



**SLOVENSKI STANDARD**  
**SIST EN 2350:2001**  
**01-januar-2001**

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**Aerospace series - Circuit breakers - Technical specification**

Aerospace series - Circuit breakers - Technical specification

Luft- und Raumfahrt - Schutzschalter - Technische Lieferbedingungen

Série aérospatiale - Disjoncteurs - Spécification technique

**Ta slovenski standard je istoveten z: EN 2350:1990**

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**ICS:**

49.060 Štejni napajalniki in električni oprema za letalsko in vesoljsko opremo in sisteme  
Aerospace electric equipment and systems

**SIST EN 2350:2001**

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English version

Aerospace series  
Circuit breakers  
Technical specification

Série aéronautique  
Disjoncteurs  
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SIST EN 2350:2001

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to CEN Central Secretariat has the same status as the official versions.

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**CEN**

European Committee for Standardization  
Comité Européen de Normalisation  
Europäisches Komitee für Normung

Central Secretariat : Rue Bréderode 2, B—1000 Bruxelles

### Brief history

This European Standard has been prepared by the European Association of Aerospace Manufacturers (AECA).

After inquiries and votes carried out in accordance with the rules of this Association, this Standard has successively received the approval of the National Associations and the Official Services of the member countries of AECA, prior to its presentation to CEN.

According to the Common CEN/CENELEC Rules, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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## 1 Scope and field of application

This standard gives design information and specifies test methods for aircraft circuit breakers covered by EN standards. It is applicable if it is referred to in these standards.

## 2 References

ISO 2669	Environmental tests for aircraft equipment - Part 3.2 : Steady state acceleration
ISO 2859-1974	Sampling procedures and tables for inspection by attributes
ISO 7137	Aircraft - Environmental conditions and test procedures for airborne equipment
IEC 50 (441)	International electrotechnical vocabulary Chapter 441 : Switchgear, controlgear and fuses
EN 2000	Aerospace series - Quality assurance - EN aerospace products - Approval of the quality system of manufacturers
MIL-A-8243D	Anti-icing and deicing - Defrosting fluid <sup>1)</sup>
MIL-H-5606E	Hydraulic fluid, petroleum base, aircraft, missile and ordnance <sup>1)</sup>
MIL-L-23699C	Lubricating oil, aircraft turbine engine, synthetic base <sup>1)</sup>
MIL-C-25769J	Cleaning compound, aircraft surface, alkaline waterbase <sup>1)</sup>
MIL-L-7808J	Lubricating oil, aircraft turbine engine, synthetic base <sup>1)</sup>
MIL-L-7870A	Lubricating oil, general purpose, low temperature <sup>1)</sup>
MIL-G-5572F	Gasoline aviation grades 80/87, 100/30, 115/145 <sup>1)</sup>
MIL-H-83282C	Hydraulic fluid, fire resistant, synthetic hydrocarbon base, aircraft, metric <sup>1)</sup>
SAE AS 1241A	Fire resistant phosphate ester hydraulic fluid for aircraft <sup>2)</sup>

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## 3 Definitions

- Circuit breaker with «trip-free release» :

A circuit breaker in which the «open» command takes precedence over the «close» command, i.e. when the electrical trip condition is reached and pressure is exerted on the depressed actuator button, the circuit is still automatically opened.

- Poles of a circuit breaker :

A circuit breaker pole denotes any main circuit from the input to the pertinent output terminal.

1) This specification is published by : Department of Defense (DOD), the Pentagon, Washington, D.C. 20301.

2) This standard is published by : Society of Automotive Engineers, Inc. (SAE), 400 Commonwealth Drive, Warrendale, PA 15096-0001.

The parts of each current path (contact, sensors, switching parts) are independent and electrically insulated.

There may be 1, 2 or 3 poles independently of any auxiliary circuits.

- Current rating ( $I_n$ ):

The current rating ( $I_n$ ) of a circuit breaker is the current in ampères for which the circuit breaker has been designed and designated.

Trip characteristics and test values are based on the current rating.

- Voltage ratings :

Voltage ratings are the voltage levels in volts for which the circuit breaker is designed. Insulation values and test voltages are related to these rated voltages.

- Indication of current and voltage values

Unless otherwise specified, the a.c. voltage and a.c. values shown are r.m.s. values.

For other definitions, see IEC 50 (441).

## 4 Design

### 4.1 Insulating housing

In addition to the switching mechanism, the insulating housing shall incorporate the connecting and mounting systems.

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### 4.2 Trip-free mechanism

The circuit breaker shall be designed to permit trip-free release, i.e. so that it is switched off at overload and remains switched off even when the button is held in the closed position. Resetting of the circuit breaker shall be possible only after complete release of the actuator button.

In no case shall operation under these conditions affect the further serviceability of the circuit breaker.

All poles of a multi-pole circuit breaker shall trip on single or multi-phase overload. The time lag between opening of the first and last pole shall not exceed 10 ms.

### 4.3 Mounting

All visible parts shall be black and non-reflective.

### 4.4 Electrical connection components

These shall be suitable to fit the cable lugs (or contacts).

#### 4.5 Actuator button

In the closed position the visible part of the actuator button shall be black. In the «off» (open) position a white strip shall be exposed. The outer part of this button shall be insulated from all live parts.

In no case shall the actuator button remain in an intermediate position or give an incorrect indication of the switching condition of the circuit breaker. It shall not be removable.

- The circuit breaker contacts shall be closed by pushing the actuator button.
- The circuit breaker contacts shall be opened by pulling the actuator button.

The current rating of the circuit breaker shall be indicated indelibly in white colour on the top of the actuator button. Arrangement of the digits is indicated in the product standard.

#### 4.6 Calibration safety device

The circuit breaker shall be designed in such a way that the calibration cannot be interfered with without breaking a seal.

#### 4.7 Leakage paths

Leakage paths and the minimum distance to be observed between live parts and all other parts of the circuit breaker in non-insulating materials and between live parts of opposite polarity shall be sufficient to avoid damage and spark-over under all operating and ambient conditions.

#### 4.8 Insulants

Insulating parts shall be of non-inflammable or self-extinguishing materials and shall not emit noxious or explosive vapours.

They shall be resistant to fungus growth and the effects of micro-organisms.

Protective coatings and materials which may chip, crack or shatter shall not be used.

#### 4.9 Protection against corrosion

All metal parts shall be either resistant to or protected against corrosion.

In case of contact between dissimilar metals, they shall be protected against electrochemical corrosion.

Where bimetals are used, any corrosion which may occur shall not affect the proper function of the circuit breaker.

#### 4.10 Fasteners

Screws and nuts shall be locked so that the connections cannot be damaged.

### 5 Tests - Requirements - Procedures - Evaluation

#### 5.1 General

5.1.1 Unless otherwise indicated, measurement conditions are as follows :

Ambient temperature ( $23 \pm 5$ ) °C

Pressure (840 to 1070) hPa <sup>1)</sup>

Relative humidity  $\leq 85$  %

5.1.2 Mechanical tests shall be carried out with the circuit breakers mounted in their normal position on a metal holder at least 2 mm thick.

5.1.3 For thermal tests the circuit breakers shall be mounted with the minimum distance between each other as specified in the product standard.

5.1.4 For electrical tests the circuit breakers shall be connected to cables as shown in table 1. The cables shall be at least 0,5 m long.

Where several circuit breakers or the poles of multi-pole circuit breakers are connected in series, the connecting cable between the circuit breakers or poles shall be  $2 \times 0,5$  m long. The cable lugs used shall be compatible with the circuit breaker terminals.

Table 1

Current rating A	Cross section mm <sup>2</sup>	Corresponding AWG *) Cross section
Up to 1	0,6	20
1,5 to 6	1	18
7 to 10	1,2	16
11 to 15	2	14
16 to 20	3	12
21 to 25	5	10
26 to 40	9	8
41 to 50	14	6

\*) American Wire Gauge

1) 1 hPa = 1 mbar



## 5.2 Mechanical tests

### 5.2.1 Visual inspection

It shall be performed without magnification. It concerns :

- General appearance (surface finish, colour, assembly)
- Conformity and quality of markings and inscriptions
- Undamaged condition of calibration seal
- After climatic environmental tests, inspection of all parts which may show corrosion or poor legibility of the markings.

### 5.2.2 Dimensions and masses

These shall conform to the requirements of the product standard and shall be checked using normal measuring instruments.

### 5.2.3 Actuating components

#### 5.2.3.1 Actuator button travel

With the circuit breaker in the closed and open positions the dimensions of the end of the actuating button in relation to the mounting surface is measured, parallel to its longitudinal axis (direction of travel).

This measurement is performed 3 times, with 1 mechanical switching operation between each measurement.

The mean values of the measurements recorded shall lie within the tolerances specified in the product standard.

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#### 5.2.3.2 Operating force

The force required to switch «on» and «off» shall be measured with a suitable gauge in the line of travel of the actuator button.

The measurement shall be taken 3 times in each direction.

The mean value of the measurements shall lie within the limits indicated in the product standard.

#### 5.2.3.3 Strength of actuating components

- Transverse load

The push button in the closed and open position shall be subjected to the load specified in the product standard at the end (rim) of the button, perpendicularly to the direction of travel.

The load shall be applied for 1 minute each in the 4 main directions.

- Longitudinal load

The push button shall be subjected to the force specified in the product standard, for 1 minute each in the push and pull directions.

No damage shall be caused by the loads applied.

- Evaluation :

Verification tests A + E + F + C of table 4.

#### 5.2.4 Strength of mounting

- Mounting

The tightening torque specified in the product standard shall be applied 3 times for 1 minute each, with 1 disassembly between each operation.

- Rotation

The circuit breaker housing shall be turned around its mounting in both directions successively at the torque specified in the product standard.

No deformation outside tolerances or rupture of the locating device shall result. The circuit breaker housing shall not break.

- Evaluation

Verification tests A + E + F + C of table 4.

#### 5.2.5 Strength of connections

- Tightening torque

The connection screws shall be tightened to the torque specified in the product standard. This torque shall be maintained for 1 minute. The connection screws shall then be loosened.

This test shall be carried out 5 times.

No deterioration of the connections shall result.

There shall be no breakage of the circuit breaker housing.

- Strength of connections

Each of the contact lugs (or terminals) shall be subjected to the forces indicated in the product standard. The forces shall be maintained for 1 minute and shall not lead to deterioration of the connections.

The circuit breaker housing shall not break.

- Evaluation

Verification tests A + C of table 4.

### 5.3 Environmental tests

#### 5.3.1 Vibration performance

- Mounting

The circuit breakers shall be mounted on the vibrator. The means of mounting shall be designed so as to transmit the vibrations over the whole frequency range without absorption or natural resonance.

The electrical connection shall be made with cables of the sections specified in table 1. The connection cables shall be attached on the vibrating support approx. 100 mm from the terminals.

- Procedure

The circuit breakers shall be subjected to the sinusoidal wave test according to ISO 7137.

The test shall be carried out in 3 mounting positions along the main axis of the circuit breaker, at ambient temperature, in the closed and open positions.

The values shall conform to the limits specified in the product standard.

- Total vibration time per direction :

in the closed position : 2 h, circuit breaker load 90 %  $I_n$

in the open position : 1 h.

This time includes determination of the resonant frequencies and a period to be determined as follows :

- resonance : if applicable — 30 min per resonance

- sweep : remainder of total time specified.

During the test it shall be established that the contacts do not close for a period equal to or greater than 10  $\mu$ s (circuit breaker in the open position) or open for a period equal to or greater than 10  $\mu$ s (circuit breaker in the closed position).

- Evaluation

Verification tests A + D + G + C of table 4.

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#### 5.3.2 Mechanical shocks

- Mounting

The circuit breakers shall be mounted on the shock table. The means of mounting shall be designed so as to transmit the pulses without absorption or natural vibration.

The connection cables shall be attached to the shock table approx. 100 mm from the terminals.