitions;
- introduction of new markings requirements;
- addition of new requirements for clearances and creepage distances;
- addition of new requirements and tests for mechanical and electrical interlocks;
- clarification of transfer sequences;
- modification of requirements for rated short-time withstand currents;
- modification of new requirements for electromagnetic compatibility;
- clarification of performance requirements for CB type TSE, in alignment with requirements stated in IEC 60947-2;
- addition of new test sequence V: Critical load current performance of equipment with DC ratings.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
121A/XXX/FDIS	121A/XXX/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 60947 series, published under the general title *Low-voltage switchgear and controlgear*, can be found on the IEC website.

This document shall be read in conjunction with IEC 60947-1:2020, *Low voltage switchgear and controlgear – Part 1: General rules*.

The provisions of the general rules are applicable to IEC 60947-6-1 where specifically called for. General rules clauses and subclauses thus applicable as well as tables, figures and appendices are identified by reference to IEC 60947-1:2020, for example, 1.2.3, Table 4, or Annex A of IEC 60947-1:2020. The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The National Committees are requested to note that for this publication the stability date is 2022

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

IMPORTANT – The “colour inside” logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

INTRODUCTION

The availability of power in low voltage electrical installations is playing an ever increasing role in modern society. In actual fact, this requirement is a fundamental characteristic for the creation of economically and functionally efficient installations. A system able to switch a load from one source to another safely and with minimum disturbance to the load reduces problems caused by faulty conditions in the normal supply to the minimum.

All these operations, commonly known as “transfer switching”, control the installations and can be done automatically, remotely or manually.

Therefore, an installation with installed “transfer switching” capability:

- ensures the continuity of production processes;
- provides a backup source of power if the main network is out of service;
- reduces the effect caused by network faults on parts of the installation;
- achieves a good compromise between reliability, simplicity and cost-effectiveness;
- provides the facility manager and managing system with a power source able to supply all or part of the installation.

Key factors motivating customers to use Transfer Switch Equipment (TSE) include:

- the continuous world growth population, the increasing number of electronic devices and the new demands of electric vehicles;
- the mediated pressure on climate change with a resulting increase in the cost of energy;
- the evolution of the electricity market with a greater number of alternate energy sources;
- the user’s expectations of better grid reliability, better economic performance, and a desire to manage their energy.

Stakeholders involved in the management of electricity also have new expectations:

- customers want to reduce the cost of their energy and to have a quality energy supply;
- suppliers want to reinforce confidence to their customers;
- producers expect to optimize their investments;
- governments and regulators are willing to create a competitive and sustainable energy market.

Today, the performance of Transfer Switching Equipment is defined by TSE manufacturers and also by this document. Consultants, integrators, facility managers and end users rely on this document for their power availability needs.

Transfer switching are often realised by implementing a transfer function within the electrical installation, but this critical function may not be appropriately designed. Using a TSE following the requirements of this document ensure the safety and the performance of the transfer function which are necessary for reaching the objectives listed above.

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 6-1: Multiple function equipment – Transfer switching equipment

1 Scope

This document applies to transfer switching equipment (TSE), to be used in power systems for ensuring the continuity of the supply and allowing the energy management of the installation, by transferring a load between power supply sources, the rated voltage of which does not exceed 1 000 V AC or 1 500 V DC.

Specific requirements for bypass/isolation transfer switch equipment are given in Annex C, ATSE having closed transition capability are given in Annex D, stand-alone ATS controllers are given in Annex E, TSE for electric driven fire pump controllers are given in Annex F.

It covers:

- manually operated transfer switching equipment (MTSE);
- remotely operated transfer switching equipment (RTSE);
- automatic transfer switching equipment (ATSE), including the controller.
- stand-alone ATS controllers;
- bypass/isolation transfer switch equipment (BTSE);
- ATSE having closed transition capability;
- fire pump TSE.

It does not cover:

- TSE configurations that are not fully manufacturer type tested and/or marked according to this document as a complete transfer switch;
- auxiliary contacts (for guidance, see IEC 60947-5-1);
- transfer switches used in explosive atmospheres (for guidance, see IEC 60079 (all parts));
- embedded software design (for guidance, see IEC TR 63201);
- cybersecurity aspects (for guidance, see IEC TS 63208);
- TSE rated for direct-on-line starting asynchronous motor of design NE and HE, according to IEC 60034-12:2016. (for guidance, see AC-3e utilisation category according IEC 60947-4-1:2018);
- other types of TSE under consideration including overlapping neutral TSE, multi-source TSE (i.e. TSE with more than two sources of supply), TSE with load-shedding functions and bus-tie TSE;
- static transfer switches covered by IEC 62310 series.

NOTE TSE used for safety services and for emergency escape lighting systems as described in IEC 60364-5-56 are subject to specific rules and/or legal requirements.

The object of this document is to state:

- 1) the characteristics of the equipment;
- 2) the conditions of the equipment with respect to:
 - a) operation for which the equipment is intended;

- b) operation and behaviour in case of specified abnormal conditions, for example, short-circuit;
- c) dielectric properties;
- 3) the tests intended to confirm that these conditions have been met and the methods for performing these tests;
- 4) the product information to be provided by the manufacturer.

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.

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests - Test B: Dry heat*

IEC 60417, *Graphical symbols for use on equipment* (available at <http://www.graphical-symbols.info/equipment>)

IEC 60715:2017, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on rails for mechanical support of switchgear, controlgear and accessories*

IEC 60812, *Failure modes and effects analysis (FMEA and FMECA)*

IEC 60947 (all parts), *Low-voltage switchgear and controlgear*

IEC 60947-1:2020, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-2:2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*
IEC 60947-2:2016/AMD1:2019

IEC 60947-3:2020, *Low-voltage switchgear and controlgear – Part 3: switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60947-4-1:2023, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters*

IEC 61000-4-13:2002, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low-frequency immunity tests*

IEC 61000-4-13:2002/AMD1:2009

IEC 61000-4-13:2002/AMD2:2015

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

CISPR 11:2015/AMD1:2016

3 Terms and definitions

3.1 General

For the purposes of this document, the terms and definitions given in Clause 3 of IEC 60947-1:2020, and the following apply.

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

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

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198	TSE	
199	equipment containing one or more switching devices and associated operating mechanism for	
200	disconnecting load circuits from one supply and connecting to another supply	
201	3.3.2	
202	manually operated transfer switching equipment	
203	MTSE	
204	transfer switching equipment operated manually and non-electrically	
205	3.3.3	
206	remotely operated transfer switching equipment	
207	RTSE	
208	transfer switching equipment that is electrically operated and not self-acting	
209	Note 1 to entry: RTSE can have a feature for local and/or manual operation.	
210	3.3.4	
211	automatic transfer switching equipment	
212	ATSE	
213	self-acting transfer switching equipment, including all necessary sensing inputs, monitoring,	
214	and control logic for transferring operations	
215	Note 1 to entry: ATSE can have a feature for local and/or remote and/or manual operation.	
216	3.3.5	
217	derived transfer switching equipment	
218	derived TSE	
219	TSE based on switching devices that have certain tests required for compliance with IEC 60947-	
220	6-1 as defined in Table 9, covered by IEC 60947-3 for Class PC, IEC 60947-2 or IEC 60947-6-	
221	2 for Class CB, or IEC 60947-4-1 for Class CC	
222	Note 1 to entry: It is not necessary to repeat tests fully covered in the switching devices product standards.	
223	3.3.6	
224	Class PC TSE	
225	transfer switch equipment based on mechanical switching devices, that do not need electrical	
226	power to hold the main contacts open or closed and capable of making, carrying, and breaking	
227	currents under normal circuit conditions including operating overload conditions, and making	
228	and withstanding short-circuit currents	

229 Note 1 to entry: For the purposes of this document, a fuse-combination unit is considered a Class PC device capable
230 of breaking short-circuit current.

231 Note 2 to entry: Class PC TSE are also capable of withstanding conditional short-circuit currents.

232 3.3.7

233 Class CB TSE

234 transfer switch equipment based on mechanical switching devices and capable of making,
235 carrying and breaking currents under normal circuit conditions including operating overload
236 conditions, and making and breaking short-circuit currents

237 Note 1 to entry: Class CB TSE for which the manufacturer has assigned a short-time withstand current are also
238 capable of withstanding short-circuit currents.

239 3.3.8

240 Class CC TSE

241 transfer switch equipment based on mechanical switching devices having only one position of
242 rest, operating otherwise than by hand, and capable of making, carrying and breaking currents
243 under normal circuit conditions including operating overload conditions

244 Note 1 to entry: Class CC TSE are not capable of making or breaking short-circuit currents. They are only capable
245 of withstanding conditional short-circuit currents.

246 Note 2 to entry: Class CC TSE is not suitable for isolation.

247 3.3.9

248 ATS (Automatic Transfer Switch) controller

249 device intended for sensing and monitoring the power supply sources, and controlling the
250 automatic transfer sequence

251 Note 1 to entry: ATS controller can be either integral to the ATSE or stand-alone to be associated with an RTSE
252 used in accordance with Annex E.

253 3.3.10

254 dedicated wiring accessory

255 prefabricated connection wiring system specifically intended for identified switchgear or
256 controlgear

257 Note 1 to entry: A dedicated wiring accessory can be integrated in the switchgear or controlgear or delivered
258 separately.

259 Note 2 to entry: A typical dedicated wiring accessory is for example a connection link.

260 3.3.11

261 bypass transfer switching equipment

262 BTSE

263 transfer switching equipment used to select an available power source and feed load circuits
264 while temporarily isolating and bypassing the main TSE for inspection, no-load test sequence
265 and maintenance purposes

266 3.3.12

267 main TSE (of a BTSE)

268 TSE intended for transferring loads between sources under normal conditions, excluding
269 inspection, maintenance and testing conditions

270 3.3.13

271 backup TSE (of a BTSE)

272 TSE intended for bypassing and isolating the main TSE

3.3.14**isolating switching devices (of a BTSE)**

switching devices used for isolation of the main TSE when the BTSE is used in bypass mode

3.3.15**bypass mode (of a BTSE)**

specific mode or position of a BTSE allowing to bypass the main TSE

3.3.16**load-break mode (of a BTSE)**

specific mode or position of a BTSE allowing to disconnect load conductors from main TSE

3.3.17**bypass / Isolation mode (of a BTSE)**

specific mode or position of a BTSE that provides isolation of the main TSE power and load terminals for testing purposes while control power may still be available

3.3.18**normal mode (of a BTSE)**

specific mode or position of a BTSE used under normal transfer switching conditions

3.3.19**test mode or test position (of BTSE)**

specific mode or position of a BTSE that provides isolation of the main TSE power and load terminals for testing purposes while control power may still be available

3.3.20**Stand-alone ATS controller**

Separately certified ATS controller intended for association with RTSE

Note 1 to entry: Stand-alone controllers are covered in Annex E.

3.3.21**TSE suitable for electric driven fire pump control equipment (fire pump TSE)**

transfer switching equipment that has specific constructional, functional, and performance characteristics required for compliance with IEC 62091

Note 1 to entry: Fire pump TSE are covered in Annex F.

3.3.22**Combined ATSE**

ATSE based on a combination of an RTSE, a stand-alone ATS controller, combined markings and combination testing with all the minimum mandatory components needed for the manufacturer of the combined ATSE to achieve compliance with this standard as a complete ATSE.

3.4 Operation of TSE**3.4.1****operating sequence**

automatic transfer of a load from one supply to another in the event of a monitored supply deviation and/or other predefined conditions

Note 1 to entry: This definition applies only for ATSE.

3.4.2**monitored supply deviation**

variation in the measured power supply characteristics that exceeds predetermined limits

Note 1 to entry: This definition applies only for ATSE.

EXAMPLE Abnormal changes in voltage or frequency of the supply are supply deviations.

3.4.3**voltage supply deviation**

change in voltage level from the nominal voltage of the monitored supply

3.4.4**frequency supply deviation**

change in frequency from the nominal operating frequency of the monitored supply

3.4.5**contact transfer time**

time applicable to all ATSE, RTSE, and two position MTSE that is measured from the mechanical opening of all poles from one set of main contacts of one power supply to the mechanical closing of any pole of a second set of main contacts on another power supply, with any adjustable time-delay set to the minimum value

3.4.6**operating transfer time**

time measured from the instant when the transfer conditions are fulfilled to the closing of the main contacts on the other source, with any adjustable time delay set to the minimum value, transfer condition being typically supply deviations and programmed conditions for ATSE or remote control commands for RTSE

Note 1 to entry: Operating transfer times from source I to source II and from source II to source I can be different, and can vary depending on the monitored supply deviation.

Note 2 to entry: Operating transfer time does not apply to MTSE.

3.4.7**open transition**

a break before make transfer operation that intentionally breaks the load current from one source for a period of time prior to making it to the other source

3.4.8**in-phase transfer**

control function of an ATSE to only allow an open transition transfer when the two sources are considered in phase, at the same voltage and frequency

3.4.9**closed transition**

a make before break transfer operation that intentionally makes the load current of a second synchronized source for a short period of time (overlap time) before breaking it from the first source

3.4.10**interlocking**

< TSE > feature(s) that makes the state of two mechanisms mutually exclusive, preventing any of the phases of source I and source II from being connected together

Note 1 to entry: Interlocking prevents the closed position of switching devices to be simultaneously achieved under all conditions. The state of two mechanisms mutually dependent prevents the change of position of operation of one mechanism depending on the position of operation of the other.

3.4.11**available source**

supply within the predetermined limits of voltage and frequency

3.4.12**unavailable source**

supply that is lost or has voltage and/or frequency outside the predetermined set limits

3.4.13**stand-alone ATS controller operating transfer time**

The stand-alone ATS controller operating transfer time is the time measured from the instant when the transfer conditions are fulfilled to the close command signal with all adjustable time delays set to the minimum and assuming the contact transfer time of an RTSE to be zero

3.4.14**synchronized sources**

condition when the two sources are considered in phase within limits of $\pm 10^\circ$, at the same RMS voltage within limits of $\pm 5\%$ and frequency within limits of $\pm 1\text{Hz}$

NOTE The setting tolerance for when two sources are considered synchronized can be narrower depending on agreement with the utility, local regulations, and the power producer.

3.4.15**interlocking for ATSE having closed transition capability**

<TSE> feature(s) that make(s) the state of two mechanisms mutually exclusive, preventing any of the phases of source I and source II from being connected together (when sources are not synchronized and/or the switch is operating in open transition), and will allow a make before break transfer operation when operating in closed transition with the two sources synchronized.

NOTE Interlocking for ATSE having closed transition capability can be achieved by purely mechanical, or purely electrical, or a combination of both electrical and mechanical means.

3.5 Main contact positions**3.5.1****switching position**

position of the main contacts defining whether the load terminals are connected to source I or source II terminals, or not connected

3.5.2**position I**

contact position of the equipment when the load terminals are connected to source I terminals

3.5.3**position II**

contact position of the equipment when the load terminals are connected to source II terminals

3.5.4**OFF position**

stable contact position of rest of the equipment when the load terminals are connected to neither source I nor source II terminals

Note 1 to entry: The OFF position may also be marked as the O position.

3.6 Symbols and abbreviations

EMC	Electromagnetic compatibility	
FMEA	Failure mode effects analysis	9.2.3.2.4
I_c	Current made and broken	Table 3
I_{cm}	Rated short-circuit making capacity	5.3.6.3
I_{cn}	Rated short-circuit breaking capacity	5.3.6.4
I_{cw}	Rated short-time withstand current	5.3.6.2
I_e	Rated operational current	5.3.3
I_q, I_{cc}	Rated conditional short-circuit current	5.3.6.5
SCPD	Short-circuit protective device	
U_e	Rated operational voltage	5.3.2.1
U_i	Rated insulation voltage	5.3.2.2
U_{imp}	Rated impulse withstand voltage	5.3.2.3
U_r	Power frequency or DC steady-state recovery voltage	Table 3

4 Classification

Transfer switching equipment is classified according to:

a) their characteristics:

- Class PC;
- Class CB;
- Class CC;

b) the method of controlling the transfer:

- manually operated switching equipment (MTSE);
- remotely operated switching equipment (RTSE);
- automatic transfer switching equipment (ATSE);

c) the number of main contact positions:

- TSE with two positions (I – II);
- TSE with three positions (I – O – II);
- TSE with overlapping contacts (I – I + II – II)

NOTE overlapping main contacts (I – I + II – II) are not suitable for RTSE

d) their suitability for isolation:

- TSE suitable for isolation in the OFF position;
- TSE not suitable for isolation;

NOTE TSE having only two positions (I – II) and all Class CC TSE are not suitable for isolation.

e) the transition type:

- open transition;
- closed transition.

5 Characteristics

5.1 Summary of characteristics

Wherever applicable, the characteristics of the TSE shall be stated as follows:

- type and characteristics of equipment (5.2);
- rated and limiting values for the main circuit (5.3);
- utilization category (5.4);
- control circuits (5.5);
- auxiliary circuits (5.6).

Where the TSE uses IEC 60947 products, the relevant characteristics from those standards may also be additionally stated.

Specific characteristics subject to agreement between manufacturer and user are listed in Annex B.

5.2 Type and characteristics of equipment

The following shall be stated:

- a) class and transfer control method of the equipment (see Clause 4);
- b) number of poles;
- c) neutral pole terminal, if applicable, by the letter “N” (see 8.1.8.4 of IEC 60947-1:2020)
- d) kind of current (alternating current or direct current or both);
- e) in case of alternating current, the number of phases and the rated frequency;
- f) number of main contact positions;
- g) suitability for isolation;
- h) transition type;
- i) type of interlock (mechanical, electrical, or electrical-and-mechanical)

NOTE In Canada, Mexico and United States of America open transition transfer switching equipment is required to use mechanical interlocking.

- j) control functions (such as in-phase transfer);
- k) contact transfer time;
- l) in case of RTSE or ATSE, operating transfer time;
- m) in case of ATSE, operating sequences;
- n) the minimum mandatory components needed to achieve compliance as a complete TSE, including:
 - switching device(s);
 - switching mechanism, where applicable;
 - mechanical and/or electrical interlock for use with separate switching devices;
 - actuator, manual (for MTSE);
 - actuator, remote (for RTSE and ATSE);
 - ATS controller for ATSE;
 - signal terminals for input signals (for RTSE and ATSE);
 - source I and source II terminals;

- load terminals;
- where applicable, bridging conductors or instructions on how to fabricate them;
- sensing cables or instructions on how to fabricate them (for ATSE).

o) wiring diagram;

p) dedicated wiring accessories.

5.3 Rated and limiting values for the main circuit

5.3.1 General

Subclause 5.3 of IEC 60947-1:2020 applies. Rated values may be different between position I and position II.

5.3.2 Rated voltages

5.3.2.1 Rated operational voltage (U_e)

Subclause 5.3.1.1 of IEC 60947-1:2020 applies.

5.3.2.2 Rated insulation voltage (U_i)

Subclause 5.3.1.2 of IEC 60947-1:2020 applies.

5.3.2.3 Rated impulse withstand voltage (U_{imp})

Subclause 5.3.1.3 of IEC 60947-1:2020 applies with the following addition:

When different values of U_{imp} are declared for circuits others than the mains, the instruction for installation shall provide specific instruction for ensuring the insulation coordination of the installation as stated by Annex H of IEC 60947-1:2020.

5.3.3 Rated operational current (I_e)

The rated operational current of TSE is stated by the manufacturer according to subclause 5.3.2.3 of IEC 60947-1:2020 for uninterrupted duty. It is possible for a device to have several I_e , depending on utilization category and operational voltages U_e .

5.3.4 Rated frequency

Subclause 5.3.3 of IEC 60947-1:2020 applies.

5.3.5 Rated making and breaking capacities

Subclauses 5.3.5.2 and 5.3.5.3 of IEC 60947-1:2020 apply.

The rated making and breaking capacities are the values of current, stated by the manufacturer, which the transfer equipment can satisfactorily make and break under specified conditions. Unless stated otherwise, they are given in terms of a steady state current value. During the making operation, the peak value of the current on contact closing may be higher than the peak value of the steady state current depending on the characteristics of the test circuit (load) and the instant of closing on the voltage wave.

The rated making and breaking capacities are stated with reference to the rated operational voltage, the rated operational current and the utilization category according to Table 3.

For alternating current, the rated making and breaking capacities are expressed by the RMS value of the AC component of the current.

5.3.6 Short-circuit characteristics

5.3.6.1 General

Class PC TSE shall have either a rated short-time withstand current or a rated conditional short-circuit current but may have both.

Class CB TSE shall have a rated short-circuit breaking capacity and a rated short-circuit making capacity and may have a rated short-time withstand current.

Class CC TSE shall have a rated conditional short-circuit current.

5.3.6.2 Rated short-time withstand current (I_{cw})

Subclause 5.3.6.1 of IEC 60947-1:2020 applies under the test conditions specified in 9.2.5.2 and the minimum value of rated short-time withstand current is given in Table 5.

5.3.6.3 Rated short-circuit making capacity (I_{cm})

Subclause 5.3.6.2 of IEC 60947-1:2020 applies under the test conditions specified in 9.2.5.3.

The rated short-circuit making capacity is the value of short-circuit making capacity assigned by the manufacturer for the rated operational voltage at rated frequency and at a specified power-factor (or time-constant). It is expressed as the maximum prospective peak current. For alternating current, the rated short-circuit making capacity shall be not less than the highest value of short-circuit breaking capacity or short-time withstand current, as applicable, multiplied by the ratio n of Table 16 of IEC 60947-1:2020. For direct current, the rated short-circuit making capacity shall be not less than the highest value of short-circuit breaking capacity or short-time withstand current, as applicable. The manufacturer may assign a higher value of short-circuit making capacity.

5.3.6.4 Rated short-circuit breaking capacity (I_{cn})

This characteristic applies only to Class CB.

Subclause 5.3.6.3 of IEC 60947-1:2020 applies under the test conditions specified in 9.2.5.4.

The rated short-circuit breaking capacity for a Class CB TSE is equivalent to the rated ultimate short-circuit breaking capacity of a circuit breaker according to IEC 60947-2.

5.3.6.5 Rated conditional short-circuit current (I_q , alternatively I_{cc})

Subclause 5.3.6.4 of IEC 60947-1:2020 applies under the test conditions specified in 9.2.6.

The minimum value of the prospective current is given in Table 5 or Table 6 at the discretion of the manufacturer.

5.4 Utilization category

TSE may be assigned to one or more of the standard utilization categories given in Table 1 at one or more rated operational voltages.

The designation of TSE utilization categories is completed by the suffix A or B, according to the type and number of operations (see 3.3.18 of IEC 60947-1:2020, Table 10, Table 11 and Table 12) required by the application.

TSE assigned any TSE utilization category shall comply with the rated making and breaking capacity (see Table 3) and the electrical and mechanical operational performance requirements (see Table 4) corresponding to the assigned utilization category.

Table 1 – Utilization categories

Nature of current	TSE Utilization category		Typical switching load
	Type A	Type B	
Alternating current	AC-31A	AC-31B	Non-inductive or slightly inductive loads
	AC-32A	AC-32B	Switching of mixed resistive and inductive loads, including moderate overloads
	AC-33A	AC-33B	Squirrel-cage motors
	AC-35A	AC-35B	Discharge lamp loads
	AC-36A	AC-36B	Incandescent lamp loads
Direct current	DC-31A	DC-31B	Non-inductive or slightly inductive loads
	DC-33A	DC-33B	Shunt-motors
	DC-36A	DC-36B	Incandescent lamp load

5.5 Control circuits

5.5.1 General

Subclause 5.5 of IEC 60947-1:2020 applies with the following additions for monitored supply (see 3.4.2).

5.5.2 Electro-mechanical devices operating the main circuit

The minimum and maximum values of voltage or voltage and frequency operating limits shall be stated by the manufacturer. The characteristics of the control circuit shall be stated as the minimum and maximum values of the rated control circuit supply voltage.

5.5.3 ATS controller

The manufacturer shall state the following:

- a) the voltage supply deviations and, if applicable, the frequency supply deviations at which transfer should be initiated;
- b) the tolerance of the voltage deviations, frequency deviations (where applicable), and anytime delays shall be specified by the manufacturer, but shall not exceed $\pm 10\%$.

5.6 Auxiliary circuits

Subclause 5.6 of IEC 60947-1:2020 applies.

6 Product information

6.1 Nature of information

All information of Table 2 below shall be given by the manufacturer.

6.2 Marking

Subclause 6.2 of IEC 60947-1:2020 applies, where applicable, and according to Table 2 below.

In addition to Table 2, all controls accessible to the operator shall be marked to indicate their function.

NOTE TSE composed of several components can be delivered with a separate nameplate to be attached to the equipment according to the instructions of the manufacturer.

Table 2 (1 of 2) – Product information

Reference	Required marking	Marking location
1.1	Switching position I – II or I – O – II, as applicable, as follows: I (IEC 60417-5007:2002-10) for ON (source I) O (IEC 60417-5008:2002-10) for power OFF II (IEC 60417-6176:2012-11) for ON (source II)	Visible
1.2	Suitability for isolation, where applicable, with the isolation function symbol according to IEC 60417-6169-1:2012-08	Visible
1.3	For RTSE or ATSE with off-load manual operations for maintenance purposes: "OFF-LOAD OPERATION ONLY, switch off all supply sources before operating manually"	Visible
2.1	Manufacturer's name or trade mark of the complete TSE	Marked
2.2	Manufacturer's name or trade mark of the complete combined ATSE ^e	Marked
2.3	Type designation or serial number	Marked
2.4	"IEC 60947-6-1", indicating the product complies with this standard	Marked
2.5	Class of equipment (PC, CC, CB), method of controlling (MTSE, RTSE, ATSE) and transition type (open transition, closed transition) according to Clause 4	Marked
2.6	Rated operational voltage(s) (U_e) as defined in 5.3.2.1 ^c	Marked
2.7	Utilization categories as defined in 5.4 and corresponding operational current(s) as defined in 5.3.3 and 5.3.5 at the rated operational voltage as defined in 5.3.2.1 ^c	Marked
2.8	Value of the rated frequency as defined in 5.3.4, or the indication "d.c." or the symbol — — — (IEC 60417-5031:2002-10) ^c	Marked
2.9	Rated short-time withstand current (I_{cw}) as defined in 5.3.6.2, if applicable ^c	Marked
2.10	Rated short-circuit breaking capacities (I_{cn}) as defined in 5.3.6.4, if applicable ^c	Marked
2.11	For ATSE and RTSE, rated control circuit supply voltage and frequency as defined in 5.5.1 ^c	Marked
2.12	Rated impulse withstand voltage (U_{imp}) as defined in 5.3.2.3 ^c	Marked
2.13	Terminal designations and markings ^c	Marked
2.14	Degree of protection of enclosed equipment according to Annex C of IEC 60947-1:2020 if the degree of protection is different than IP00 ^d	Marked
2.15	Identification of neutral pole terminals, if applicable	Marked
2.16	For TSE including parts with stored charge components according to 8.1.8, a warning notice shall be provided on the product	Marked
2.17	For TSE Class CB, reference temperature for non-compensated thermal releases, if different than 30°C	Marked
2.18	For TSE Class CB, range of the current settings (I_r) of the adjustable overload releases	Marked
2.19	For TSE Class CB, range of the rated instantaneous short-circuit current setting (I_l),	Marked

	for adjustable releases	
3.1	Type of interlock as defined in 5.2 item i)	Literature
3.2	Number of poles	Literature
3.3	Rated short-circuit making capacities (I_{cm}) for Class PC and Class CB if higher than the minimum value as defined in 5.3.6.3 ^c	Literature
3.4	Rated conditional short-circuit current (I_q , alternatively I_{cc}) as defined in 5.3.6.5 and associated SCPD if applicable ^c	Literature
3.5	Rated insulation voltage (U_i) as defined in 5.3.2.2 ^c	Literature
3.6	Number of main contact positions ^c	Literature

568

Table 2 (2 of 2) – Product information

Reference	Required marking	Marking location
3.7	For RTSE and ATSE, operating limits of electromechanical devices operating the main circuit, as defined in 5.5.2 ^c	Literature
3.8	For ATSE, monitored supply deviations and operating limits as defined in 5.5.3 ^c	Literature
3.9	Auxiliary circuits characteristics as defined in 5.6 ^c	Literature
3.10	For ATSE, operating sequence ^c	Literature
3.11	Contact transfer time ^{a, c} and operating transfer time ^{b, c} and additional information including time delays with their position in the operating sequence, if any	Literature
3.12	EMC Environment A or B as defined in 8.3.1 of IEC 60947-1:2020	Literature
3.13	Conductor strip length ^c	Literature
3.14	Maximum number of conductors which may be clamped ^c	Literature
3.15	Conductor designation for non-universal screwless terminals ^c : - “s” or “sol” for rigid-solid conductors - “r” for rigid (solid and stranded) conductors - “f” for flexible conductors	Literature
3.16	References of minimum mandatory component of the complete unit which are required for the TSE (refer to 5.2 item n))	Literature
3.17	Control functions ^c such as in-phase transfer	Literature
3.18	Wiring diagram	Literature
3.19	Dedicated wiring accessories (if applicable)	Literature
3.20	For TSE Class CB only (see cl. 9.2.5.4.3) – tripping/time characteristic – temperature/current characteristic, if applicable	Literature
Key 1.x Visible The marking on the product shall be visible to the operator after the product is installed 2.x Marked On equipment or nameplate 3.x Literature In provided literature NOTE In the case of electronically controlled electromagnets, other information can also be considered for example the control circuit configuration (see 5.5 and Annex U of IEC 60947-1:2020). ^a Not required for three-position MTSE. ^b Not required for MTSE.		

- ^c Where the characteristic is different for position I versus position II, the manufacturer shall state both.
- ^d Several degrees of protections may be given in the literature for different types of access such as front face, terminals, etc.
- ^e Additional requirement for combined ATSE.

569 NOTE 1 The RTSE manufacturer may declare and label the equipment not suitable for use with stand-alone ATS
570 controllers.

571 NOTE 2 In addition to the above requirements, a QR code may be provided to guide a user to literature in
572 electronic/digital format.

573

574 **6.3 Instructions for installation, operation and maintenance, decommissioning and**
575 **dismantling**

576 Subclause 6.3 of IEC 60947-1:2020 applies with the following addition.

577 The instructions shall also cover the dedicated wiring accessories, if applicable.

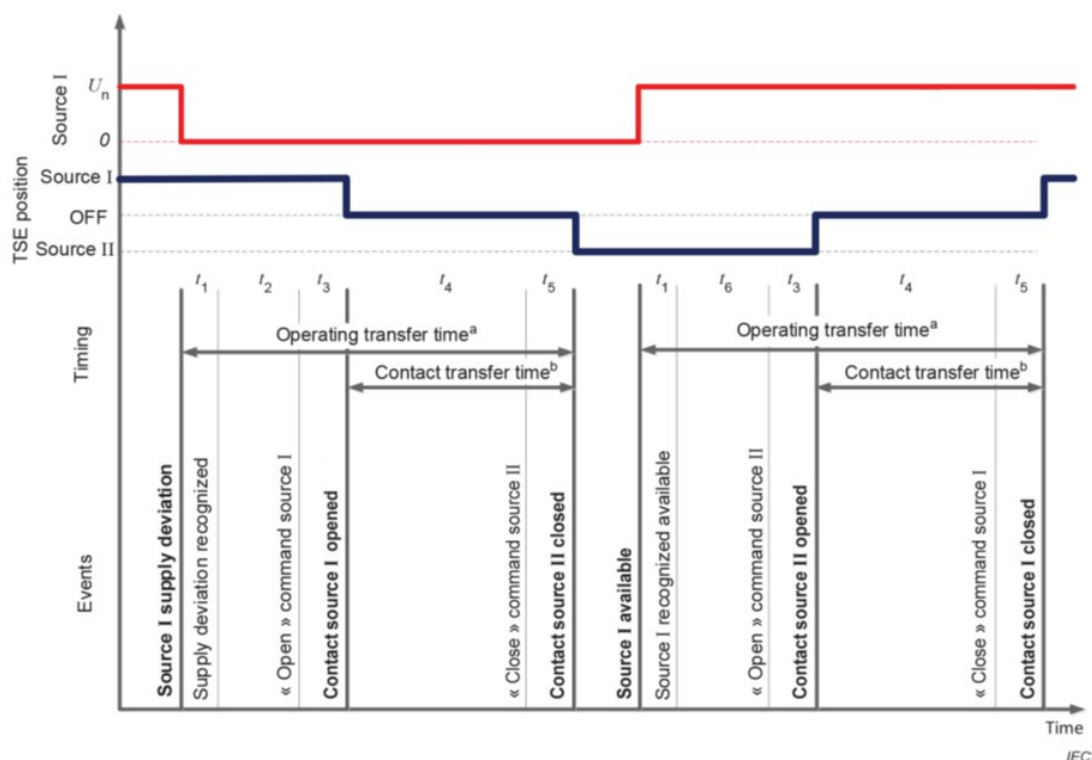
578 For TSE tested according to this document and delivered to the customer unassembled or
579 partially assembled, the TSE manufacturer shall provide instructions for proper assembly,
580 wiring, marking, any remaining routine tests as defined in 9.3, commissioning, operation and
581 maintenance of the TSE. For sensing cables and bridging conductors not supplied with the TSE
582 or not made available as a type tested accessory, the manufacturer shall provide instructions
583 on how to fabricate.

584 NOTE 1 The instruction can include appropriate references to IEC 61439 (all parts) for the integration of the TSE
585 into an assembly.

586 NOTE 2 For combined ATSE the manufacturer of a stand-alone ATS Controller or of an RTSE can provide, for
587 example, a wiring diagram, wiring instructions, combined ATSE test requirements, configuration settings and a list
588 of compatible RTSE and stand-alone ATS controller combinations including all the minimum mandatory components
589 required to achieve compliance with this standard as a complete ATSE.

590 The operation manual of the TSE shall include the description of the operating sequences. An
591 example is shown in Figure 1.

592



Key

- t_1 time to detect source I supply deviation
- t_2 purposely introduced adjustable transfer time delay
- t_3 system induced time delay
- t_4 purposely introduced adjustable OFF position time delay
- t_5 system induced time delay
- t_6 purposely introduced adjustable return time delay

NOTE This figure assumes source II is available.

^a equal to operating transfer time when all purposely introduced time delays (t_2 , respectively t_6 , t_4) are set to a minimum value.

^b equal to contacts transfer time when all purposely introduced time delays (t_4) are set to a minimum value.

Figure 1 – Example of operating sequences for TSE with three positions

6.4 Environmental information

When required, material declarations shall be established according to Annex W of IEC 60947-1:2020.

NOTE IEC TS 63058 give the method for assessing the environmental impact of switchgear and controlgear.

7 Normal service, mounting and transport conditions

Clause 7 of IEC 60947-1:2020 applies.

Standard conditions of vibration are defined in footnote b of Table Q.1 of IEC 60947-1:2020.

Rail mounting shall be specified according to IEC 60715:2017, when relevant.

8 Constructional and performance requirements

8.1 Constructional requirements

8.1.1 General

Subclause 8.1 of IEC 60947-1:2020 applies with the following additions.

Subclauses 8.1.1 through 8.1.10 of this document apply.

Measures shall be provided to reduce the likelihood of injury and property damage, under installation, maintenance, normal operation conditions, abnormal operation conditions and reasonably foreseeable misuses. The requirements of this document are generically providing these measures.

Where the product is intended to be used together with specific auxiliary equipment and dedicated wiring accessories, the safety evaluation and test shall include this auxiliary equipment and accessories unless it can be shown that it does not affect the safety of any equipment.

The accessible part of the device and especially the operating means shall not present sharp edges and corners which can injure the operator.

The minimum components which shall be verified by the manufacturer as a complete unit to achieve compliance as a TSE are defined in 5.2 item n):

For sensing cables and bridging conductors not supplied with the TSE or not made available as a type tested accessory, the manufacturer shall provide instructions on how to fabricate.

Where different ratings are declared for position I and position II, each position shall be tested.

For CC class TSE, standard conditions of vibration are defined in footnote b of Table Q.1 of IEC 60947-1:2020.

NOTE Refer to Annex O of IEC 60947-1:2020 for considerations for substitution or reduction in use of hazardous substances.

8.1.2 Materials

Subclause 8.1.2 of IEC 60947-1:2020 applies.

When tests on the equipment or on sections taken from the equipment are used, parts of insulating materials necessary to retain current-carrying parts of power circuits in position shall conform to the glow wire test of 9.2.2.1 of IEC 60947-1:2020 with a test temperature of:

- 850°C for Class CC TSE, or
- 960°C for Class CB and Class PC TSE.

NOTE Fire risk analysis and risk reduction measures of switchgear and controlgear are given by IEC TR 63054.