INTERNATIONAL STANDARD 1949

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Design requirements for aircraft electrical plug and socket connectors

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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 1949 was drawn up by Technical Committee ISO/TC 20, *Aircraft and space vehicles.*

It was approved in August 1970 by the Member Bodies of the following countries :

Belgium	Italy	Spain
Brazil	Japan	Switzerland
Czechoslovakia	Korea, Rep. of	Thailand
Egypt, Arab Rep. of	Netherlands	Turkey
France	New Zealand	United Kingdom
Greece	South Africa, Rep. of	

The Member Body of the following country expressed disapproval of the document on technical grounds :

U.S.A.

Printed in Switzerland

Design requirements for aircraft electrical plug and socket connectors

PART I : GENERAL

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard specifies the general performance requirements and standardization principles for aircraft connectors. It is intended to cover future types of connectors primarily designed to use crimped contacts accommodating aircraft cables not larger than size 12. Solder/welded contacts are not excluded. It does not define a particular type of connector dimensionally but it does propose limitations on the number of variants in any particular range.

1.2 This International Standard outlines the basic design mechanical and electrical requirements for the connectors and also the basic environmental conditions of operation.

1.3 International Standard ISO 2100 details the tests referred to in this International Standard.

1.4 To obtain approval for a range of connectors to this International Standard it is necessary to prepare a detail specification around the specific types for which approval is sought. The detail specification shall provide :

1) drawings sufficiently dimensioned to ensure interchangeability;

2) the degree of severity of the test clauses;

3) drawings and illustrations of the jigs, tools and gauges which are required to implement the tests;

4) a full description of the type designations based on the requirements of IEC Publication 130-1;

5) a complete table of samples, tests and periodic frequencies of such tests, to ensure maintenance of quality and inspection levels on all aspects of manufacture and production;

6) a declaration of the performances and limitations of use, which should also be declared on the standard form prescribed in ISO/R 224.

2 REFERENCES

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

ISO 2100, *Tests for aircraft plug and socket connectors.*

IEC Publication 130-1, *Connectors for frequencies below 3 MHz — Part 1 : General requirements and measuring methods.*

3 DEFINITIONS

For the purposes of this International Standard the following definitions apply.

3.1 barrel (conductor) : That part of the contact which is designed to accommodate the conductor.

3.2 barrel (insulation) — (also known as insulation bucket) : That part of the contact which is designed to accommodate the conductor insulation.

3.3 bunch rating : The current rating (derating) applied to specific numbers of cables when formed into looms, i.e. bunched together.

3.4 cable clamp : A part of a connector or an accessory attached to the connector body to support the cable or wire to provide stress relief and absorb mechanical stress which would otherwise be transmitted to the termination.

3.5 cable outlet : A part of a connector or an accessory consisting of rigid housing for attachment to the connector body. It may incorporate provision for a cable clamp or seal for terminating screens, and provide shielding to electrical interference. (May be straight or angled.)

3.6 connector, electrical : A component which permits the termination of conductors for the purpose of providing connection and disconnection to a suitable mating component.

3.7 connector, fixed : A connector for attachment to a rigid surface.

3.8 connector, free : A connector for attachment to the free end of a wire or a cable.

3.9 connector interface : The two surfaces of the contact side of a pair of connectors which face each other when the connectors are mated.

3.10 contact holding force : That force which is required to retain a male contact gauge of specified weight and size in a female contact.

3.11 contact pin (or contact male) : A contact having an engaging end which makes contact by insertion into a female socket.

3.12 contact retention force : The axial force in either direction which a contact can withstand without being permanently displaced from its position within the insulator.

3.13 contact socket (or contact female) : A contact having an engaging end which will accept entry of a male contact.

3.14 coupling : The mechanical device used to mate and retain a pair of connectors in correct engagement with each other.

3.15 crimped contact : A contact with the conductor barrel designed to be physically compressed (deformed) around the conductor to make good electrical and mechanical contact.

3.16 datum checks : Checks designed to establish that all parts of the specimens are in conformity with the detail drawings.

3.17 generic type : Type having the same general characteristics.

3.18 insert : An insulating element designed to support and position contacts in a connector.

3.19 insert retention : Ability of the insert to withstand specified axial load in either direction without being dislodged from its normal position within the shell.

3.20 key : A projection which engages with a keyway, to guide a connector during mating.

3.21 keyway : The slot or groove in which a key engages.

3.22 mated pair[1] **:** A combination, when mated, of two connectors designed for being coupled.

3.23 orientation : A secondary polarization system designed to prevent, by rotation of the keys from the normal, cross connection of connectors having the same shell and contact arrangements.

3.24 plug (electrical) : An inter-connecting device carrying a preponderance of male contacts for connection with a corresponding socket.

3.25 polarization : The provision of features on mating connectors to prevent incorrect mating.

3.26 restricted entry : Socket contact or insert hole design, which prevents permanent distortion of the socket contact by a male contact or test probe.

3.27 scooped : The action of touching contacts with the front edge of the mating shell during the search for correct engagement of connectors.

3.28 shell : The outside case of a connector into which the insert and contacts are assembled.

3.29 socket (electrical) : An inter-connecting device carrying a preponderance of female contacts for connection to a corresponding plug.

3.30 type approval[1] **:** The decision by the proper authority (the customer himself or his nominee) that the manufacturer can be considered able to produce components in reasonable quantities meeting the relevant specification.

3.31 type tests[1] **:** All the tests to be carried out on a number of specimens representative of the type of component of one manufacturer, with the object of determining whether the manufacturer can be considered able to produce components meeting the relevant specification.

1) As defined in IEC Publication 130-1.

PART II : DESIGN REQUIREMENTS

4 ENVIRONMENTAL CONDITIONS

4.1 Temperature range

Connectors shall be classified as follows, according to the maximum working temperature for which they are suitable :

Class 1 : − 65 °C to + 155 °C

Class 2 : − 65 °C to + 200 °C

NOTE — To meet the temperature requirements it might be more economical to produce only one class to cover the whole temperature range from − 65 °C to + 200 °C. This would be particularly advantageous from the stocking point of view as it will reduce the range accordingly.

A fireproof version, if available, shall be identified by a suffix F.

4.2 Altitude

Connectors shall be suitable for operation at altitudes up to 31 000 m.

4.3 Sealing classifications

Connectors shall be classified as follows according to the sealing for which they are suitable :

Class H : Hermetic (fixed connectors or bulkhead types only) sealed to a leakage rate of 1×10^{-7} cm^3/s at a differential pressure of 100 kN/m^2.

Class N : Sealed to a leakage rate not exceeding 15 cm^3/h at a differential pressure of 100 kN/m^2.

4.3.1 *Examples of classifications*

Temperature and sealing are the only classifications imposed by this International Standard. Examples are given for clarification purposes.

Class 2.H : A fixed connector which is hermetically sealed to operate within the temperature range of − 65 °C to + 200 °C.

Class 2.N : A normally sealed connector to operate within the temperature range of − 65 °C to + 200 °C.

Class 2.N.F : A normally sealed connector to operate within the temperature range of − 65 °C to + 200 °C and which meets the fireproofness requirement of Test 21.

4.4 Vibration, acceleration and climatic proofness

The connectors shall be so designed and constructed as to satisfy the test requirements in Part III of this International Standard in respect of vibration, acceleration and climatic conditions.

4.5 Explosion proofness

The engaged connectors complying with this International Standard do not normally constitute an explosion hazard but must be disengaged in an explosive atmosphere while carrying current.

4.6 Resistance to fluids

The connectors shall be so designed, together with their accessories, as to be resistant to aircraft fluids. Any limitations in this respect should be declared in the detail specification and on a declaration of design performance complying with ISO/R 224.

4.7 Salt spray

The materials, finishes and design of the connectors shall be such as to resist contamination by salt spray sufficient to meet the requirements of Test 22.

4.8 Dust

Compliance with the requirements of this International Standard in respect of resistance to dust contamination is not mandatory, but when specifically requested by the user, or claimed by the connector manufacturer, the connectors should satisfy the test requirements of ISO . . ..[1)]

4.9 Magnetic interference

The connectors and their accessories shall be designed to satisfy the requirements of Test 17.

Exceptions to this requirement may be stated in the detail specification and in the declaration of the design and performance.

5 MECHANICAL REQUIREMENTS

5.1 Engagement

Correct engagement shall be achieved by the combined use of both the systems specified below. No connector pair in any shell size or type, of any orientation or polarization

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position, even if carrying like contacts, shall make or allow the coupling mechanism to engage, except those items which are truly intended to be mated pairs.

5.1.1 *Shell-to-shell keying*

Keys and keyways shall be provided to ensure

1) that the axis of the male shell remains substantially coincident with the axis of the female shell during the search for correct engagement;

2) that, for circular connectors, each shell has no less than three keys and/or keyways widely disposed and that the keyways are not open slots in the shell, but "blind" keyways;

3) that the angular coincidence of the shells precedes the operation of the insert keying system.

5.1.2 *Insert-to-insert keying*

Insert keying shall be provided to ensure

1) that all contacts are correctly aligned and engaged, the contacts being mechanically engaged prior to engagement of the coupling device;

2) that it is impossible to engage an insert of a particular contact arrangement with any other contact arrangement in the connector.

NOTES

1 Contact disposition is not to be used for the purpose of insert-to-insert keying.

2 Orientation by insert rotation is specifically prohibited.

5.2 Coupling

The coupling arrangement shall ensure

1) that full engagement and disengagement, the maximum forces for which shall be declared, can be achieved without the use of tools;

2) that the male and female shells are retained in the correct position when engaged, and that correct engagement can be visually checked;

3) that in the coupling, devices such as screw threads, bayonet tracks or cams are preferably accessible for cleaning;

4) that contacts cannot be scooped, bent or otherwise deformed by the mating plugs or receptacles of like sizes.

5.3 Engagement endurance

Connectors shall be capable of at least 500 engagements.

5.4 Thread form

ISO Class 2 inch screw threads shall be used.

5.5 Inserts

5.5.1 Inserts for housing socket contacts should be of the hard-faced, restricted entry type.

5.5.2 Inserts for Class N connectors carrying either male or female contacts shall be capable of being contained in either fixed or free shells.

5.5.3 Inserts for Class N connectors shall provide adequate cable insulation support and shall be capable of accepting a full complement of the maximum size of cable of the type declared by the manufacturer (see 10.2).

5.6 Contacts

5.6.1 Crimped contacts, when used, shall satisfy the requirements of ISO . . .[1]

5.6.2 The hardness of the crimped barrel portion of all contacts, except the thermocouple types, shall be within the range of 60 to 110 HV. The crimp barrel portion of the contacts shall also contain an inspection hole to prove correct insertion of the conductor within the barrel.

5.6.3 Female contacts shall be of the restricted entry types.

5.6.4 Means shall be provided to lock the contacts axially within the insert. Any movable part of the locking device should preferably not be part of the contact.

5.6.5 The contact locking device should be capable of replacement in the event of damage.

5.7 Declared engagement (contacts)

The manufacturer shall declare for each contact shell combination in the detail specification (see 1.4) the maximum and minimum mechanical engagement of contacts which will ensure effective electrical contact having regard to the accumulative tolerances on all detail parts.

The minimum engagement shall be that which obtains when the free member has moved to the outward limit of any travel permitted by the correctly engaged coupling device.

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5.8 Sealing

5.8.1 Class N connectors should preferably be sealed against air pressure at the following points :

1) fixed or bulkhead member to panel;

2) insert to shell;

3) connector interface, and preferably shell to shell;

4) cable entry;

5) contact to insert.

5.8.2 Filler plugs as specified by the manufacturer may be used on those cable ways which are not wired.

5.8.3 The manufacturer shall detail any special method of sealing when using small diameter cables.

5.8.4 Class H connectors shall be sealed at all points as described in 5.8.1 except 4).

6 ELECTRICAL REQUIREMENTS

6.1 Voltage

The working voltages of the engaged (or capped) connectors between contacts and between contacts and shell under any natural combination of the environmental conditions (as specified in section 11) shall be at least 350 V d.c or a.c peak.

The connectors shall satisfy the requirements of Test 11.

6.2 Current rating

Four sizes of contacts, 22 and smaller, 20, 16, and 12, shall be provided to accommodate standard conductors not larger than size 12. Individual contacts when assembled in the connector shall be capable of carrying the appropriate cable bunch rating under equivalent conditions.

6.3 Insulation resistance

The connectors shall satisfy the insulation requirements of Test 3.

6.4 Contact resistance

The connector shall satisfy the requirements of Test 2.

6.5 Shell-to-shell conductivity

Stable low resistance continuity shall be obtained between engaged connectors to satisfy the requirements of Test 4.

7 IDENTIFICATION

7.1 Contact identification

Contacts for Class N connectors shall be marked only by the manufacturer's symbol. The marking shall not distort the contact dimensions or shape beyond the drawing limits.

Thermocouple contacts shall also be colour coded in accordance with ISO . . ..[1)]

7.2 Contact position identification

7.2.1 Unless otherwise agreed with the national approving authority, the arrangement and identification of contacts shall be as specified in 7.2.2 and 7.2.3.

7.2.2 All contacts shall be arranged in parallel straight rows in one plane.

Identification of the contact position shall be provided. This shall be numerical, the commencement and direction of count in every line being indicated by an arrow positioned as in Figures 1 and 2.

7.2.3 A means of affording rapid identification of contact position shall be provided. This shall be legible, permanent, unambiguous, and in a contrasting colour to that of the insert. It shall not affect the sealing or electrical performance of the connector. A preferred system is shown in Figures 1 and 2.

7.3 Connector identification

The identification of the connector shall be legible and permanent. It shall appear on the body or shell.

7.4 Accessory identification

Each accessory item shall be legibly and permanently identified. There shall be no single reference number for the complete assembly of the connector with its accessories.

8 FIXING AND ACCESSORIES

8.1 Attachment methods

Three basic types of fixed shells shall be provided, as follows :

1) panel mounting, i.e suitable for wall and box mounting;

2) jamb nut mounting (Class N or H) (circular connectors only);

3) hermetic solder/welded mount.

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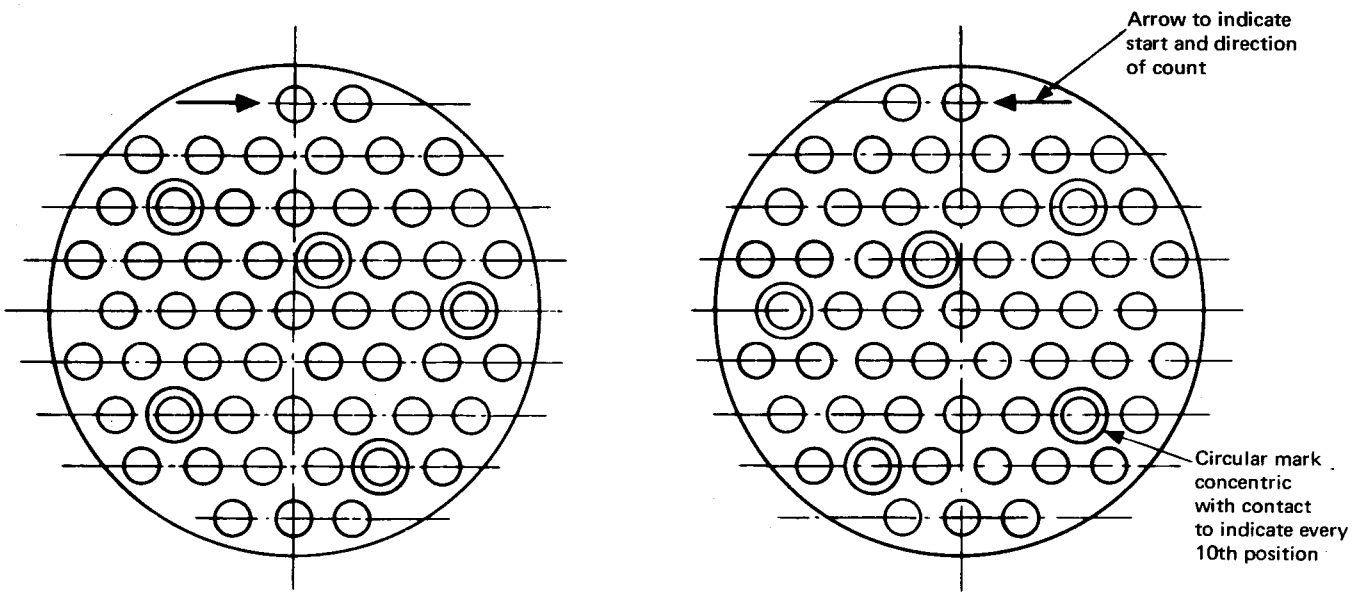

FIGURE 1 – **Plug insert**

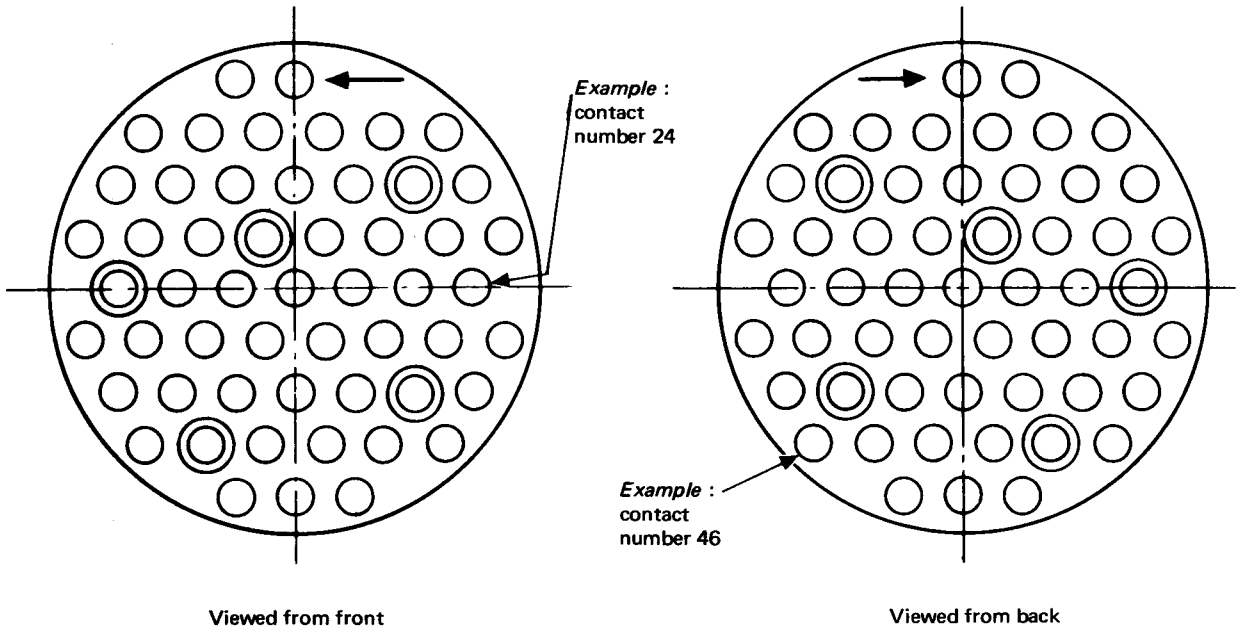

FIGURE 2 – **Socket insert**

8.2 Panel thickness

Panel mounting shells shall accommodate panel thicknesses varying between 0,7 mm and 3,3 mm. Jamb nut shells shall accommodate panels of maximum thickness 6,5 mm.

8.3 Screening (shielding)

Provision shall be made for terminating all types of cable screening, overall cable screens, individual core screens or groups of core screens, bonded to or insulated from the connector shell.

8.4 Cable outlets

Straight and elbow outlets shall be provided. These outlets should be capable of fitting to either free or fixed connectors of the same shell size without adaptation.

8.5 Protective caps

Protective caps fitted by normal connector engagement methods shall be available to provide protection against ingress of moisture or foreign matter, to protect live contacts and to preserve the performance of disengaged, live items. Caps shall be provided with a means of retention to the connector by a link chain or equivalent.

8.6 Cable clamps

Provision may be made for cable clamps when the particular design necessitates the use of separate strain relievers.

9 TOOLING

9.1 Contact insertion and extraction tools

If contact insertion and extraction tools are necessary, their use shall not adversely affect compliance with the performance requirements of this International Standard. Any such tools should preferably be non-metallic and shall not require lubrication for satisfactory insertion.

9.2 Crimping tools

All crimping tools shall comply with the requirements of ISO . . ..[1)]

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