INTERNATIONAL STANDARD ISO 4084

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Aircraft — Repairable contactors (not hermetically sealed) — Performance requirements

Aéronautique — Contacteurs réparables (non hermétiquement scellés) — Performances

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4084 was developed by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, and was circulated to the member bodies in October 1976.

It has been approved by the member bodies of the following countries :

Australia	India	Romania
Austria	Italy	Spain
Belgium	Japan	Sweden
Canada	Korea, Rep. of	Turkey
Chile	Mexico	U.S.A.
Czechoslovakia	Philippines	U.S.S.R.
Germany	Poland	Yugoslavia

The member bodies of the following countries expressed disapproval of the document on technical grounds :

France
United Kingdom

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Aircraft — Repairable contactors (not hermetically sealed) — Performance requirements

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard specifies the performance requirements for repairable contactors (not hermetically sealed) for use in nominal 28 V d.c. or 115/200 V three-phase, 400 Hz a.c. systems having the characteristics specified in ISO 1540.

This International Standard specifies requirements for contactors carrying loads greater than 1 kVa a.c. or 0,5 kW d.c. Three temperature classes and two types of sealing, environmentally sealed and enclosed, are specified.

1.2 This International Standard is applicable to single-pole and multi-pole contactors, electromagnetically operated and magnetically held, or electromagnetically operated and mechanically or magnetically latched, controlled by a voltage of 28 V d.c. or 115 V, 400 Hz a.c.

2 REFERENCES

ISO/R 224, *Standard form of declaration of performance of aircraft electrical equipment.*

ISO/R 469, *Dimensions and conductor resistance of general purpose electrical cables with copper conductors, for aircraft.*

ISO/R 470, *Dimensions and conductor resistance of heat resisting* (190 °C) *electrical cables with copper conductors, for aircraft.*

ISO/R 539, *Dimensions and conductor resistance of heat resisting* (260 °C) *electrical cables with copper conductors, for aircraft.*

ISO/R 1076, *General purpose electrical cables with aluminium alloy conductors for aircraft.*

ISO 1540, *Aircraft — Characteristics of aircraft electrical systems.*

ISO 3667, *Aircraft — Dimensions of hermetically sealed contactors.*[1)]

IEC Publication 50 (446), *International electrotechnical vocabulary, Chapter 446, Electrical relays.*

Environmental tests for aircraft equipment :

ISO 2650, *Part 1 : Scope and applicability.*

ISO 2652, *Part 2.2 : Humidity* (24 h *cycle).*[1)]

ISO 2657, *Part 2.7 : Change of temperature.*

ISO 2658, *Part 2.8 : Mould growth.*

ISO 2659, *Part 2.9 : Salt mist.*[1)]

ISO 2663, *Part 2.13 : Sealing tests.*[2)]

ISO 2668, *Part 3.1 : Mechanical vibration.*[1)]

ISO 2669, *Part 3.2 : Constant acceleration.*[2)]

ISO 2678, *Part 4.3 : Insulation resistance and high voltage tests for electrical equipment.*[1)]

ISO 2683, *Part 5.1 : Explosion proofness.*[1)]

ISO 2684, *Part 5.2 : Fluid contamination.*

3 TERMINOLOGY

The terms used in this International Standard are in accordance with IEC Publication 50 (446).

4 GENERAL PERFORMANCE REQUIREMENTS

4.1 Temperature classes

The temperature classes which define the maximum and minimum temperatures for use shall be as follows :

Class 1 : − 20 °C to + 55 °C

Class 2 : − 55 °C to + 70 °C

Class 3 : − 60 °C to + 85 °C

4.2 Sealing

The type of enclosure design shall be one of the following :

Type 1 : Environmentally sealed

Type 2 : Enclosed

1) At present at the stage of draft.

2) In preparation.

4.3 Maximum altitude

The contactor shall be suitable for use up to an altitude of 15 000 m.

4.4 Contact voltage drop

The voltage drop values, measured at the appropriate terminal with rated load current and voltage, based on a mean of five successive measurements, shall not exceed the values in table 1.

TABLE 1 — **Contact voltage drop**

Terminals	Rated current strength A	Voltage drop mV	
		Initial	Long term
Main contacts	Same rating as contactor	125	180
Auxiliary contacts[1)]	5 (or as rated)	100	180

1) When a connector is used for connecting the auxiliary circuits, the voltage drop value must be increased by the amount permitted for the connector.

4.5 High voltage

The insulation of the contactors shall be capable of withstanding, without damage, at least the values specified in ISO 2678. Table 2 gives preferred values which the contactor shall withstand without damage for 5 to 10 s.

TABLE 2 — **Preferred dielectric strength**

Voltage used in circuit	Test voltage
200 V effective	1 800 V effective, 50 to 60 Hz
115 V effective	1 500 V effective, 50 to 60 Hz
28 V direct current	500 V effective, 50 to 60 Hz

4.6 Insulation resistance

The insulation resistance shall be in accordance with ISO 2678.

4.7 Transient voltage

The contactor shall be capable of withstanding the transient voltage tests specified in ISO 1540, annex B.

4.8 Fluid contamination

The contactors shall not be damaged by accidental contact with the oils, fuels and cleaning liquids used in aircraft. The manufacturer shall indicate the liquids the use of which is compatible with satisfactory behaviour of the contactors.

4.9 Storage period

The contactors shall be guaranteed for a minimum storage period of 5 years, the equipment being packaged in accordance with the manufacturer's instructions.

5 DIMENSIONS

The dimensional characteristics of the contactors shall comply with the requirements of ISO 3667.

6 DESIGN REQUIREMENTS

6.1 The contactor shall be suitable for mounting on a panel and shall operate satisfactorily when mounted in any attitude. The size and mass shall be the minimum compatible with the required reliability and strength.

6.2 The contactor shall be of the single-pole or multi-pole (main contacts) type, with or without auxiliary contacts.

6.3 The auxiliary contact or contacts of the contactor shall be mechanically connected to the main contacts and shall indicate the position of the latter (i.e. contact normally open or normally closed).

6.4 The main terminals shall accept the forms of connection which can be used (crimping type clips made of copper or aluminium, or copper bars). The auxiliary circuits and control coil shall be electrically connected by means of connectors, contacts or terminals. A flat washer having a diameter at least equal to that of the base of the terminal, and a self-locking nut or standard nut with suitable locking washer shall be used on each terminal.

6.5 Suitable partitions shall be disposed between the terminals in order to prevent an accidental short-circuit. The height and extent of these barriers shall be sufficient to prevent the short-circuiting of all the terminals through the presence over these partitions of a flat conducting part.

6.6 It shall be possible to use the operating coil of the contactor in a 28 V d.c. or 115/200 V, 400 Hz a.c. (rated characteristics) system having the characteristics specified in ISO 1540.

6.7 For type 1 sealed contactors the assembly constituted by the mechanism and the contacts shall be contained in an environmentally sealed enclosure containing dry air or a suitable inert gas. The leakage rate of this enclosure shall not exceed 1×10^{-3} cm^3/s.

6.8 The contactors shall be designed to ensure that the essential electrical performances are not jeopardized in the event of a failure of the environmental sealing in service.

7 RATED VOLTAGE AND CURRENT CHARACTERISTICS

7.1 Voltage

The contactor shall be suitable for operation on rated voltages of 28 V d.c. and 115/200 V, three-phase 400 Hz a.c. systems having the characteristics specified in ISO 1540.

7.2 Rated current and operating life

The contactor shall perform at least 50 000 operating cycles at the value of the rated current which is permissible on a resistive load circuit, a self-inductance load circuit (with the permitted value for the coefficient L/R of self-induction) and on a motorload circuit. The value of the minimum permissible current shall be indicated by the manufacturer.

The preferred values for the rated current strength (on a resistive load circuit) are as follows :

25, 50, 100, 200, 300, 400 and 600 A.

Other ratings may be provided.

The contacts shall have the following make and break capability :

Main contacts — 10 times the rated motorload current;

Auxiliary — 2 times the rated load current.

7.3 Load transfer, polyphase a.c.

When polyphase load transfer is specified, the contactor shall perform at least 10 000 transfer cycles, at the load current level specified by the manufacturer.

8 ENVIRONMENTAL CONDITIONS

The contactor shall satisfy the relevant requirements of ISO 2650 specified in this International Standard.

9 TEST CONDITIONS

9.1 Contactors shall comply with the requirements of clause 10 when tested in accordance with the relevant International Standards. When specific details are not given in this International Standard or the relevant International Standard, tests shall be conducted in accordance with the requirements and practices of the relevant national standards.

The purchaser shall have access to proof that contactors identical to those supplied as conforming to this International Standard have successfully undergone the type tests specified in clause 10. To ensure that the quality (standard) of type approved contactors is maintained in production, the manufacturer shall carry out production tests and quality tests. The minimum conditions for those tests are specified in clauses 11 and 12.

9.2 All electrical tests shall be carried out with the contactor connected to electrical cables that comply with the requirements in ISO/R 469, ISO/R 470, ISO/R 539 or ISO/R 1076 and which are of suitable size and temperature class. Each cable shall be at least 0,5 m long and shall be fixed to the contactor by means of a crimped lug of an approved type.

9.3 Unless otherwise specified, the tests shall be carried out at a temperature of 15 to 30 °C, a pressure of 86 to 106 kPa (860 to 1 060 mbar), and at a relative humidity of not more than 90 %. When these test conditions are permitted in the detailed requirements the ambient temperature at which each test is carried out shall be recorded.

9.4 For three-phase contactors the neutral point shall be connected to the mounting arrangement via a 100 mA fuse the rupturing of which shall indicate an earth leaking fault.

10 TYPE TESTS

Type tests shall be carried out, in compliance with a scheme approved by the Approving Authority, on contactors which have previously passed the production tests.

All the contactors for type approval testing shall be subjected to the tests specified in clause 10. A separate contactor may be used for the make and break capacity test specified in 10.14.

10.1 Environmental sealing test

Type 1 enclosed contactors shall undergo the relevant sealing test for Grade 1 equipment specified in ISO 2663 or in accordance with the test procedure specified by the manufacturer. The leakage rate of the enclosure shall be not greater than 1×10^{-3} cm^3/s at a differential pressure of 1 atm.

10.2 Calibration at normal ambient temperatures

10.2.1 *Resistance of the control coil*

The resistance of the operating coil shall be measured between the terminals of the coil by the bridge method, the value obtained being referred to 20 °C. The value shall be within the limits specified for the contactor and shall be recorded.

10.2.2 *Pick-up voltage*

All contacts shall make positive contact or open, as applicable, in the operated position when a voltage not in excess of the specified pick-up voltage is applied to the contactor coil. The pick-up voltage shall be taken as a product of minimum operating current and coil reistance at 20 °C.

10.2.3 *Drop-out voltage*

The operating coil of the contactor shall first be supplied with the maximum voltage specified by the manufacturer; the voltage shall then be reduced until the contactor opens. The coil voltage and current strength shall be recorded immediately after the contactor opens. The drop-out voltage shall be taken as a product of the maximum drop-out current and coil resistance at 20 °C.

This test shall be repeated with the contactor in a number of different attitudes, in order to determine the maximum and minimum values of the pick-up and drop-out voltages.

The pick-up and drop-out voltages shall be within the limits declared by the manufacturer.

10.2.4 *Contact voltage drop set*

The contact voltage drop shall be measured at rated load current across the terminals of the main and auxiliary circuits.

In the case of contactors which can be used on an alternating current circuit the test shall be carried out at nominal load current delivered by a three-phase 400 Hz circuit.

Contacts which are capable of functioning both on direct current and alternating current shall be tested at the appropriate direct or alternating currents. The contact voltage drop measured at the terminals and established over a mean of five successive measurements shall be lower than the value specified in 4.4.

10.2.5 *Operating times*

The operating times of the contactor shall be determined at the specified voltage at 20 °C,

a) with the contactor in the most favourable and least favourable mounting positions;

b) with the control coil of the contactor subjected to the maximum functioning voltage and then to the minimum functioning voltage specified by the manufacturer.

The operating times shall be within the limits declared by the manufacturer.

10.3 Humidity test

The test shall be carried out in accordance with the requirements in ISO 2652. The selected test severity grade shall be declared.

10.4 High voltage test

On conclusion of the test specified in 10.3, the contactor shall undergo and satisfy the high voltage test specified in ISO 2678 as a minimum.

Preferred voltage values which the contactor insulation should meet are as follows.

a) Circuits operated at 200 V (effective value) 400 Hz : value of test voltage 1 500 V, effective value 50 or 60 Hz.

b) Circuits operated at 115 V (effective value) : value of test voltage 1 000 V, effective value 50 or 60 Hz.

c) Circuits operated at 28 V d.c. : value of test voltage 500 V, effective value 50 or 60 Hz.

The test voltage shall be applied for a period of 5 to 10 s between :

1) each terminal and all others not connected to it;

2) all terminals connected together and the casing of the contactor.

The test shall be carried out with the contacts of the contactor in the open position and then in the closed position. The test voltage shall be increased and reduced progressively. No defect in insulation shall be encountered during these tests.

10.5 Insulation resistance test

On conclusion of the test specified in 10.4 the insulation resistance shall be measured in accordance with the requirements specified for category A equipment in ISO 2678. The potential shall be re-applied between the points specified in 1) and 2) of 10.4. The test shall be carried out with the contacts of the contactor in the open position and then in the closed position.

10.6 Calibration at the maximum ambient temperature

10.6.1 With the contactor operating at the maximum temperature and with the supply voltage to the operating control coil equal to the maximum operating voltage, the various circuits shall be subjected to rated load current, under continuous duty for a period of time such that thermal equilibrium is reached. The temperature rise at the following points shall be recorded :

a) terminals of main contacts;

b) terminals of auxiliary contacts;

c) control coil (by measuring variations in the resistance);

d) base of the assembly near the system of attachment.

During this test the contactor shall be located in still air. It may be supported by the cables or mounted on an insulating support.

10.6.2 Immediately after this test, with the contactor still at the maximum ambient temperature, a check shall be carried out to determine if the functioning of the contactor corresponds to the limits specified by the manufacturer.

10.6.3 Immediately after this test, with the contactor still at the maximum ambient temperature, a check shall be carried out to determine if the operating time corresponds to that specified by the manufacturer.

10.7 Calibration at the minimum ambient temperature

After bringing the contactor to the minimum temperature for a period of time such that thermal equilibrium is reached, the contactor shall function correctly as specified in 10.6.2 and 10.6.3.

10.8 Acceleration test

The test shall be carried out in accordance with the requirements specified in ISO 2669 and the selected severity grade shall be declared.

The contactor shall be successively placed in three planes perpendicular to one another and subjected to the test accelerations. A check shall be made to determine that the contact action is unaffected with the coil energized and de-energized in each attitude.

10.9 Vibration tests

10.9.1 Vibration tests shall be carried out on the contactor in accordance with the requirements of an appropriate test category selected by the manufacturer from ISO 2668. The selected test category shall be declared.

10.9.2 The point of support of the wiring connected to the contactor shall be at a distance of at least $D = 0{,}3$ m from the point of connection to which it leads. The sag in the wiring between the point of connection to the apparatus and the point of attachment shall be at least equal to $D/10$.

During these tests the contactor shall operate with nominal voltage, with its contacts carrying rated current at maximum rated voltage, for 50 % of the duration of the test and shall be tested with zero load for the remainder of the test. It shall not be possible to detect any interruption in the passage of the current for 10 μs or more or any other anomalies or defects.

On completion of these tests a check shall be carried out in accordance with 10.2.

10.10 Change of temperature test

The contactor shall be subjected to the Category A — Temperature variation test as specified in ISO 2657. During this test the appropriate temperatures for the classes in 4.1 shall be used. Repeated cycling tests shall be performed, for 25 complete cycles and with a rate of change of temperature appropriate for equipment located in non-temperature controlled zones. The contactor shall not be supplied with power and shall not function; the object being to ensure successive expansions and contractions of the component parts.

At the end of this test a check shall be carried out to test the environmental sealing of the contactor for Type 1 enclosures in accordance with 10.1 and the correct functioning of the contactor in accordance with 10.2.

10.11 Salt spray test

The contactor shall be subjected to the salt spray Method 1 test in accordance with the requirements in ISO 2659.

10.12 Electrical endurance test

10.12.1 *Test conditions*

The contactors shall be subjected to a minimum of 50 000 operating cycles as specified in a) to e), at a rate corresponding to 5 s in the working position followed by a rest period of 5 s. The contact voltage drop shall be checked every 1 000 cycles and shall not exceed the values indicated in 4.4. Operation of the contacts shall be monitored throughout the test to ensure correct operation.

a) 29 % of the total number of operating cycles shall be carried out at a temperature of 15 to 25 °C at sea level pressure.

b) 1 % of the total number of operating cycles shall be carried out at the minimum temperature specified in 4.1 appropriate to the class and at sea level pressure.

c) 50 % of the total number of operating cycles shall be carried out at the maximum temperature specified in 4.1 appropriate to the class and at sea level pressure.

d) 15 % of the total number of operating cycles shall be carried out at a pressure equivalent to an altitude of 15 000 m and at the minimum temperatures specified in 4.1 appropriate to the class.

e) 5 % of the total number of operating cycles shall be carried out at a pressure equivalent to an altitude of 15 000 m and at the maximum temperature specified in 4.1 appropriate to the class :

During the test the following loads shall be applied :

main contacts — resistive load, d.c.

— inductive load, a.c. (cosine ϕ between 0,7 and 0,75)

— inductive load, d.c. (time constant between 0,020 and 0,026 s)

— motor load

— load transfer load (when specified)

auxiliary contacts — resistive load, d.c.

— inductive load, a.c. (cosine ϕ between 0,7 and 0,75)

— inductive load, d.c. (time constant between 0,020 and 0,026 s).

When the number of auxiliary contacts is greater than one, 50 % of the contacts shall be tested under a resistive load and 50 % tested under an inductive load.

The case of the contactor shall be electrically connected via a 100 mA fuse to the negative or neutral of the supply network. Rupturing of this fuse during the test shall constitute a defect.