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Aircraft — Electrical connectors — Tests

Aéronefs — Connecteurs électriques — Essais

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Foreword

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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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 2100 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles.*

This second edition cancels and replaces the first edition (ISO 2100 : 1972), of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Aircraft — Electrical connectors — Tests

0 Introduction

This International Standard has been prepared to provide a statement of the detailed test procedures and performance requirements for aircraft electrical connectors. It should be read in conjunction with ISO 1949 which specifies the design requirements.

1 Scope and field of application

This International Standard lays down the test procedures and performance requirements for aircraft electrical connectors.

2 References

ISO 1949, *Aircraft — Electrical connectors — Design requirements.*

ISO 2669, *Environmental tests for aircraft equipment — Steady state acceleration.*

ISO/TR 2685, *Aircraft — Environmental conditions and test procedures for airborne equipment — Resistance to fire in designated fire zones.*

ISO 7137, *Aircraft — Environmental conditions and test procedures for airborne equipment.*[1)]

IEC Publication 512-6, *Electromechanical components for electronic equipment; basic testing procedures and measuring methods — Part 6: Climatic tests and soldering tests.*

3 Test details

The tests and performance requirements shall comply with the details given in the table on the following pages.

1) Endorsement, in part, of the publication EUROCAE ED-14B/RTCA DO-160B (a document published jointly by the European Organisation for Civil Aviation Electronics and the Radio Technical Commission for Aeronautics).

Test No.	Title of test	Test procedure	Test results required
1	**Engaging and separating (locking and unlocking) forces — connector**	Mount fixed items in the normal way. Fully engage and separate the correct mating item in the normal way. Measure the forces of engagement and separation (or locking and unlocking).	The forces shall lie within the limits laid down in the detail specification. Full engagement and separation shall be achieved without the use of tools.
2	**Contact resistance**	Fully engage the connectors and pass the applicable test current through each contact to be tested until stable conditions are obtained. The test current shall be the d.c. rated current stated in the detail specification. The open circuit voltage of the source shall not exceed 2,5 V. Measure the voltage drop of each contact to be tested and record the results. Special measurements apply to wired contacts which are required to have their resistance recorded for use in later tests. The resistance of the conductor and the crimp or solder joint shall be measured between the conductor extremity and the centre of the crimp or solder barrel, and shall be recorded. Each contact and conductor measured in this way shall be carefully identified before assembly into a connector. The resistance attributable to the conductors and the crimp or solder joint shall be deducted from the overall value obtained in the contact resistance test in order to determine the value applicable to the mating contacts. Final tests in accordance with this procedure, involving comparison, shall be made on the contacts originally tested. These contacts, with their wires, shall then be removed from the connectors and remeasured as above, and the value obtained shall be deducted from the final recordings.	The initial contact resistance shall not exceed the values laid down in the detail specification.
3	**Insulation resistance**	Measure the insulation resistance using 500 ± 50 V d.c. applied for 1 min between each contact being tested and all others connected together and to the housing and mounting plate. Connect all other contacts to the mounting plate during the test. The conductor connected to the contact being tested may be separated from the remainder of the bunch.	The insulation resistance shall not be less than the values laid down in the detail specification.
4	**Shell continuity**	Using a d.c. voltage source, the open circuit voltage of which does not exceed 2,5 V, pass a current of 1 A from the cable accessory on one side, through the engaged connector, to the cable accessory on the opposite side. Measure the potential drop between the extremities of both cable accessories. NOTE — This test is not applicable to connectors with a non-conductive finish.	The value shall not exceed that laid down in the detail specification.

Test No.	Title of test	Test procedure	Test results required
5	**Sealing**	The test described in 5a for non-hermetic connectors shall be carried out at the stated normal temperature ± 5 °C, and, if required by the detail specification, at the stated maximum temperature ± 5 °C and the stated minimum temperature ± 5 °C. Hermetic connectors shall be tested (see 5b) at normal temperature only.	
5a	**Non-hermetic** (class S connectors)	Mount fixed items of class S connectors on a jig in the normal way. Such a jig shall be suitable for determining the leakage of air through the component. Apply a differential pressure of 86 to 106 kPa (860 to 1 060 mbar) in one direction. Measure the leakage. Repeat the test with the pressure in the opposite direction. Measure the leakage. The leakage shall include all seals. Means satisfactory to the approving authority shall be provided for determining the air leakage rate.	The recorded leakage rate shall not exceed 1 cm^3/h, expressed at normal temperature and pressure.
5b	**Hermetic** (class H connectors)	Mount class H connectors in the normal way (e.g. soldered or welded in accordance with the manufacturer's instructions) such that they may be suitably jigged for determining the leakage of pressurized gas through the connector in either direction. Apply a pressure differential of 86 to 106 kPa (860 to 1 060 mbar) in one direction. Measure the leakage. Repeat the test with the pressure in the opposite direction. Measure the leakage. Means satisfactory to the approving authority shall be provided for determining the leakage of pressurized gas through the connector.	The recorded leakage rate shall not exceed 1×10^{-7} cm^3/h, expressed at normal temperature and pressure.
6	**Contact holding force**	Six female contacts of each size shall be used for tests 6a and 6b.	
6a	**Preconditioning**	Precondition the test contacts by hand 10 times, using a gauge of the maximum permitted contact pin diameter.	The female contacts shall retain gauge A and not retain gauge B. NOTE — The respective diameters, engaged lengths and masses of gauges A and B are to be stipulated in the detail specification.
6b	**Holding force**	Mount the sockets vertically with the mating end down. Insert gauges A and B, each having a surface finish of 0,15 µm to 0,25 µm and of specified mass, in each socket to simulate maximum and minimum diameter pin contacts.	

Test No.	Title of test	Test procedure	Test results required
7	**Contact retention**	Cable securing devices shall be inoperative for this test.	
7a		Remove and insert two widely spaced contacts 10 times, using the appropriate tool, then mount the connector with its axis vertical and apply the appropriate axial loads (see note below) to the selected contacts at a rate not exceeding 5 N/s. Apply the load for 5 s. NOTE — The appropriate axial loads are to be stipulated in the detail specification.	Movement of the contacts relative to the insert shall not exceed the values laid down in the detail specification.
7b		Repeat the procedure described in test 7a on two other pin contacts applying the forces in the opposite direction by an approved means.	Movement of the contacts relative to the insert shall not exceed the values laid down in the detail specification.
7c		Using the appropriate insertion and removal tools, completely remove the contacts from the connector and insert 50 %, or not less than three, of the contacts in each mating half.	The insertion force of the tool, with or without a contact fitted, shall not exceed the value laid down in the detail specification.
		Measure the force needed to insert the tool and the force needed to extract the tool, wire and contact assembly.	The force necessary to remove the tool, wire and contact assembly shall not exceed the value laid down in the detail specification.
8	**Low temperature handling**	Maintain the engaged connectors at a temperature of -25 ± 2 °C for a period of at least 2 h. After this period and while the specimen is still at the controlled temperature, disengage the connectors. Make a visual examination upon return to ambient temperature.	Separation shall be achieved by hand without recourse to tools. There shall be no sign of damage.
9	**Immersion at low air pressure**	Test plugs and sockets as mated sets. Suitably seal the back of the panel portion of the fixed items (class S and H connectors) against the ingress of moisture. Do not seal the free ends of the cable. Separate individual cable leads as widely as practical. Immerse the connectors in a container of water to which has been added a quantity 5 % (m/m) of sodium chloride to make the water conductive. Place the container in a suitable chamber with the free ends of the cable terminated inside the chamber, but not immersed.	
9a	**Low air pressure cycle**	Reduce the air pressure inside the chamber to 3,4 kPa absolute (equivalent to an altitude of 24 000 m) and maintain it at this value for 30 min. Then return the chamber to normal atmospheric pressure. Repeat the above procedure twice.	
9b	**Insulation resistance**	At the end of the third cycle, and while the connectors are still submerged, subject them to test No. 3.	The value shall be not less than that laid down in the detail specification.

Test No.	Title of test	Test procedure	Test results required
10	**Resistance to fluids**	First expose the test specimens while disengaged, for at least 24 h, to the following ambient conditions : — temperature: 15 to 35 °C; — relative humidity: 45 % to 75 %; — pressure: 86 to 106 kPa (860 to 1 060 mbar). For the fluid resistance test, use separate specimens for each fluid. (For the list of fluids, see the detail specification.) The fluid shall be either at the temperature stated or at the maximum temperature for the connector, whichever is the lesser. When necessary, a break of not more than 3 days may be made at the end of any cycle. Subject mating specimens to the following treatment: Immerse the disengaged specimens for a period of 15 to 20 min. When the use of grease is specified, liberal smearing over all exposed surfaces of the inserts will suffice.	
		Engage and disengage the specimens immediately after removal from the solvent.	Full engagement shall be achieved by hand without recourse to tools.
		The specimens shall then remain disengaged under normal conditions for a period of 15 to 24 h.	
		Then engage the specimens and subject them to the maximum working temperature of the connectors for a period of 7,0 to 7,5 h at the end of which they should be disengaged and engaged. This operation completes the first cycle. Repeat the above sequence for a further four cycles. **CAUTIONARY NOTE — Some test fluids may have a critical flash point temperature. Testing should always be undertaken in a suitable bomb calorimeter if that temperature is exceeded.** **Some test fluids may themselves, or in combination with the specimen, be toxic. Due consideration should be given to this possibility before starting the test.**	Full engagement shall be achieved by hand without recourse to tools.

Test No.	Title of test	Test procedure	Test results required
11	**Voltage proof**	Place engaged specimens in an altitude chamber, taking care to separate cable leads as widely as possible. Terminate the connections outside the chamber. Then reduce the pressure within the chamber to 3,4 kPa absolute (the equivalent of an altitude of 24 000 m). Maintain this condition for at least 2 h at the end of which period, while the condition still obtains, apply a test potential of 700 V d.c. or 500 V a.c. (r.m.s.) for a period of 1 min between each contact to be tested and all other contacts connected together and to the shell.	Leakage current shall not exceed 10 µA, or as otherwise laid down in the detail specification.
12	**Vibration**	Test specimens shall include engaged pairs and disengaged, but capped fixed connectors. Secure fixed connectors to the vibration table according to their normal mounting arrangement. Secure cables or wires from wired specimens to the table at points not less than 200 mm from where they emerge from connectors. Means shall be provided for continuously monitoring the resistance of all, or of six engaged contacts, whichever is the lesser, wired in series. The contacts selected shall be the centre contact and others extending radially as widely as possible. Monitor the resistance of the chain continuously while passing a current not exceeding 1 A at an open circuit voltage not exceeding 2,5 V d.c.	
		Subject the specimens to the severe vibration environment detailed in ISO 7137. The tests shall be carried out firstly in one plane and, secondly, in a mutual perpendicular plane using the vibration test curves shown in clause 8 of ISO 7137. Use test curve W1, shown in figure 8.6 for the sinusoidal test procedure. For random motion vibration endurance, use the test curve D1 shown in figure 8.5. For identifying critical frequencies, use the curve W1 shown in figure 8.6. Robustness tests should be allotted using 30 % of the time at approximately the stated maximum temperature, and 10 % of the allotted time at approximately the stated minimum temperature. For these tests, a stabilizing period of 2 h at the appropriate temperature shall elapse before vibration begins.	During the entire period, no change in resistance shall exceed 100 mΩ for a period of more than 5 µs.
		After robustness tests have been completed, examine the items visually. (The method adopted for testing at temperature extremes should be to the satisfaction of the approving authority.)	After testing has been completed, there shall be no loosening of parts or undue wear which would impair performance.

Test No.	Title of test	Test procedure	Test results required
13	**Thermal shock**	Subject engaged connectors to 10 cycles as follows: Place the specimen for not less than 1 h in a chamber maintained at the stated minimum temperature ± 5 °C. Within a period not exceeding 2 min, transfer the specimen to a chamber maintained at the stated maximum temperature ± 5 °C where the specimen should remain for not less than 1 h. After the tenth cycle has been completed, allow the specimen to return to normal conditions and then separate the engaged pair by hand without the use of tools.	There shall be no obvious material deterioration.
14	**Endurance at maximum temperature**	Subject engaged connectors to the stated maximum temperature ± 5 °C for a period of 1 000 h. At the end of this period of 1 000 h and while the specimen is still at maximum temperature, measure the insulation resistance in accordance with test No. 3.	The value shall be not less than that laid down in the detail specification. The specimens shall exhibit no obvious material deterioration.
15	**Resistance to damage by test prod**	Insert a standard test prod of nominal pin diameter into the female contact, while in the insert, to the depths specified in the detail specification. At each of these depths, apply the appropriate bending moment (see note below) to the prod about the inserted end and rotate the socket assembly in one direction through 360° so that a uniform force is applied around the inside surface of the contact. Contacts may be locked against rotation. NOTE — The appropriate bending moments ± 10 %, expressed in newton metres, are to be stipulated in the detail specification.	NOTE — This is a conditioning procedure before subsequent tests.
16	**Mechanical endurance**	Fully engage and separate the mating connectors 500 times using the normal means (i.e. coupling devices such as bayonet or screwed coupling rings). The maximum number of engagements per minute should be 15.	NOTE — This is a conditioning procedure before subsequent tests.
17	**Magnetic effect** (only applicable to those types containing ferrous material)	Specimens for this test shall be fully engaged but shall not carry current. Measure compass safe distance as specified in clause 15 of ISO 7137, class Z.	Safe distance shall not exceed 127 mm.
18	**Climatic**	The test samples shall include specimens which are disengaged but capped. All leads may be separated as widely as practical. Throughout the climatic tests (except during measurements), odd-numbered contacts shall be connected together, and even-numbered contacts connected together and to the shell. During test 18b there should be a potential difference of 100 V d.c. between these two circuits which should be monitored throughout the test.	The leakage current shall not exceed 10 µA, or as otherwise laid down in the detail specification.