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Aircraft — Hybrid remote power controllers — General requirements

Aéronefs — Contacteurs-disjoncteurs hybrides commandés à distance — Prescriptions générales

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Contents

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10296 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Sub-Committee SC 1, *Aerospace electrical requirements*.

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Aircraft — Hybrid remote power controllers — General requirements

1 Scope

This International Standard specifies the general design and performance requirements of hybrid remote power controllers for aircraft. They consist of an electromagnetic device or a combined electromagnetic/solid-state device for load switching, and a solid-state control circuit for control of the load-switching devices.

On aircraft, remote power controllers are used to close and open the electrical circuit and to protect wiring and equipment in the event of overload or short-circuit conditions.

The load-switching device and solid-state control circuit may be mounted in a common enclosure or may be discrete inter-connected units.

NOTE 1 This International Standard recognizes the need to have hybrid units which are, as far as practical, interface-compatible with fully solid-state power controllers.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2678:1985, *Environmental tests for aircraft equipment — Insulation resistance and high voltage tests for electrical equipment.*

ISO 7137:1987, *Aircraft — Environmental conditions and test procedures for airborne equipment.*

3 Definitions

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

3.1 remote power controller: Device providing a power switch which presents a low impedance to the flow of current from its supply to its load terminal when in the ON state and a high impedance in the OFF state.

NOTES

2 The state of the power switch normally conforms to that represented by the last command signal applied to the controller.

3 The controller reverts to the OFF state on detection of an electrical overload or other specified condition regardless of the command signal. A resetting operation is required to terminate the trip state. Trip-free action prevents the ON state being held in the presence of an overload trip condition.

4 The state of the power switch is represented by an indication signal supplied from the controller.

5 A remote controller may be fully solid-state or hybrid.

3.2 hybrid remote power controller: Combination of an electromagnetic or combined electromagnetic/solid-state device(s), for load switching, and a solid-state control circuit.

NOTE 6 The load-switching device and solid-state control circuit may be mounted in a common enclosure or may be discrete inter-connected units.

3.3 trip-free: When a controller has tripped open on overcurrent or on short circuit, a trip-free feature prevents subsequent reclosure unless preceded by a reset sequence.

4 General characteristics

4.1 Materials

Materials shall be used which will enable the controllers to meet the performance requirements of this International Standard.

Materials used shall not support combustion, give off noxious gases in harmful quantities, give off gases in quantities sufficient to cause contamination of any part of the controller, or form current-carrying tracks when subjected to any of the tests specified herein.

Unless otherwise specified, the selection of materials shall be such as to provide a shelf life of ideally 20 years without affecting the operation of the controller. Parts having a significantly shorter life, such as seals, shall be declared.

4.2 Construction

Power controllers shall be of design, construction, minimum mass and physical dimensions compatible with requirements. Controllers shall be designed so as to ensure proper operation when mounted in any attitude.

The construction of the controllers shall preclude mechanical damage, flaking of the finish, loosening of terminals, or deterioration of marking when subjected to the test methods of this International Standard.

4.3 Terminals

4.3.1 Main terminals

There are two acceptable standards of main terminal.

4.3.1.1 Stud terminal (threaded)

These terminals shall accept connections using crimped-type lugs made of copper or aluminium. 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. Suitable insulation barriers shall be placed 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 any adjacent terminals through the presence over these partitions of a flat conducting part (see also 4.7).

No rotation or other loosening of a terminal, or any fixed portion of a terminal, shall be caused by material flow or shrinkage, or by any mechanical force (specified in table 1) involved in connection or disconnection, throughout the life of the controller.

Table 1 — Strength of threaded terminals (static value of pull and torque)

Thread designation[1)]	Force		Torque	
	N	lbf	N·m	lbf·in
No. 4-40 UNC	22,2	5	0,5	4,4
No. 6-32 UNC	133,4	30	1,1	10
No. 8-32 UNC	155,7	35	2,2	20
No. 10-32 UNF	177,9	40	3,6	32
No. 10-24 UNC	177,9	40	4	35
1/4-28 UNF	222,4	50	8,5	75
5/16-24 UNF	311,4	70	11,3	100
3/8-24 UNF	444,8	100	16,9	150
7/16-20 UNF	444,8	100	16,9	150
1/2-20 UNF	444,8	100	16,9	150

1) See ISO 263:1973, *ISO inch screw threads — General plan and selection for screws, bolts and nuts — Diameter range 0.06 to 6 in.*

Each terminal shall have a terminal seat that shall provide the normal current-conduction path. The diameter of the seat shall not be less than the area necessary to ensure that the current density does not exceed 1,55 A/mm^2. The seat does not include the cross-sectional area of the stud.

Stud terminals shall be capable of accommodating at least two crimped-type lugs with hardware as specified in the detailed specification. A minimum of one and a half threads shall remain above the nut with all parts tightened in place.

4.3.1.2 Plug-in terminal

Plug-in terminals, where applicable, shall conform to the dimensions and requirements necessary for proper mating with the associated sockets.

The mounting arrangement of the unit and its corresponding socket shall be designed so that the entire mass of the unit is suspended and the stability of its mounting is provided by an auxiliary mounting device other than the electrical terminals of the socket.

Electrical and environmental tests shall be performed on the units with the appropriate or specified socket or connector assembled to the unit.

Plug-in terminals shall be gold plated over an underplate of nickel plate.

4.3.2 Auxiliary terminals

The auxiliary circuits and control/status connections may be connected by stud, plug-in or connector terminals to the appropriate specification (see also 4.7).

4.4 Enclosures

Enclosures shall be of sufficient mechanical strength to withstand the requirements of this International Standard without causing malfunction or distortion of parts.

Enclosures shall be one of the following forms:

- ventilated explosion-proof,
- hermetically sealed, or
- environmentally sealed (non-hermetic).

4.4.1 Ventilated explosion-proof enclosures

Unsealed units shall be totally enclosed for mechanical and dust protection and shall be explosion proof.

4.4.2 Hermetically sealed enclosures

Hermetically sealed enclosures shall be constructed as gas-tight enclosures which have been completely sealed by fusion of glass or ceramic to metal, or by welding, brazing or soldering of metal to metal.

Hermetically sealed units shall be purged and filled with a suitable inert gas of such characteristics that the leakage rate may be determined by conventional means. The fill gas shall have a dew point at least 5 °C lower than the lowest temperature specified for the unit.

The unit shall be filled to an absolute pressure of (1 030 $\pm$ 70) hPa [(15 $\pm$ 1) lb/in^2].

The units shall be designed to ensure that the essential electrical performance is not jeopardized in the event of failure of the hermetic seal in service.

4.4.3 Environmentally sealed (non-hermetic) enclosures

Environmentally sealed enclosures shall be constructed by any means other than that defined under hermetically sealed enclosures to achieve the degree of seal specified.

Environmentally sealed units shall be purged and filled with a suitable gas of such characteristics that the leakage rate may be determined by conventional means. The fill gas shall have a dew point at least 5 °C lower than the low-temperature rating of the unit.

The unit shall be filled to an absolute pressure of (1 030 $\pm$ 70) hPa [(15 $\pm$ 1) lb/in^2].

The units shall be designed to ensure that the essential electrical performance is not jeopardized in the event of failure of the environmental seal in service.

4.5 Grounding of enclosures

The mounting shall provide an effective electrical contact to ground when the unit is mounted as specified. Alternatively, the enclosure shall be provided with a grounding connection such as a terminal or lug.

The cover shall be rugged in design, constructed of high-impact materials, and securely mounted to the unit. Metal covers shall be provided with a means of grounding.

4.6 Installation clearances

Adequate clearance shall be provided for the installation of terminals and mounting hardware. Clearance for socket wrenches shall be provided, where appropriate. Special installation tools shall not be required.

4.7 Terminal marking

Stud terminal identification shall be durable and legibly marked.

4.8 Terminal covers and barriers

The unit shall be provided with adequate covering or separation of terminal parts to provide protection against inadvertent shorting, grounding, or contact by personnel. Barriers may be removable or may be integral with removable covers.

Terminal covers and barriers shall be designed to meet performance requirements applicable to the unit. The enclosure(s) shall be so designed that when the cover is removed, the controller shall be capable of operating without adjustment.

The cover design shall be such that pressure differentials cannot exist between the inside and outside.

4.9 Mounting

No rotation or other loosening of a stud, or any fixed portion of a stud, shall be caused by material flow or shrinkage, or by any mechanical forces (as specified in table 2) involved in mounting or demounting, throughout the life of the controller.

Table 2 — Strength of threaded mounting studs (static value of pull and torque)

Thread size designation	Force		Torque	
	N	lbf	N·m	lbf·in
No. 4-40 UNC	31,1	7	1,1	10
No. 6-32 UNC	111,2	25	2	18
No. 8-32 UNC	155,7	35	4,2	37
No. 10-32 UNF	222,4	50	6,8	60
1/4-28 UNF	266,9	60	11,3	100
5/16-24 UNF	355,9	80	18,1	160
3/8-24 UNF	511,5	115	31,1	275
7/16-20 UNF	622,8	140	53,7	475

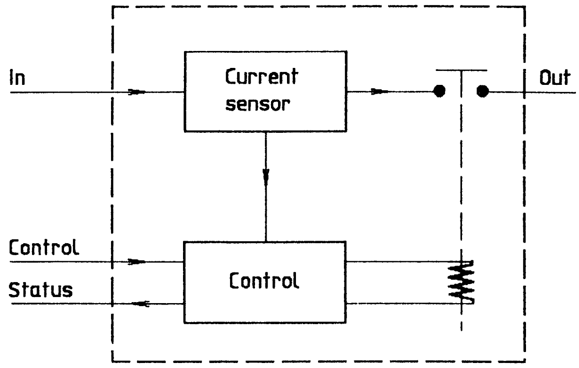

Figure 1 — Diagrammatic illustration of a type A hybrid remote power controller

5 Design characteristics

5.1 General

There are two basic types of hybrid remote power controller.

5.1.1 Type A

For this type, the power switching is carried out only by an electromagnetic device. See figure 1.

A type A control circuit has an output capable of switching the associated contactor coil.

5.1.2 Type B

For this type, the primary function of the main contact(s) of the electromagnetic device is to carry current. The function of making and breaking (i.e. switching) the load current is achieved by a solid-state switch. (The electromagnetic switch may be required to break the fault current.) See figure 2.

In type B, the solid-state switching element(s) may vary impedance to give "soft" switch(es) and thereby minimize switching transients.

A type B control circuit has an additional output to operate the solid-state power switch.

Both types A and B use solid-state devices for the control circuit of the power switch and have many design features in common.

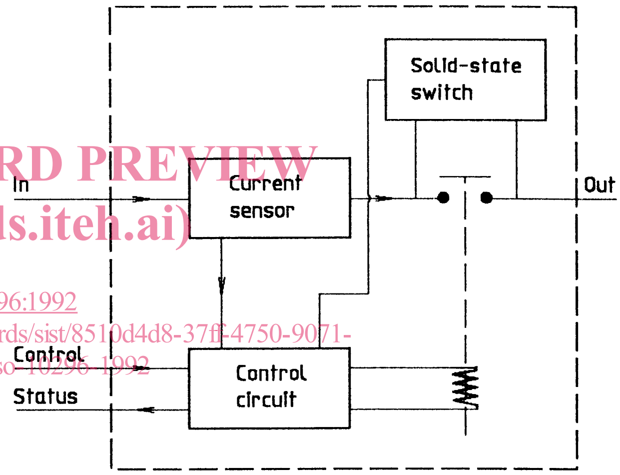

Figure 2 — Diagrammatic illustration of a type B hybrid remote power controller

5.2 Design of solid-state control circuit

The control circuit of type B devices shall control the sequence of operation.

In the event of a short-circuited electromagnetic switch coil, neither the control circuit nor the solid-state switch shall be damaged.

The control circuit shall (if specified), in the case of three-phase a.c. devices, detect a phase imbalance greater than a specified value and trip all load switching devices to OFF.

The control circuit shall detect specified overcurrents, including short circuits, and trip the controller to OFF. A trip-free feature shall be incorporated which requires a subsequent resetting action to reclose.

5.3 Design of solid-state switch

A solid-state switch for a type B controller shall be capable of making, breaking and carrying the maximum overload current, including a short-circuit current, and function so as to minimize arcing of the electromechanical switch under fault-current conditions.

5.4 Design of electromagnetic switch

5.4.1 Type A controller

The electromagnetic switch shall be fully specified in terms of its performance by its related controller specification.

5.4.2 Type B controller

The electromagnetic switch shall be designed in conjunction with a solid-state device to optimize the performance of the unit. In addition, this electromagnetic switch shall be fully specified in terms of its individual performance by its related specification.

5.5 Control signal

Each controller shall be designed to operate from one of the following types of input signal.

a) 28 V d.c. nominal voltage.

b) Grounded controller input to switch controller to ON. In the ON state, the impedance seen by the input control shall not exceed 600 Ω.

c) Logic level signal for interfacing to a control bus (TTL or CMOS).

d) Impedance control multiplexed with status and BITE.

e) Maximum source of 10 mA at 1 V to 12 V to switch controller to ON. [This allows compatibility with existing residual current operated circuit-breakers (RCCBs).]

5.6 Status signal

Status signals for type A and B controllers shall be derived from the physical position of the main contacts. In the case of type B controllers this shall also incorporate a status signal derived from the solid-state switch.

The following status signal shall be provided:

a) power switch ON or OFF.

The following additional signals are recommended:

b) controller tripped (external fault);

c) controller fault (internal fault).

In the case of type B controllers, the position of the electromagnetic switch contacts should represent the correct state of the switch within a maximum time error of 10 ms, allowing for operation of the solid-state switch sequence.

6 Operating characteristics

6.1 General

All controllers shall function satisfactorily over the full specified range of applied electrical and mechanical steady-state and transient conditions.

6.2 Timing sequence

The timing sequence shall be as given in figure 3.

NOTES

7 Type B may be equipped with the capability of interrogating the load so that under a potential fault condition a trip-free operation occurs with the solid-state switch; the contactor is not then energized.

8 Type B may be equipped with a current-limiting capability.

9 Type B may have a controlled rate of rise of impedance.