



**International
Standard**

ISO 1509

**General purpose push-pull three-
pole circuit-breakers for aircraft —
Performance requirements**

*Disjoncteurs tripolaires à bouton-poussoir d'usage courant
utilisés à bord des aéronefs — Caractéristiques*

**Second edition
2024-04**

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Published in Switzerland

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Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO 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 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.

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

This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 1, *Aerospace electrical requirements*.

This second edition cancels and replaces the first edition (ISO 1509:1973), which has been technically revised.

The main changes are as follows:

- ambient temperature and altitudes have been updated;
- operation forces have been updated;
- time/current characteristics have been updated;
- mechanical shocks test have been updated;
- high voltage and insulation tests have been updated;
- tests of temperature rise and minimum and maximum limit of ultimate trip current have been updated;
- operating forces test have been updated;
- mechanical strength tests have been updated;
- overload and re-closure test have been updated.

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

This document provides performance requirements of the general purpose push-pull three-pole circuit-breakers normal ratings up to and including 35 A for aircraft.

The purpose of this document are as follows:

- a) To standardize the requirements for push-pull three-pole trip-free circuit-breakers that are physically and environmentally diversified.
- b) To provide the applicable document for push-pull three-pole trip-free circuit-breakers.

In order to satisfy the purpose of this document, requirements such as those for physical, environmental and individual items are specified in accordance with the detail requirements that are issued individually.

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General purpose push-pull three-pole circuit-breakers for aircraft — Performance requirements

1 Scope

This document specifies the performance requirements for push-pull, three-pole, trip-free circuit breakers having an inverse time/current characteristic of normal ratings up to and including 35 A for use in nominal 115 V/200 V three-phase 400 Hz a.c. circuits.

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 2635, *Aircraft — Conductors for general purpose aircraft electrical cables and aerospace applications — Dimensions and characteristics*

ISO 1033, *Aircraft — Dimensions for general purpose push-pull three-pole circuit-breakers*

ISO 1540, *Aerospace — Characteristics of aircraft electrical systems*

ISO 7137, *Aircraft — Environmental conditions and test procedures for airborne equipment*

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

push-pull three-pole circuit-breaker

circuit-breaker with a single button to trip and reset the breaker, by pushing to make and pulling to break

3.2

trip-free circuit-breaker

Circuit-breaker so designed that holding the push-button in the closed position does not override the tripping mechanism and does not permit subsequent closure of the contacts, until the push-button has been returned to the open position and the tripping mechanism has reset

4 Design requirements

4.1 Ambient temperature and altitudes

The circuit-breaker shall be suitable for use at specified ambient temperatures and altitudes. There are two temperature ranges: -55 °C to $+70\text{ °C}$ or -55 °C to $+125\text{ °C}$; and the maximum altitude according to the product standard shall not be less than 22 000 m.

4.2 Operation and instructions

The circuit-breaker shall be operated by a single button, perpendicular to the plane of the mounting panel, pushed to make and pulled to break the circuit. The portion of the button visible when the circuit-breaker is in the closed position shall be black. A white band on the button shall be exposed when the circuit-breaker is in the open position.

4.3 Fixing type

The circuit-breaker shall be suitable for through-panel mounting, preferably by single-hole fixing, and shall operate satisfactorily when mounted in any attitude.

4.4 Trip-free function

The circuit-breaker shall be trip-free and shall incorporate an automatic overload tripping device in each pole.

4.5 Working characteristics

The three sets of contacts shall open and close together when manually operated at normal load and shall open together when automatically tripped on overload current in one or more lines, when the push-button shall move to the open or off position. The difference in time between the making or breaking of the three sets of contacts shall be not more than 5 ms.

4.6 Re-close

The circuit-breaker shall be so designed that, after tripping on overload, it cannot re-close automatically.

5 Dimensions

The envelope and fixing dimensions for the circuit-breakers should conform to ISO 1033.

6 Construction

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6.1 Push-button

The push-button shall be insulated from all current-carrying parts, and shall not remain in an intermediate position, or give a false indication.

6.2 Operation forces

The circuit-breaker shall be so constructed that the forces required to operate it manually do not exceed the following values:

- closing force: 8 N to 80 N;
- tripping force: 5 N to 30 N.

6.3 Surface treatment

The portion of the circuit-breaker visible when mounted shall have a non-glaring finish.

6.4 Rating inviolability

The circuit-breaker shall be so constructed that tampering with the calibration is not possible without dismantling the device or breaking a seat.

6.5 Electrical connections

Each terminal screw or stud shall be size M4 X 0,7 or No. 6 UNC and shall be capable of accepting two tag-type terminations.

6.6 Fasteners

The circuit-breaker shall be mounted by means of a threaded bush suitable for use with the panel mounting hole specified in ISO 1033. Two hexagon mounting nuts, one locating washer and one internal shakeproof washer shall be provided with each circuit-breaker.

7 Voltage and current ratings

7.1 Voltage

The circuit-breaker shall be suitable for operation in a nominal 115 V/200 V three-phase 400 Hz a.c. supply having the characteristics described in ISO 1540.

7.2 Current ratings

The preferred normal current ratings of the circuit-breakers are 1 A, 2 A, 3 A, 5 A, 7,5 A, 10 A, 15 A, 20 A, 25 A, 30 A or 35 A.

8 Environment

The circuit-breakers shall conform to the requirements of ISO 7137, including vibration, acceleration, crash-landing, climatic, explosion proofness and magnetic influence. They shall not support mould growth and shall not deteriorate even after storage for long periods in the tropics.

9 Time/current characteristics

The time/current characteristics of each circuit-breaker can be within the limits shown in [Table 1](#), or the product standard.

Table 1 — Time/current characteristics

Nominal current rating	Ambient temperature	Tripping current	Tripping time
A	°C	%normal current	s
1 to 35	23 ± 2	200	1,5 to 60
		500	0,15 to 7,5
		1 000	0,035 to 1,2
1 to 5	-55 ± 2	200	1,5 to 350
		500	0,15 to 15
		1 000	0,035 to 2
7,5 to 35	-55 ± 2	200	1,5 to 200
		500	0,15 to 12
		1 000	0,035 to 1,75
1 to 35	+70/+125 ± 2	200	1,5 to 45
		500	0,15 to 7
		1 000	0,035 to 1

10 Making and breaking capacity

The circuit-breaker shall have a making and breaking capacity appropriate to the relevant categories shown in [Table 2](#), when tested under the conditions described in [13.15](#).

Table 2 — Making and breaking categories

Rupturing capacity category	Calibrated test current (A) (prospective current)			
	1 A	—	—	1 000 ^a
2 A	—	—	1 000 ^b	750 ^b
3,5 A	3 500 ^a	2 000 ^b	1 000 ^b	750 ^b
^a 0,4 to 0,5 lagging power factor.				
^b Unity power factor.				

11 Endurance

The circuit-breaker, when carrying current, shall be capable of withstanding 10 000 cycles of manual close and open operations or some other number of cycles of operations which the manufacturer may declare, at the fastest practical rate, but at not less than two complete cycles per minute, with a ratio of time open of approximately 1:1, under the conditions described in [13.14](#).

12 Tests

12.1 General

Evidence shall be available to the purchaser that circuit-breakers have satisfactorily passed type tests conducted in accordance with [Clause 13](#). In order that a consistent standard of quality be maintained, the manufacturer shall conduct production tests in accordance with [Clause 14](#) and quality tests in accordance with [Clause 15](#).

12.2 Requirements

The tests shall be made with the cover on. With the exception of the making and breaking capacity test (see [13.15](#)), for which the test circuit is prescribed, all tests shall be performed with the circuit-breaker connected on each side by copper-cored cable conforming to ISO 2635, of the appropriate size, as given in [Table 3](#).

Table 3 — Cable size

Circuit-breaker rating A	Cable size
1 to 5	22
7,5	20
10	18
15	16
20	14
25 and 30	12
35	10

Each cable shall be at least 915 mm in length and shall be attached to the circuit-breaker by a crimped termination of approved design.